# MODELING THE FEEDBACK DYNAMICS BETWEEN POVERTY AND EDUCATION OPPORTUNITY

by

Nazmiye Gizem Bacaksızlar
B.S., Industrial Engineering, Yıldız Technical University, 2010

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***to my mother***

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# ABSTRACT


## MODELING THE FEEDBACK DYNAMICS BETWEEN POVERTY AND EDUCATION OPPORTUNITY

Poverty is a persistent problem for most countries, including the United States, the EU countries and Turkey. This study is about the “vicious circle of poverty” among the working poor in Turkey, which has been considered a fundamental socio-economic problem in recent decades. The purpose of this study is defined at two levels. First, the thesis aims to build a generic system dynamics model of the interactions between the working poor and education opportunities. The biggest question is whether the poor will remain poor in following generations. In other words, whether there can be upper intergenerational socioeconomic mobility among the poor. Secondly, the model seeks to examine some of the policy options related to education aimed at alleviating or combating working poverty. The rise in privatized education is at the center of this study since the inequality in education opportunity has a vital influence on quality of employment, which is critical to tackling working poverty. The high capability to reach education services and equality in education opportunities are pre-conditions for high-skilled jobs. There is a huge discrepancy in the quality of education in Turkey. As a result, unemployment and unskilled employment have been an increasingly complex problem for the society. The results of the model verify that inequality in education opportunity can make it impossible for the poor to reach high-quality education services; hence suppressing the opportunity to join highly skilled and highly paid labor markets. The study shows that the lack of opportunity for better education and employment, in turn prevents the poor breaking the “circle of poverty”. Finally, the study investigates which educational policies can potentially help the poor break this vicious cycle.

# ÖZET


## YOKSULLUK VE EĞİTİM FIRSATI ARASINDAKİ GERİBİLDİRİM DİNAMİĞİNİN MODELLENMESİ

Yoksulluk, Amerika Birleşik Devletleri, Avrupa Birliği ülkeleri ve Türkiye de dâhil olmak üzere birçok ülke için kalıcı bir sorundur. Bu çalışma Türkiye' de son yıllarda temel sosyoekonomik bir sorun olarak kabul edilen, çalışan yoksullar arasındaki "yoksulluk kısır döngüsü" ile ilgilidir. Çalışmanın amacı, iki düzeyde tanımlanmıştır. İlk olarak; tez, yoksulluk ve eğitim olanakları arasındaki etkileşimlerin modellendiği genel bir sistem dinamiği modeli oluşturmayı hedeflemiştir. Oluşturulan modeldeki temel soru yoksulun gelecek nesillerde de yoksul kalıp kalmayacağıdır. Diğer bir deyişle, yoksullarda kuşaklar arası yukarı doğru sosyoekonomik hareketlilik olup olmadığı araştırılmaktadır. İkinci olarak, kurulan modelde çalışan yoksulluğunu azaltmak ya da çalışan yoksulluğu ile mücadele etmeyi amaçlayan bazı eğitim politikalarının incelenmesi amaçlanmıştır. Eğitimde özelleştirmedeki artış bu incelemenin merkezindedir, çünkü bu artış eğitimde fırsat eşitsizliği yaratarak çalışan yoksulluğu ile mücadele için önemli olan istihdam kalitesini etkilemektedir. Eğitim hizmetlerine ulaşılabilirlik ve eğitim olanaklarında eşitlik, istihdam piyasasındaki yüksek vasıflı işler için ön koşullardır. Türkiye'de eğitim kalitesinde büyük farklılıklar bulunmaktadır. Bu sebeple, işsizlik ve vasıfsız istihdam toplum için giderek daha karmaşık bir sorun olmuştur. Çalışmadaki modelin sonuçları, eğitim fırsatlarındaki eşitsizliğin, yoksulların yüksek kaliteli eğitim alarak yüksek vasıflı işgücüne dâhil olup yüksek maaşlı işlerde çalışmalarını imkânsızlaştırabildiğini doğrulamaktadır. Bu çalışma, eğitimdeki ve istihdamdaki fırsat eşitsizliğinin yoksulluk döngüsünün kırılmasına engel teşkil ettiğini göstermiştir. Son olarak, yoksulluk döngüsünün kırılmasında yardımcı olabilecek eğitim politikaları incelenmiştir.

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| | |
|---|---|
| AAS | annual average salary |
| acc | access |
| act | actual |
| aff | affordability |
| avg | average |
| chl | children |
| CL | child labor |
| Dmnl | dimensionless |
| ECT | extreme condition test |
| edu | education |
| eff | effect |
| emp | employee |
| EU | European Union |
| fr | fraction |
| grad | graduation |
| HS | highly skilled |
| HQ | high-quality |
| HQE | high-quality education |
| ILO | International Labor Organization |
| ILCS | Income and Living Conditions Survey |
| ISCED | International Standard Classification of Education |
| ISCO | International Standard Classification of Occupations |
| MAS | monthly average salary |
| P | poor |
| PISA | Programme for International Student Assessment |
| priv | private |
| R | rich |
| RSSP | retired semi-skilled poor |
| SS | semi-skilled |

| | |
|---|---|
| OECD | Organization for Economic Co-operation and Development |
| LF | labor force |
| LQE | low-to-average quality education |
| SLF | salaried labor force |
| TL | Turkish Lira |
| TUBITAK | Scientific and Technological Research Council of Turkey |
| TURKSTAT | Turkish Statistical Institute |
| TUSIAD | Turkish Industrialists’ and Businessmen’s Association |
| UE | unemployed |
| UER | unemployment ratio |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNICEF | United Nations International Children's Emergency Fund |
| US | unskilled |

# 1. INTRODUCTION

Poverty is a major socioeconomic problem all over the world, which has been qualitatively and quantitatively associated with various actors in socioeconomics sphere; such as the unemployed, unskilled, retired, socially-excluded and homeless [1]. For a long time, increasing labor qualifications have generally been considered an effective way to solve the poverty trap [2]. Yet, this has not been the case with rises in atypical work patterns, and a growing polarization in the labor market between unskilled jobs and highly skilled jobs, which have created new poverty risks among the employed population [1]. As a result of this trend, the concept of "working poor", which has risen in the United States since the 1970s and 1980s, has become appropriate also for social and labor market realities within Turkey and the European Union [1, 3].

Poverty is a circumstance of complex relations between economic and employment factors, as well as social and financial policies at national and regional levels. It would be helpful to consult Amartya Sen's definition of poverty, in which being poor is said to be a person in "capability deprivation" [4]. He introduced a new insight to the literature, which pointed out the multidimensional capability deprivations for the poor; such as lack of access to public health and education services, or to public transportation, social services etc [5].

There is a difference between poor and working poor due to their labor market activity statuses. Even if there is an increase in employment, which is a positive thing, the connection between quality and quantity of employment is crucial. The "working poor in European Union" report, which is a beneficial contribution to the literature, has suggested that there is an increased risk of labor market polarization in society. Furthermore, it is increasingly difficult for individuals who are essentially low skilled, from staying competitive in the rapidly evolving demands of the current labor market [1]. As in Turkey's labor market, obtaining and maintaining a proper job requires a constant updating of skills. According to this report, "the rapid growth of the knowledge-based society, information and communication technologies can therefore continue to increase the gap between the rich and the poor"[1].

It is also increasingly difficult to obtain high-quality education in the reality of privatization. In Turkey, educational attainment and the income level of a student's parents have a large impact on the quality of education that a student receives. High-income families are able to pay for private teaching institutions and tutors, and this leads to inequality of opportunity in high school and university entrance examinations that already tends to harsh competition [6].

The main hypothesis in this study then, is that having a low paying job can lead to an increased risk of being, becoming or staying a member of the working poor; especially with the presence of inequality in access to education opportunity due to the privatization of educational institutions. As it is stated in the literature; the quality of work and employment covers wide areas such as; health and wellbeing, skills development and reconciliation of working and non-working life issues [2]. On the other hand, before the quality of work and employment, there is a need to discuss the quality of education. Education opportunities' effect up on employment has persisted for a long time. David Card states: "Education plays a central role in modern labor markets. Hundreds of studies in many different countries and time periods have confirmed that better-educated individuals earn higher salaries, experience less unemployment, and work in more prestigious occupations than their less-educated counterparts" [7].

The sub-questions behind the hypothesis are; "Is there indeed a poverty cycle?" and "If there is; is there any way to break the cycle?" Ragnar Nurkse introduced this socio-economic problem as "the vicious circle of poverty". He claims, "A country is poor because it is poor." [8] It could be converted to micro level by considering a person or family. Questions like "Is a person is poor because his family is poor?" or "Is a person rich because her family is rich?" can rise for these problems.

To investigate these questions, system dynamics modeling, which is a powerful methodology for complex, interrelated socio-economic problems, is applied. Modeling socioeconomic systems allows to see the long-term dynamics of interrelated subparts and capture the results of proposed policies without any real experiments on humans and countries [9]. As Sen defined, "capability deprivation for poor" is a multidimensional problem. Naturally, not all dimensions of this problem can be included to the system dynamics model because of the model scope. So, the main dimension for the model is accepted as the access to education services in this study. The model is constructed to address causal relations between the inequality in education opportunity and qualified employment. Various scenario and policy analysis aimed at alleviating or combating working poverty in the presence of Turkey are thus examined.

According to the OECD Education Strategy report; growth, development, and poverty reduction are not necessarily dependent on the number of years individuals spend in a classroom [10]. The matter is the knowledge and skills the students acquired in school. In other words, “access to school and access to education are not necessarily interchangeable concepts” [10]. Quality of education below certain standards indicates that human potential as well as physical and technical infrastructure is not adequately utilized. Equality in access to education opportunity does not only mean having individuals from disadvantaged backgrounds secure access to schools, but it also means that offering high-quality knowledge and skills in schools irrespective of socioeconomic levels is necessary [10].

As mentioned before, there is a causal relationship between high-quality education and earning a high level of salary. This relation affects the income dynamics in the labor market. An individual, who has a high-quality education, tends to later acquire a highly skilled job. So, s/he earns higher salary. To have a high-quality education is not an ordinary case. There is also causal relation between socioeconomic background of that individual and her/his education level [6]. This causal loop is a crucial point of this study. If an individual is born to a high level of income family, s/he has a chance to have a high-quality education with the opportunity that her/his family supplies. High-income families are able to pay for private teaching institutions and tutors. Therefore, that individual has a higher chance to obtain a high-quality education rather than another individual born into a low-income family does.

There is an international survey, which supports the relationship between socioeconomic background and education performance. The survey is called the Programme for International Student Assessment (PISA) that aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old children in 65 countries and economies, including all 34 OECD countries. According to this programme, it is possible to define the education system in Turkey with the “low quality-high inequality” duo [6]. There is a comparison between the percentage of variance in student performance explained by students' socio-economic background and average PISA mathematics score for 15-year-old children in 65 countries and economies, including all 34 OECD countries in Figure 1.1. According to this test’s mathematics scores, Turkey is among the top in terms of inequality of opportunity and is at the bottom in terms of the quality of education. In other words, the living condition of a student is a very essential determinant in the quality of education offered to them in Turkey. The OECD calculates the impact of the socioeconomic status indicator. The OECD calculation based on the information collected about the parents and life conditions of students who participated in the 2009 PISA survey [6].

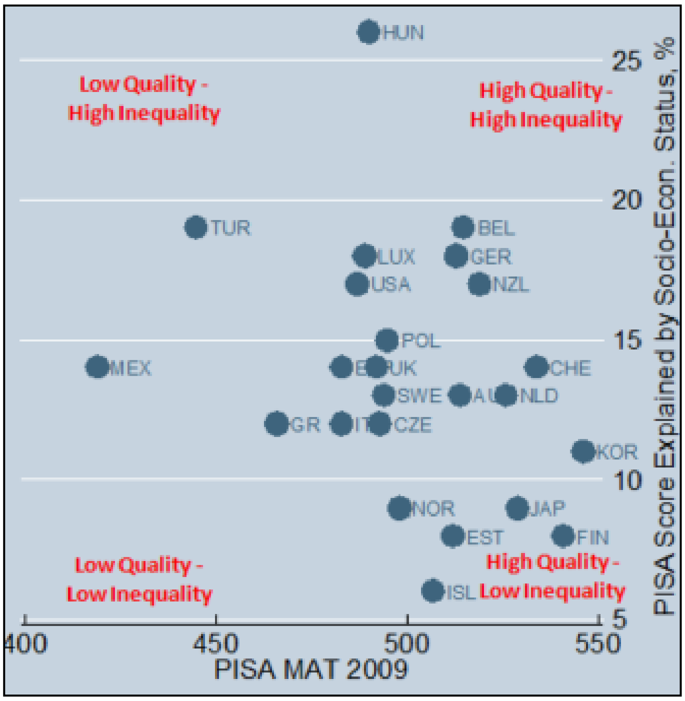


Figure 1.1. Average PISA mathematics score and % effect of socio-economic status in explaining PISA scores, 2009 [6].

For further socio-economical analysis, TURKSTAT statistics for non-institutional population by labor force status in Turkey is evaluated for 2004 to 2013 in Table 1.1 by the author of the thesis [11]. Non-institutional population means all population that excludes the residents of dormitories of universities, orphanage, and rest homes for elderly persons, special hospitals, prisons and military barracks etc. Unemployment ratio among the non-institutional working age population is the proportion of unemployed over the total labor force. The non-institutional working age population indicates the population 15-year-olds and over within the non-institutional civilian population. Furthermore, the total labor force comprises all employed people and all unemployed. Employed people are among all the non-institutional working age population who are defined as a person "at work" and "not at work". A person who is at work means that s/he is economically active during the reference period for at least one hour as an employee, employer, self-employed or unpaid family worker. Also, a person who is not at work implies all self-employed and employer who have a job but not at work in the reference week for various reasons. On the other hand, the unemployed comprises all 15-year-olds and over people who are not employed during the reference period. The reference period of the seeking job is the last three months.

As mentioned, the unemployment ratio is the ratio of unemployed people within the labor force. The graphical function of unemployment ratio in Turkey from 2004 to 2013 is provided in Figure 1.2.

Table 1.1. Non-institutional population by labor force status (Thousand person, 15+ age, %) [11].

| Year | Labor Force | Employed | Unemployed | Unemployment Ratio |
|---|---|---|---|---|
| 2004 | 22 016 | 19 632 | 2 385 | 10.8 |
| 2005 | 22 455 | 20 067 | 2 388 | 10.6 |
| 2006 | 22 751 | 20 423 | 2 328 | 10.2 |
| 2007 | 23 114 | 20 738 | 2 376 | 10.3 |
| 2008 | 23 805 | 21 194 | 2 611 | 11.0 |
| 2009 | 24 748 | 21 277 | 3 471 | 14.0 |
| 2010 | 25 641 | 22 594 | 3 046 | 11.9 |
| 2011 | 26 725 | 24 110 | 2 615 | 9.8 |
| 2012 | 27 339 | 24 821 | 2 518 | 9.2 |
| 2013 | 28 271 | 25 524 | 2 747 | 9.7 |

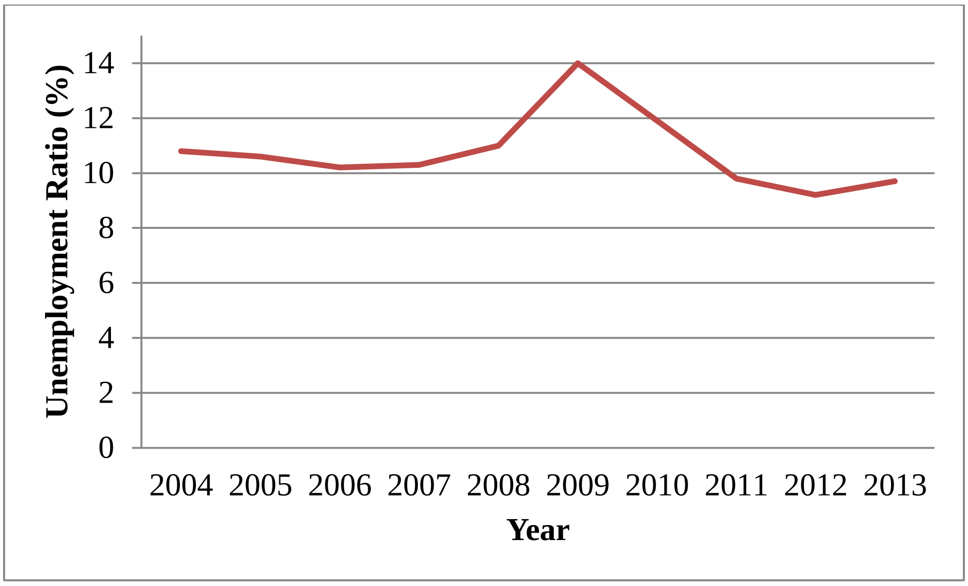


Figure 1.2. The unemployment ratio in Turkey from 2004-2013 [11].

As it is seen in Figure 1.1, unemployment ratio increases rapidly from 2007 to 2010; but then, it decreases around to 10 % in 2013. Unemployment ratios in some selected OECD countries from 2005 to 2012 are given Figure 1.2 [12]. The unemployment ratio in Turkey is higher than the OECD average.

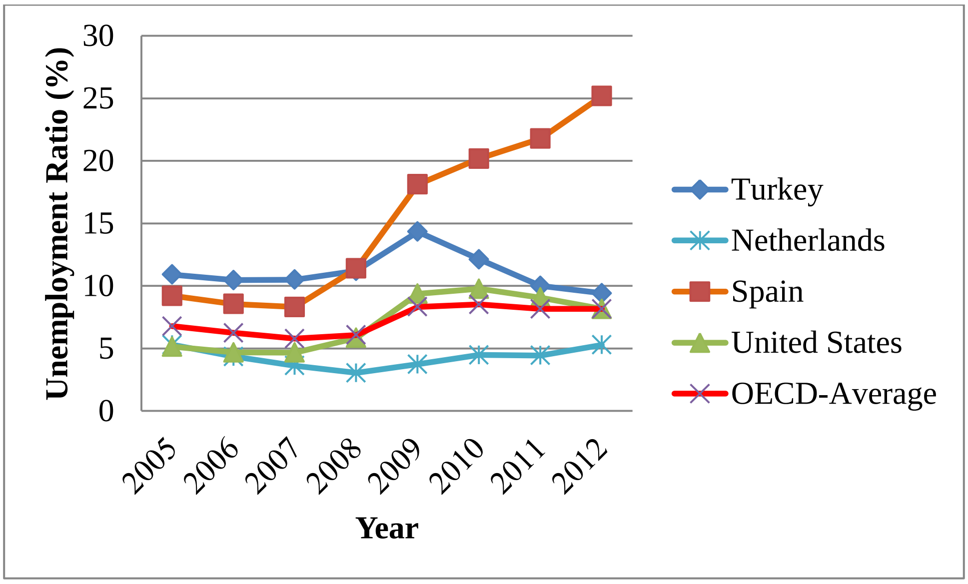


Figure 1.3. Unemployment ratio in some selected OECD countries for 2005 to 2012 [12].

In this study, unemployment ratio is interpreted to analyze the working poor, but generally, unemployment ratios for the poor and the rich are evaluated to answer the questions behind this study. Although total unemployment ratio is proper to analyze the labor market, the difference between unemployment ratios for the poor and the rich is important to understand the dynamics of the poverty cycle. Furthermore, the gap between the annual average salaries of the poor and the rich is much more critical for the aim of evaluating the poverty cycle.

# 2. RESEARCH OBJECTIVES

The thesis of a “vicious circle of poverty”, which is proposed by Nurkse, is the motivating theory of this study [8]. He states that a country is poor because it is poor. In other words, poverty itself sets up a powerful barrier to its own success. The idea behind this claim is that individuals who have low-level incomes are in trouble with saving because capital accumulation needs to increase the income. The ability and willingness to save controls the supply of capital. On the other hand, the incentives to invest control the demand for capital. There is a circular relationship then between both sides of the problem of capital formation in poverty [13].

The work of Joao Cesar das Neves (1988) uses systemic analysis to the original theories for poor stagnant economies, which is also called the poverty equilibrium. He reformulated the similarities and dynamic structure of these theories with system thinking. The works of Ragnar Nurkse, Gunnar Myrdal, John K. Galbraith and Harvey Leibenstein are presented as components of a general theory of stagnation at low income [14]. Neves does not introduce a simulation model to the literature since the aim of this work is to clarify mathematically the hypothesis in order to test the poverty equilibrium.

There is a related term to “the vicious circle of poverty” in the literature, which is called “intergenerationality”. This term means that interactions between members of different generations impact each other. Additionally, intergenerational mobility refers to a measure of the changes in social status, which occurs between the financial mobility of parents’ to their children’s generations.

There are no modeling examples of poverty equilibrium in system dynamics literature. However, the contribution of Neves’s paper to the literature is stimulating for our modeling study. We introduce a system dynamics model about selected aspects of “the vicious circle of poverty”. Specifically, the main focus is to investigate the relationship between poverty and education opportunity. Inequality in access to education opportunity stems from socioeconomic status. Two main socioeconomic groups, who belong to the low and high levels of income, are presented in this study. The poor represents individuals from a low level of income and the rich represents individuals from a high level of income. Their socioeconomic and education backgrounds are different from each other; the rich has higher living standards than the poor has.

This study aims to model the feedback dynamics between poverty and education opportunity to understand whether there can be an upper intergenerational socioeconomic mobility among the poor. Education is one of the factors, which determines the quality of human capital [10]. A high-quality education is critical for a child, who is born into a low-income family, in order for that child to be able to eventually switch to a higher level of income then the one they were born into. In other words, education is a major tool for generating intergenerational social mobility [6]. When a child receives a high-quality education, and is enabled to then become a member of a highly skilled labor force, this also means that s/he will likely receive a higher income.

Modeling socioeconomic systems allows to see the long-term dynamics of interrelated subparts and to capture the results of proposed policies without any real experiments on humans and countries [9]. As mentioned, this modeling study mainly aims to investigate whether there can be an upward intergenerational mobility in socioeconomic status for people born to low level of income families, with respect to the access to education opportunity. The questions behind the aim of this study are “Is there indeed a poverty cycle?” and “If there is, are there any opportunities to break the cycle as a result of high-quality education?” These questions can be extended to “Is a person poor because his family is poor?” or “Is a person to stay rich because her family is rich?”

Building a proper and credible system dynamics model to understand the feedback dynamics between poverty and education opportunity is the first goal of this study. A second goal is to modify the model for analyzing the effects of social policy proposals in the long run. Finally, the study aims at investigating whether there can be an upward intergenerational mobility in socio economic status among the poor. In order to understand the dynamic behaviors of intergenerational mobility under different social policy proposals, the gap between salaries of the poor and the rich are evaluated.

# 3. RESEARCH METHODOLOGY

System dynamics methodology helps to develop understanding about the behavior of complex, large-scale systems and investigate their structures. A complex system cannot be understood by merely dividing it into its component parts; rather, there is a need to holistic approach, which states that a complex system is more than the sum of its subparts. There are causal relationships present between the subparts of the system, and these can be defined as the internal structure of the system. This structure creates a recognizable system behavior over time. In other words, the relationships between system variables shows the behavior of a system, which is the operation of its internal structure over time [15]. When a model structure is constructed properly and credible, system dynamics methodology enables the design of new policies, and allows these new policies to be analyzed via simulation runs. Modeling socio-economic systems provides researchers with the tools to see the long-term dynamics of interrelated subparts in a complex system, and to capture the results of proposed policies without any real experiments on humans and countries [9].

According to Barlas [15], “System dynamics discipline is an attempt to address such dynamic, long-term policy problems. Applications cover a very wide spectrum, including national economic problems, educational problems, energy systems, sustainable development, politics, psychology, medical sciences, health care, and many other areas.” Feedback relations then, between education level and income among aging population in this complex long-term socioeconomic problem, make system dynamics methodology appropriate to apply for the goals of this study. An aging population must be considered in order to see the effects of poverty cycle in long term. Therefore, this methodology is also proper for modeling the dynamics of aging population.

There is a difference between statistical correlations and causal relations in system dynamics approach. In system dynamics methodology, the model is not built for the point prediction of the system’s variables [16]. A system dynamics approach aims to understand the overall dynamic behavior of the system. So, it becomes a useful tool in the modeling of socioeconomic systems by analyzing the system’s overall its long-term interrelated dynamics.

Two main concepts are used in system dynamics modeling. The first one is stocks, which represent the accumulations in a system. The stocks are changed only by their flows. If flow is into the stock, it is named inflow, and if it is out of the stock, it is called outflow. The rate of change of that stock accounts for the net flow. To visualize stock and flow variables; temperature level in a room can be given as an example of stock variable, heating and cooling can be given as example of an inflow and outflow variables [15].

In a model diagram, rectangular boxes and valves on arrows show stocks and flows, respectively. In system dynamics methodology, there is also a third type of variable, which is called a converter, or auxiliary variable. Converters, or auxiliary variables, help to define parameters or variables explicitly. Hence, they can be either constant or the function of stocks and/or flows [9].

An example stock-flow diagram of a simple population model is shown in Figure 3.1.

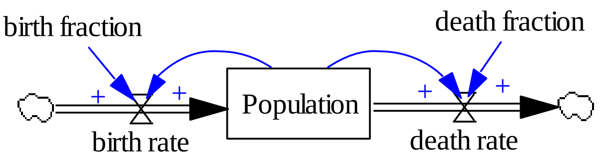


Figure 3.1. Stock-flow diagram of a simple population model.

$$\text{Population}(t) = \text{Population}(t - dt) + (\text{birth rate} - \text{death rate}) \times dt \tag{3.1}$$

$$\text{birth rate} = \text{Population} \times \text{birth fraction} \tag{3.2}$$

$$\text{death rate} = \text{Population} \times \text{death fraction} \tag{3.3}$$

In this simple model, Population is the stock variable. The inflow to the stock is birth rate and the outflow is death rate. If the birth rate is higher than the death rate, then population increases from its present value, or vice versa. Birth fraction and death fraction are auxiliary variables. The arrows connecting the variables show the causal relationships between the variables. Positive signs on these arrows state that increase in Population and birth fraction (death fraction) as an increase of birth rate (death rate). Increase in birth rate increases population from its present value while increases in death rate decrease it.

For the mathematical description, a stock variable and its flows together correspond to a first order differential equation. The stock is the system variable and the flows are the rates of change over time.

# 4. OVERVIEW OF THE MODEL

The model is constructed for understanding the feedback dynamics between poverty and education opportunity. It is aimed to investigate whether there can be an upper intergenerational socioeconomic mobility among the poor. The model design considers two major socioeconomic groups that are poor or rich. They are contrasted in comparison to respective income levels. The main assumption behind defining income levels for this study is explained extensively in next chapter. In this model, people are salaried labor forces or salaried employees, and they earn different salaries according to their occupation levels. Therefore, in short, the purpose of this study is to investigate intergenerational poverty dynamics among salaried classes.

The model consists of two main sectors. The first one is the population-education sector, which is concerned with the aging of poor and rich populations; and the second one is concerned with the employment sector, which consists of salaried labor force population and employment market. Population among poor and rich is divided into four age groups separately, which are age group for 0-14-year-old children, age group for 15-24-year-old students, age group for 25-54-year-old labor force and an age group for older than 55-year-old retired people. Students can receive two different types of education, which are called high quality and low-to-average education. According to students' background of education, they join a related skill level of the labor force. If students receive high-quality education, they are able to join a highly skilled labor force, and if students receive low-to-average quality education, they join a semi-skilled labor force. On the other hand, if they drop out of school during the education period, they directly join an unskilled labor force. For the employment sector, there are three different levels of job occupations. Highly skilled, semi-skilled and unskilled job levels are introduced; along with the respective number of available jobs per level.

A simplified causal loop diagram is illustrated in Figure 4.1. For the sake of simplicity, the logic behind the causal relationships between education background and skill level are given together for both the poor and the rich. A "+" sign on the head of an arrow means a positive causal relationship between the variables on the tail and the head of the arrow. Positive causal relationships means that a change in the variable on the tail of the arrow causes a change in the variable on the head of the arrow (effect) in the same direction, by an amount more than what it would have been otherwise. Conversely, a "–" sign indicates a negative causality. It represents an increase (decrease) in cause leads effect to decrease (increase) or increase (decrease) to less than what it would otherwise have been [16].

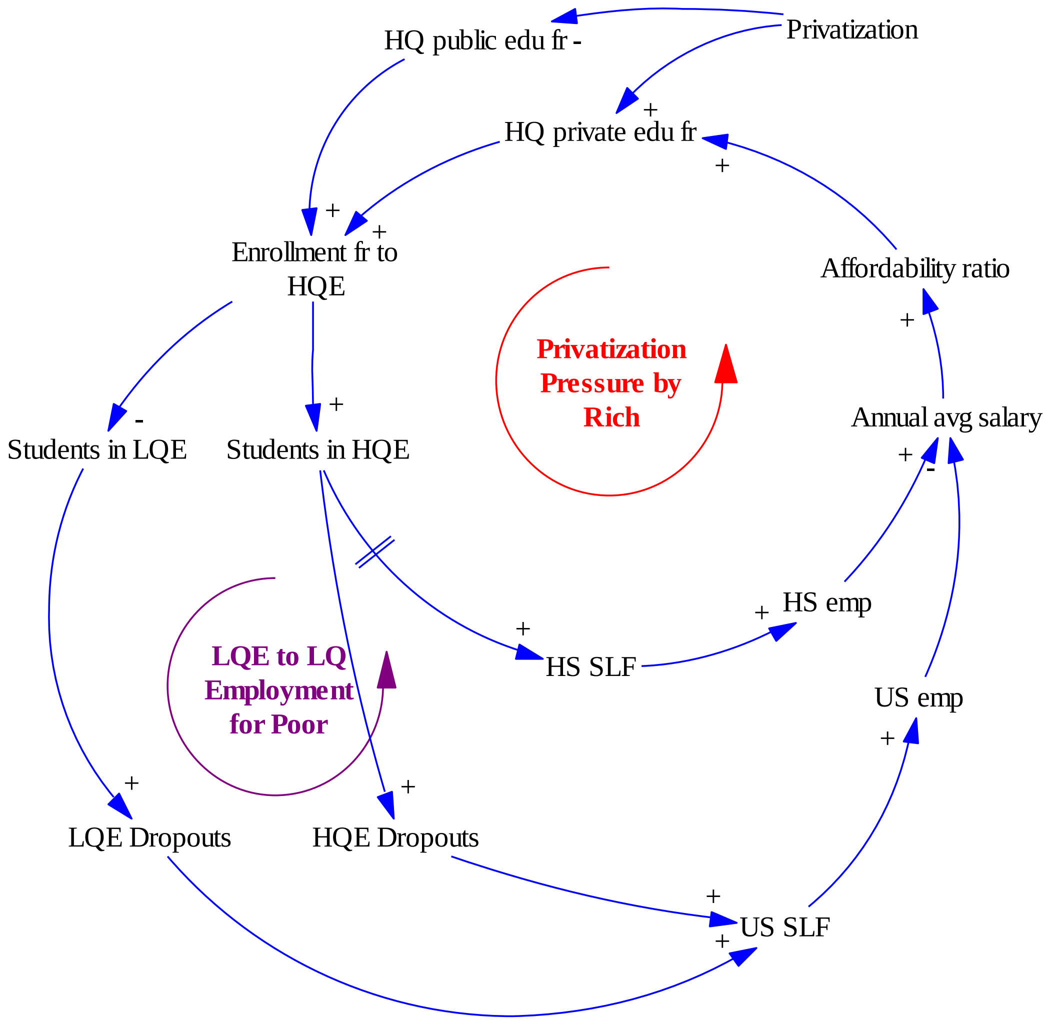


Figure 4.1. Simplified causal loop diagram of the model.

In a simplified causal loop diagram, the most significant reinforcing loop is inspired by Card's statement [7]: "Education plays a central role in modern labor markets." When a person has a high-quality education, it widens the chance to secure a highly skilled job, which indicates having a higher salary. Increases in annual average salary also increase the affordability of high-quality education. According to this, if there is an increase in privatization in high-quality education, this person has chance to afford highly qualified education. Again, receiving high-quality education widens the chance to secure a high skilled job, which means having higher salary. Here is a feedback loop, which is called "privatization pressure by rich".

On the other hand, if there is an increase in privatization in high-quality education, a person with low level of salary cannot afford high-quality education. So, the person likewise receive a low-to-average quality education. This person will then likely get a low skilled job level, which results in having a lower salary. Again, there is no chance to have privatized highly qualified education with a lower salary. Therefore, a feedback loop named "low-to-average quality education to low qualified employment for poor" takes part in this model.

The detailed explanation of the model is provided in the next chapter.

# 5. DESCRIPTION OF THE MODEL

## 5.1. Population-Education Sector

### 5.1.1. Background Information

The relevant parts of the demographics of Turkey's population are modeled in the population sector. This sector is divided to two subpopulations, which are designated as poor and rich. The poor and the rich are part of low and high-income level of household, respectively. Although the calculations for them are different, the overall modeling mechanisms for the population are parallel. Therefore, there will be a general explanation of the structure of this sector.

There are three main stages of education level according to the International Standard Classification of Education (ISCED 1997): primary education, secondary education and tertiary education. This classification is the revised version of the ISCED, which was adopted by UNESCO's General Conference in replacement of the former version [17]. Primary education (ISCED 1) usually begins at ages five, six or seven and lasts for four to six years (the mode of the OECD countries being six years). Lower secondary education (ISCED 2) generally continues the basic programmes of the primary level, but teaching is typically more subject-focused. Lower secondary education may either be "terminal" (i.e., preparing students for entry directly into working life) and/or "preparatory" (i.e., preparing students for upper secondary education). This level usually consists of two to six years of schooling (the mode of OECD countries is three years). The upper secondary education (ISCED 3) corresponds to the final stage of secondary education in most OECD countries. Instruction is often more organized along subject-matter lines than at ISCED level 2. Teachers typically need to have a higher level, or more subject-specific, qualifications than at ISCED 2. The entrance age to this level is typically 15 or 16 years. In Turkey, the upper secondary education is known as the "high school" period.

Some programmes straddle the boundary between upper secondary and post-secondary education. They are covered with ISCED level 4 in ISCED-97. These programmes typically have a full-time equivalent duration of between 6 months and 2 years. In Turkey, these kinds of programmes are known as a two-year college. ISCED 5 programmes have an educational content, which is more advanced than those offered at Levels 3 and 4. Entry to these programmes normally requires the successful completion of ISCED Level 3a or 3b or a similar qualification at ISCED Level 4a or 4b. Programmes at Level 5 must have a cumulative theoretical duration of at least 2 years from the beginning of this level. They do not lead directly to the award of an advanced research qualification, whose programmes are at Level 6. The second stage of tertiary education is reserved for tertiary programmes, which lead directly to the award of an advanced research qualification. The theoretical duration of these programmes is 3 years and is full-time in most countries. Education levels in ISCED-97 are given in Table 5.1.

Table 5.1. Education level groups in ISCED-97 [17].

| ISCED-97 groups |
| --- |
| 6 Second stage of tertiary education (leading to an advanced research qualification)<br>5a First stage of tertiary education, 1st degree (medium duration) |
| 5b First stage of tertiary education (short or medium duration) |
| 4 Post-secondary, non-tertiary education<br>3 Upper secondary level of education<br>2 Lower secondary level of education |
| 1 Primary level of education |

In addition to the ISCED-97 level of education, the formal educational system in Turkey consists of eight years of primary schooling, three or four years of high schooling and tertiary levels of schooling. High schools include general, vocational and technical high schools. General high schools give three or four years of training. Vocational high schools give three years and technical high schools give four years of training. Tertiary levels of schooling take place at institutions of two-year programs or at universities of four to six year programs. Formal education is free of charge in public schools. There are private schools at all levels and of all kinds except vocational and technical high schools [18].

In the model, requirements of education levels are similar with the ISCED-97 but the levels of education are described in two stages. Primary and lower secondary levels of education are represented as the first stage of education. Then, upper secondary and tertiary levels of education are counted as the second stage of education. Additionally, the quality of education is categorized in two levels: high-quality education and low-to-average quality education. As mentioned, the duration of high and low-to-average quality education covers upper secondary and tertiary education. This means that students spend 10 years on average in high school to university graduation. In other words, the second stage of the education lasts for ten years, on average. The quality of education is explicitly considered in the second stage of education.

As mentioned before, there are different types of private and public high schools in Turkey. For instance, Science High Schools, Anatolian High Schools and Anatolian Vocational High Schools select their students based on a national entry examination, while other schools do not. All of the public Science High Schools, some of the private Science High Schools, some of the public and private Anatolian High Schools are counted as high schools in high-quality education. Among students who study in Science High Schools, perform the best in university entrance examinations. Therefore, there is a link between receiving a qualified education in high school and university. It could be said that there is a transmission of education quality in high school to university. Furthermore, there are public and private universities in Turkey. These universities merely select their students based on a national university entrance examination, which is held once in a year.

For classifying quality of education in public and private universities, the Entrepreneurial and Innovative University Index, which is conducted by TUBITAK, is consulted [19]. There are fifty universities cited in this index, which is calculated by some parameters of universities, such as; economical support with innovative and entrepreneurial culture, scientific and technological research competence and improvement, intellectual property pool etc. The most successful fifteen universities among fifty universities are counted as universities in the high-quality education for this study. High-level education continues at least for four years in these universities. On the contrary, low-to-average quality education refers to the other universities, which are not included in these fifteen. It should be noted that the education period in low-to-average quality universities could continue at least for two to four years. So, on average a student can have a low-to-average quality or high-quality education in ten years. Note that "low quality" education represents "not high quality" (i.e. "low-to-average") education in this thesis.

In Turkey, educational attainment and income level of parents have a large impact on the quality of education students receive. High-income families are able to pay for private teaching institutions and tutors, which leads to an inequality of opportunity in high school and university entrance examinations, which are also already impacted by harsh competition [6]. As mentioned before, in labor markets, education plays a main role. Many studies in many different countries and times have confirmed that better-educated individuals earn higher wages, experience less unemployment, and work in more prestigious occupations than their less-educated counterparts [7]. Therefore, inequality in education opportunity creates an income gap between the poor and the rich. In the model, if students receive high-quality education, it indicates that they are more likely to join a highly skilled labor force. On the other hand, if they receive low-to-average quality education, they tend to join a semi-skilled labor force. Some of them may drop out of school, so they can immediately become a part of the unskilled labor force. In short, labor force statuses are categorized in three levels: highly skilled, semi-skilled and unskilled labor force. After an active and/or passive working life period, people are counted as retired people until they die (see Figures 5.4 and Figure 5.5 below). The detailed background information about labor market will be given in employment sector chapter.

### 5.1.2. Fundamental Approach and Assumptions

Two levels of income groups are modeled in this study, which are the groups of high (top 60-80%) and low (bottom 10-40%) levels of income. The high level of income group is called salaried rich and the low level of income group is called salaried poor. Thus we only focus on salaried workforce (no entrepreneurs or self-employed). Therefore about 50% of Turkey's population is modeled in this study. The household who belongs to low level of income is represented as the poor and the one who belongs to high level of income is the rich in the model. They are named by considering distribution of income.

Income distribution indicators are needed not only for the economic reasons but also for the various social systems' evaluation as it is needed for this study. Therefore, the survey, which is called "Income and Living Conditions Survey (ILCS), is evaluated [20]. Since 2006, TURKSTAT has started to carry out the annual ILCS, in which the panel survey method is used. Panel studies are a particular design of longitudinal study in which the unit of analysis is followed at specified intervals over a long period (often many years). The key feature of panel studies is that they collect repeated measures from the same sample at different points in time. The scope of the studies of this survey is in compliance with the European Union (EU). The aim of the survey is to supply comparable data on income distribution, living conditions, social exclusion and relative poverty based on income. For the evaluation of this survey, the individuals are sorted in ascending order based on equivalised household disposable income. They are divided into 5 parts. The bottom income group is defined as "the first quintiles" and the top income group is defined as "the last quintiles".

According to ILCS (ILCS, 2012), the income of the richest part of the population is 8 times that of the poorest part [20]. Distribution of annual equivalised household disposable incomes by quintiles, ordered by equalized household disposable income, is shown in Table 5.2. Considering the income quintiles, the share of the highest income group - the fifth quintile group - is 46.6%. On the other hand, the share of the first quintile that has the lowest income is 5.9%. Therefore, the share of the fifth quintile of the total income is 8 times more than the first quintile.

The claim of this study's hypothesis is the annual average salary of the rich is about two times higher than that of the poor's annual average salary. According to this hypothesis, the half of the first quintile and the second quintile are summed up as the percentage of the poor population. Therefore, 30% of the population is the poor in the model. On the other hand, the fourth quintile is defined as the rich for the model so, 20% of the population is rich in the model. Therefore, in total, half of the Turkey's population is modeled in this study.

Table 5.2. Distribution of annual equivalised household disposable incomes by quintiles ordered by equivalised household disposable income, 2011-2012 [20].

| | | Year | Percentage (%) | Avg income (TL) | Median income (TL) |
|---|---|---|---|---|---|
| Quintiles | 1st 20% | 2011 | 5.8 | 3 129 | 3 247 |
| | | 2012 | 5.9 | 3 468 | 3 619 |
| | 2nd 20% | 2011 | 10.6 | 5 698 | 5 692 |
| | | 2012 | 10.6 | 6 301 | 6 294 |
| | 3rd 20% | 2011 | 15.2 | 8 178 | 8 139 |
| | | 2012 | 15.3 | 9 055 | 9 030 |
| | 4th 20% | 2011 | 21.7 | 11 693 | 11 533 |
| | | 2012 | 21.7 | 12 850 | 12 772 |
| | 5th 20% | 2011 | 46.7 | 25 172 | 20 039 |
| | | 2012 | 46.6 | 27 624 | 22 042 |
| | Total 100% | 2011 | 100.0 | 10 744 | 8 139 |
| | | 2012 | 100.0 | 11 859 | 9 030 |

As mentioned before, even though modeling process of aging chains among the poor and the rich population is similar; their respective net birth rates of population are different. Calculations based on the ILCS (ILCS, 2009) indicate that the average number of children per household in low-income households is higher than in high-income households [21]. An average number of children per household by 5% income brackets is shown in Figure 5.1 Average number of children per household is 1 in the highest-income group and 3.5 in the lowest-income group.

For our model, since half of the first quintile and second quintile are defined as the poor, the average number of children per poor household is 2.5; whereas the average number of children per rich household in the fourth quintile is 1.5. In the view of this, we approximately take net birth fraction of the poor to be two times the rich's net birth fraction.

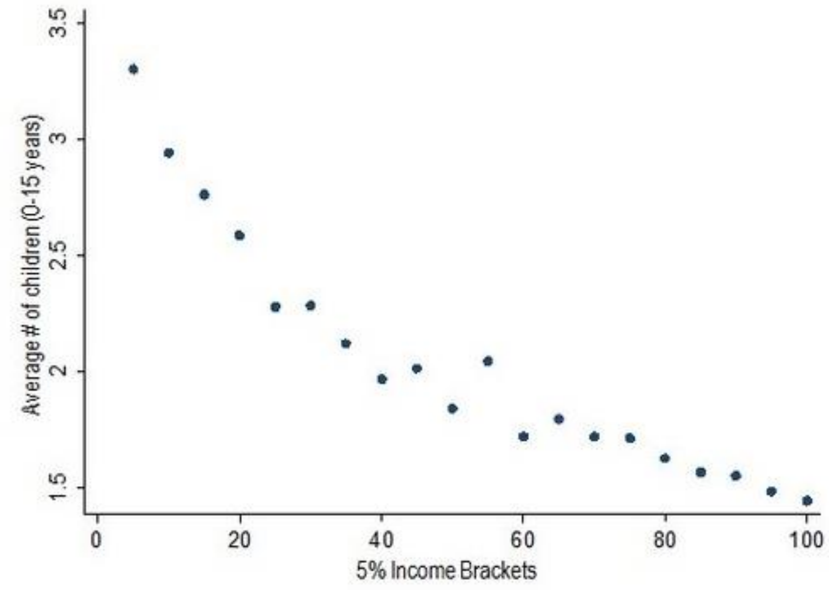


Figure 5.1. Average number of children per household by 5% income brackets [21].

As previously mentioned, net birth rate between the poor and the rich are different. Calculations for the birth and death fractions for both of them are conducted according to TURKSTAT's data. TURKSTAT shared the 2013-2075 projections of crude birth and death rates (see Figure 5.2 and Figure 5.3). The crude birth and death rates are the number of births and deaths occurring among the population of a given area during a given midyear.

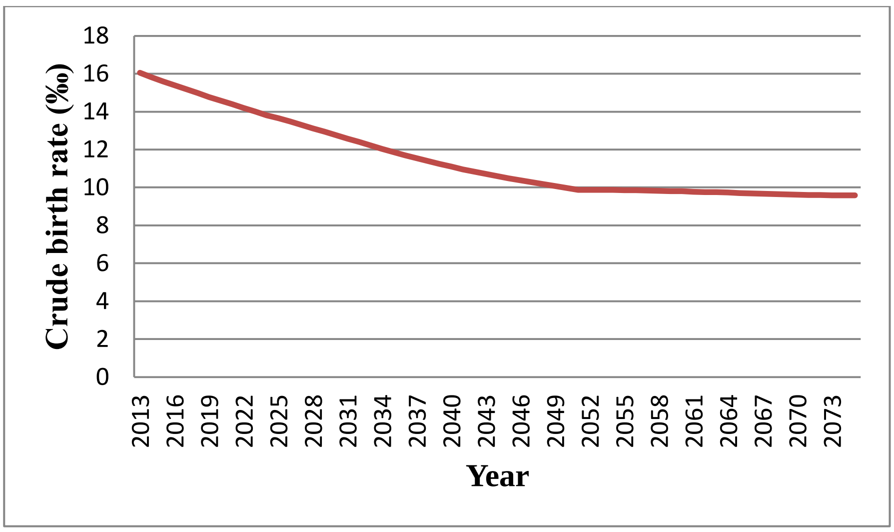


Figure 5.2. TURKSAT 2013-2075 projection for crude birth rate [22].

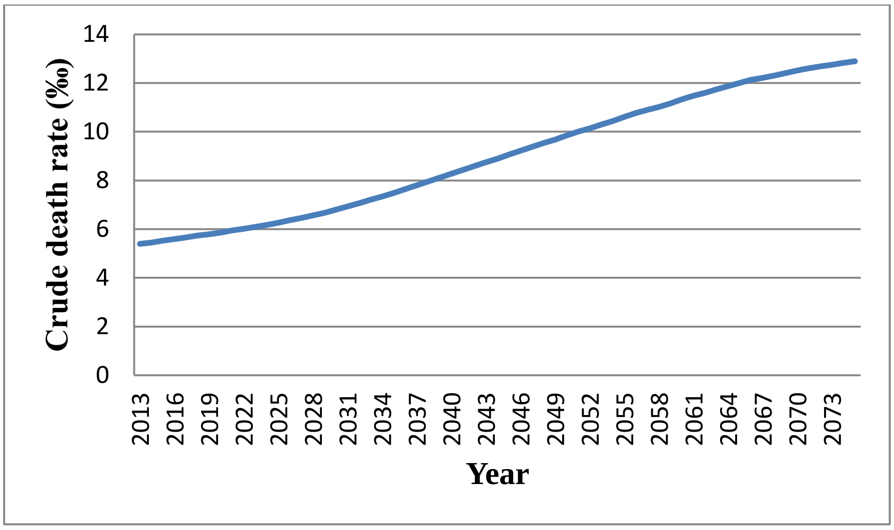


Figure 5.3. TURKSAT 2013-2075 projection for crude death rate [22].

For both poor and rich students, there is an enrollment fraction to high-quality education, which is affected by privatization and affordability ratio to annual average education fees. As mentioned earlier, high-quality education can be in public or private schools. It is important to define what is meant by public and private education. For this purpose, it is relevant to look at the definition provided by UNESCO, which distinguishes between a public agency and a private entity according to who applies the “ultimate control” over an institution [23]. Ultimate control is decided with reference to who has the power to determine the general policies and activities of the institution and to appoint the officers who manage it. It is also important to consider whether an institution is providing education in a “non-profit” or “for-profit” manner, as this directly influences the purpose, mission, organisation and methods of governance and work. Thus, this definition allows us to define as private all educational institutions, belonging to private owner (individual or collective), as opposite to public agency (state, municipality) [23].

In the view of private education, privatization is a ratio that indicates the proportion of private school capacities at the high-quality education level to the capacities of all schools at that qualified education level. For the calculations of the privatization ratio, statistics from the Ministry of Education is consulted. The data set for university entrance examination for 2010 is open to the public. Therefore, the data among all types of high schools is investigated according to student success in this examination. In the data, 40%

of the students in high quality universities come from private high schools. These private high schools can be Science, Anatolian or just regular high schools. To make a proper assumption for the privatization ratio, the value of 40% is taken as a base privatization ratio, which refers to the percentage of private high-quality schools among all high quality ones.

There is a difference between the base enrollment fraction into high-quality public education among poor and rich students. There is also a difference between enrollment fractions to high-quality private education for the poor and rich. As was explained before, educational attainment and the income level of parents have a large impact on the quality of education a student receives in Turkey. The student's educational background differs according to their family income.

High-income families are able to pay for private teaching institutions and tutors; so, rich students' base enrollment fraction to private high-quality education is higher than poor students' base enrollment fraction. Annual average education fees to high-quality private education are accepted as 20 000 TL. This amount cannot be measured exactly, so it is a scenario variable. To afford annual average education fees, the annual average salary of the poor and rich should be at least 1.3 times higher than 20 000 TL. Although it is a hard financial condition, this normalized value is the lower bound for a person who really wants his/her child to receive high-quality education before his/her own needs.

On average, 4% of students in low-to-average quality education may drop out of school. It is calculated based on the child labor statistics form TURKSTAT [24]. A much smaller fraction of dropouts from high-quality education is used in the model. Students do not work while in education. If and only if they drop out of school, can they then join the unskilled labor force. On the other hand, it is assumed that when a student has the chance to enter into high-quality education, s/he does not want to lose this chance.

Although there are four skill levels required for different education backgrounds in ISCED-97, three skill levels are called highly skilled, semi-skilled and unskilled in this study for the sake of maintaining simplicity. When students in low-to-average and high-quality education become 24-years-old, they join semi-skilled and highly skilled labor force, respectively. Besides this, if some students drop out from low-to-average or high-quality education, they then join the unskilled labor force. People can be counted as being in the labor force for thirty years, after that they are counted in the model as retired people until they die.

### 5.1.3. Description of the Structure

The stock-flow diagrams of the population-education sector for the poor and the rich are shown in Figure 5.4 and Figure 5.5, respectively.

There are four main stocks to describe aging population: up to 15-year-old children, 15 to 24-year-old students, 25 to 54-year-old labor force and over 55-year-old retired people. As explained before, people in the labor force are sorted into three skill levels, according to their education background.

There is a difference between the modeling mechanism among the poor and the rich: If children are born into a low-level income family (poor family), some of them may work as a child laborers legally after they reach 15 years of age. According to UNICEF, children who work under eighteen years old are called child laborer [25]. However, Turkey has accepted the ILO's definition that a 15-year-old child can join the labor force legally [3]. For building a proper model, children in child labor are placed into the aging chain of the poor population.

As mentioned earlier, net birth rate between the poor and the rich are different. Calculations for the birth and death fractions for both are conducted according to TURKSTAT's data. Formulations for poor and rich children are given in the fallowing equations.

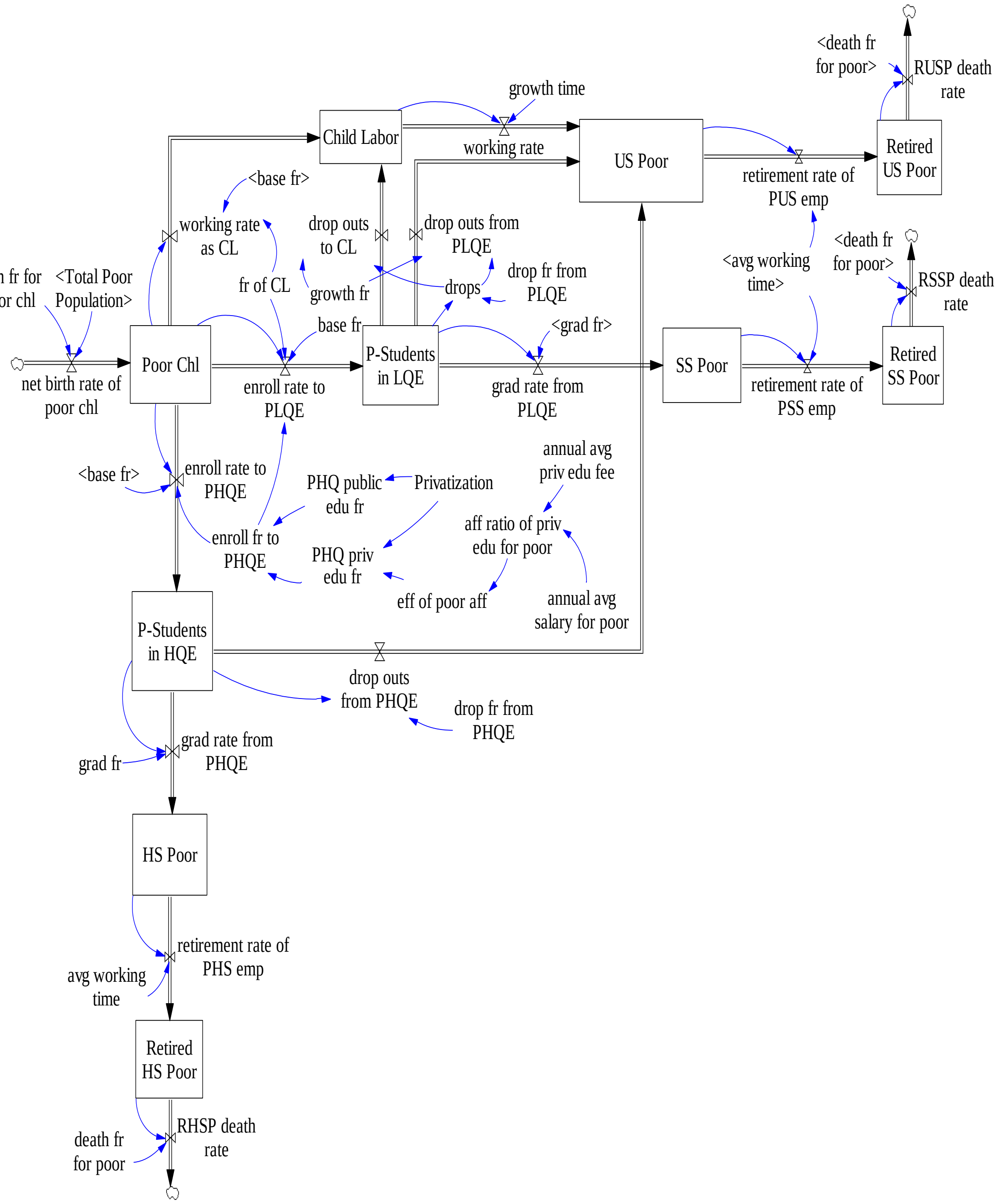


Figure 5.4. Stock-flow diagram of the population-education sector among the poor.

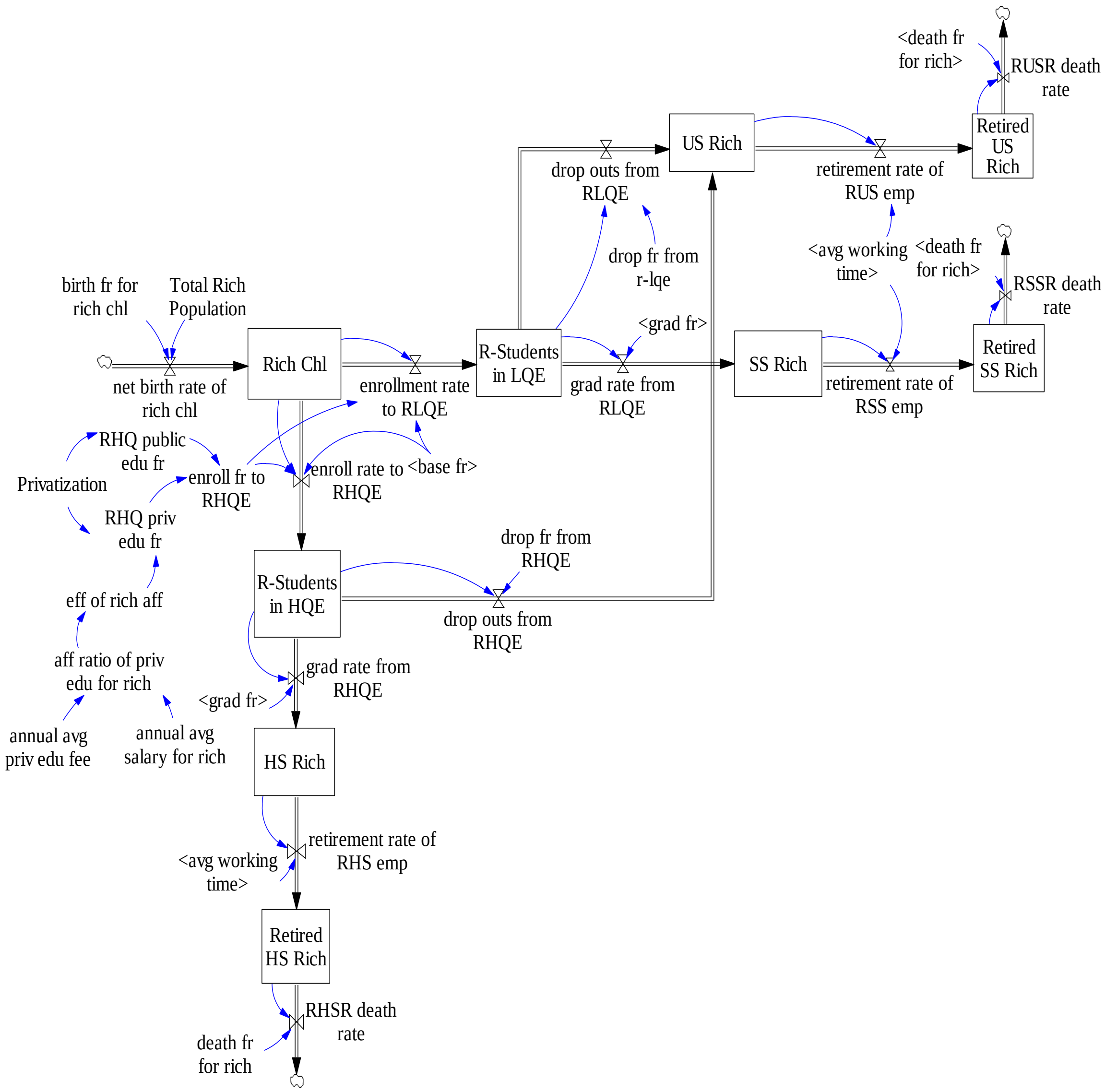


Figure 5.5. Stock-flow diagram of the population-education sector among the rich.

$$\text{Poor Chl}(t) = \text{Poor Chl}(t - dt) + (\text{net birth rate of poor chl} - \text{working rate as CL} - \text{enroll rate to PHQE} - \text{enroll rate to PLQE}) * dt \tag{5.1}$$

$$\text{Rich Chl}(t) = \text{Rich Chl}(t - dt) + (\text{net birth rate of rich chl} - \text{enroll rate to RHQE} - \text{enroll rate to RLQE}) * dt \tag{5.2}$$

$$\text{net birth rate of poor chl} = \text{Total Poor Population} * \text{birth fr for poor chl} \tag{5.3}$$

$$\text{net birth rate of rich chl} = \text{Total Rich Population} * \text{birth fr for rich chl} \tag{5.4}$$

The data from TURKSTAT (Figures 5.2 and 5.3 above) is implemented to the calculations of birth and death fractions for the poor and rich (see Figure 5.6 and Figure 5.7). For the sake of simplicity, just retired people die in this model.

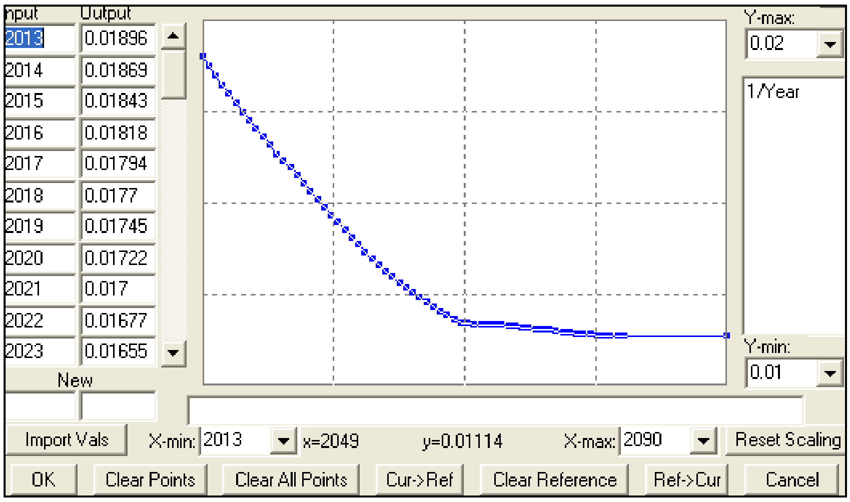


Figure 5.6. Graphical function for the birth fraction of the poor in the model.

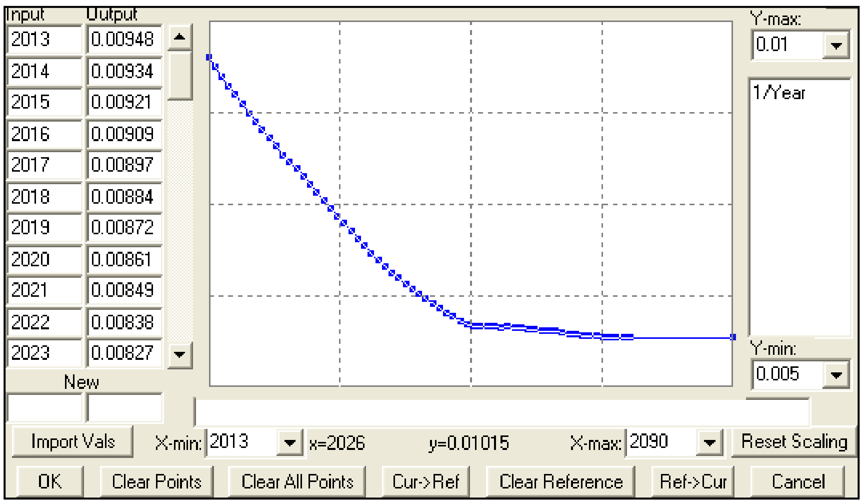


Figure 5.7. Graphical function for the birth fraction of the rich in the model.

There is a base fraction that implies a 15-year period for child maturity. After children become 15-year-old, they can enroll in low-to-average or high-quality education.

For this point, there is an enrollment fraction to high-quality education, which is calculated for the enrollment rate to high-quality education and low-to-average quality education among students. These rates are affected by privatization and affordability of education fees. Whether it is in privatized or public education, high-quality education is not an ordinary achievement. Therefore, two base fractions are introduced to the model for high-quality public and private education. The high-quality public education base fraction refers to students' entrance rate to high-quality public schools under normal conditions. With the same logic, a high-quality private education base fraction indicates students' entrance rate to high-quality education in private schools under normal conditions.

According to the difference between poor and rich students' background, the high-quality private education base fraction for the rich is higher than it is for the poor. It is known that; if there is an increase in privatization, then the rich could afford the increased amount much more easily than the poor could [26]. For that reason, there is an effect of affordability on privatized education for the high-quality private education fraction. In addition, this effect on the high-quality private education fraction also has an influence on the enrollment fraction to high-quality education. Formulations for poor and rich students in high-quality education are shown in the following equations.

$$\begin{aligned}\text{P Students in HQE}(t) = \text{P Students in HQE}(t - dt) + (&\text{enroll rate to PHQE} - \\ &\text{drop outs from PHQE} - \text{grad rate from PHQE}) * dt\end{aligned} \tag{5.5}$$

$$\begin{aligned}\text{R Students in HQE}(t) = \text{R Students in HQE}(t - dt) + (&\text{enroll rate to RHQE} - \\ &\text{drop outs from RHQE} - \text{grad rate from RHQE}) * dt\end{aligned} \tag{5.6}$$

$$\text{enroll rate to PHQE} = \text{Poor Chl} * \text{base fr} * \text{enroll fr to PHQE} \tag{5.7}$$

$$\text{enroll rate to RHQE} = \text{Rich Chl} * \text{base fr} * \text{enroll fr to RHQE} \tag{5.8}$$

$$\text{enroll fr to PHQE} = \text{PHQ public edu fr} + \text{PHQ priv edu fr} \tag{5.9}$$

$$\text{enroll fr to RHQE} = \text{RHQ public edu fr} + \text{RHQ priv edu fr} \tag{5.10}$$

$$\text{PHQpublicedu fr} = (1 - \text{Privatization}) * \text{PHQpublicedu base fr} \tag{5.11}$$

$$\text{RHQpublicedu fr} = (1 - \text{Privatization}) * \text{RHQpublicedu base fr} \tag{5.12}$$

$$\text{PHQprivedu fr} = \text{Privatization} * \text{eff of pooraff} * \text{PHQprivedu base fr} \tag{5.13}$$

$$\text{RHQprivedu fr} = \text{Privatization} * \text{eff of rich aff} * \text{RHQprivedu base fr} \tag{5.14}$$

The graphical effect function of affordability of privatized education on the enrollment fraction to high-quality education is same for the poor and the rich. Privatized education affordability has power to increase high-quality private education fraction at most 1.75 times. The high-quality private education fraction refers to the fraction of the students in private education among all students who can enter the high-quality private education. If affordability ratio to privatized education is very low, then the high-quality private education fraction decreases to zero. The related graphical function is provided in Figure 5.8.

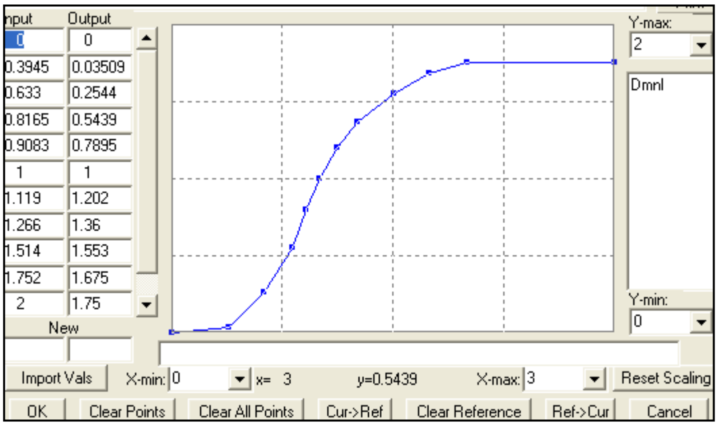


Figure 5.8. Graphical effect function of affordability of privatized education on the enrollment fraction to high-quality education.

Formulations for the students who cannot enter the high-quality education are shown in the next equations. In other words, enrollment rates to low-to-average quality education among poor and rich students are given by below equations:

$$\text{enroll rate to PLQE} = \text{Poor Chl} * \text{base fr} * (1 - (\text{enroll fr to PHQE} + \text{fr of CL})) \tag{5.15}$$

$$\text{enroll rate to RLQE} = \text{Rich Chl} * \text{base fr} * (1 - \text{enroll fr to RHQE}) \tag{5.16}$$

There is a very small fraction of child labor (fr of CL) to indicate the ratio of child laborer among poor children. In the first step of labor force dynamics, although child labor is a small proportion of the labor force, it is built for 15 to 18-year-old children who work in the labor market. Children in child labor need to grow to join the unskilled labor force, so, three working years are defined as a growth time for child labor. These poor children are either dropouts from low-to-average quality education or work directly when they reach 15-years-old. Related equations to child labor are given below:

$$\begin{aligned}\text{Child Labor }(t) = \text{Child Labor }(t - dt) + (&\text{working rate as CL} + \text{dropouts to CL} - \\ &\text{working rate}) * dt\end{aligned} \tag{5.17}$$

$$\text{working rate as CL} = \text{Poor Chl} * \text{fr of CL} * \text{base fr} \tag{5.18}$$

$$\text{dropouts to CL} = \text{drops} * \text{growth fr} \tag{5.19}$$

$$\text{drops} = \text{P Students in LQE} * \text{drop fr from PLQE} \tag{5.20}$$

$$\text{working rate} = \frac{\text{ChildLabor}}{\text{growth time}} \tag{5.21}$$

As mentioned before, there are three skill levels for the labor force as unskilled, semi-skilled and highly skilled. Formulations for the poor and rich labor force are similar. Formulation mechanisms for the poor labor force are shown as a general idea of the labor force dynamics.

$$\begin{aligned}\text{USPoor}(t) = \text{USPoor}(t - dt) + (&\text{dropouts from PHQE} + \text{dropouts from PLQE} + \\ &\text{working rate} - \text{retirement rate of PUSemp}) * dt\end{aligned} \tag{5.22}$$

$$SS\,Poor(t) = SS\,Poor(t-dt) + (grad\ rate\ from\ PLQE - retirement\ rate\ of\ PSS\ emp) * dt \tag{5.23}$$

$$HS\,Poor(t) = HS\,Poor(t-dt) + (grad\ rate\ from\ PHQE - retirement\ rate\ of\ PHS\ emp) * dt \tag{5.24}$$

$$dropouts\ from\ PHQE = P\ Students\ in\ HQE * drop\ fr\ from\ PHQE \tag{5.25}$$

$$dropouts\ from\ PLQE = drops * (1 - growth\ fr) \tag{5.26}$$

$$grad\ rate\ from\ PLQE = P\ Students\ in\ LQE * grad\ fr \tag{5.27}$$

$$grad\ rate\ from\ PHQE = P\ Students\ in\ HQE * grad\ fr \tag{5.28}$$

$$retirement\ rate\ of\ PUS\ emp = \frac{US\ Poor}{avg\ working\ rate} \tag{5.29}$$

As explained before, it is assumed that just retired people die in this model for the sake of simplicity. Therefore, death rates are the outflows of only stocks of retired people among the poor and the rich population. For the general view, formulas of the death rate of unskilled retired people among the poor and rich population are shown in the following equations. These equations can be modified to other skill levels of retired people.

$$RUSP\ death\ rate = Retired\ US\ Poor * death\ fr\ for\ poor \tag{5.30}$$

$$RUSR\ death\ rate = Retired\ US\ Rich * death\ fr\ for\ rich \tag{5.31}$$

## 5.2. Employment Sector

### 5.2.1. Background Information

As explained in the population sector, when the education period ends for students, they join the labor force according to their qualifications. The difference between labor force qualifications comes from their educational backgrounds. As mentioned before, if they receive high-quality education, they then join a highly skilled labor force. On the other hand, if they receive low-to-average quality education, they then join a semi-skilled labor force. Students may drop out of school during their education period, and then they directly join the unskilled labor force. Therefore, there are three levels of labor force: highly skilled, semi-skilled and unskilled.

People may have different statuses in employment market. They can work as employees, employers, own-accounts or be contributing family workers. Since the model deals with poverty dynamics among the working poor, and tries to investigate the trap of poverty in the long run, only the salaried labor force is taken into account. In other words, salaried employees are modeled in this study.

According to the OECD statistics, the ratio of number of employees to total employed people changes from country to country. Some examples of this ratio from other countries in 2008 are: 93% in United States, 87% in United Kingdom, 88% in Germany, 90% in France, 87% in Japan, 83% in Cuba and 61% in Turkey. Many different reasons account for the different between ratios among the different countries mentioned. For Turkey, the ratios of number of those with own-accounts and family workers compared to total employed people, can be higher than in the other countries'. Also, the record of employment is a crucial factor. There is an informal economic sector, which is not included in this study because of its ambiguity in nature.

The International Standard Classification of Occupations (ISCO) is one of the main international classifications for which the ILO is responsible. There are major occupational groups according to ISCO-08. All occupational groups require different educational backgrounds. In those cases where formal education and training requirements are used as part of the measurement of the skill level of an occupation, these requirements are defined in the terms of the ISCED-97, which is mentioned in the population-education sector.

Table 5.3. Mapping of ISCO-08 major groups to skill levels [17].

| ISCO-08<br>Major occupational groups | Skill<br>Level |
|---|---|
| 1 Managers | 3+4 |
| 2 Professionals | 4 |
| 3 Technicians and associate professionals | 3 |
| 4 Clerical support workers | 2 |
| 5 Service and sales workers | |
| 6 Skilled agricultural, forestry and fishery workers | |
| 7 Craft and related trades workers | |
| 8 Plant and machine operators and assemblers | |
| 9 Elementary occupations | 1 |
| 0 Armed Forces Occupations | 1+2+4 |

Table 5.4. Mapping of the four ISCO-08 skill levels to ISCED-97 levels of education [17].

| ISCO-08<br>skill levels | ISCED-97<br>Education groups |
|---|---|
| 4 | 6 Second stage of tertiary education (leading to an advanced research qualification)<br>5a First stage of tertiary education, 1st degree (medium duration) |
| 3 | 5b First stage of tertiary education (short or medium duration) |
| 2 | 4 Post-secondary, non-tertiary education<br>3 Upper secondary level of education<br>2 Lower secondary level of education |
| 1 | 1 Primary level of education |

### 5.2.2. Fundamental Approach and Assumptions

There is an endogenous growth of available total jobs in this model. It changes by the net growth rate of all the labor force. Here, it should be remembered that the salaried labor force is considered while building this model. Therefore, there is a salaried job ratio to calculate the number of salaried jobs. This ratio is equal to the salaried employee ratio in the model structure. As mentioned in the background information of this sector, the salaried employee ratio in Turkey according to the OECD is around 60%. This ratio is also used to calculate the number of total salaried labor force.

As explained in population-education sector, there are four skill levels requiring different education backgrounds in ISCED-97. However, for the sake of simplicity, these four levels are introduced into the model as three levels. They are named as highly skilled, semi-skilled and unskilled labor force; to indicate the skill levels of the overall labor force. According to this classification of skill level, there are three different salaried jobs qualifications. Just as with the labor force levels, these salaried jobs are named: highly skilled, semi-skilled and unskilled salaried jobs in this study. According to nature of the labor market, the number of unskilled salaried jobs is higher than number of semi-skilled salaried jobs, which is higher than the number of highly skilled salaried jobs. Their ratios to all salaried jobs are calculated according to the distribution of employees within the labor market in 2010, which is shown in Table 5.5. It is assumed that 20% of the jobs are highly skilled, 35% are semi-skilled, and 45% are unskilled jobs; and, they are at their constant values in the model runs.

Table 5.5 Monthly average gross wage and annual average gross earnings by major occupational group, 2010 [27].

| Major occupational group ISCO-88 | Number of employees | The distribution of employees (%) | Monthly average gross wage (TL) | Annual average gross wage (TL) |
|---|---|---|---|---|
| Total | 13.762.000 | 100.0 | 1 512 | 19 694 |
| 1 Managers | 688.100 | 5.0 | 3 710 | 49 170 |
| 2 Professionals | 1.032.150 | 7.5 | 2 683 | 33 974 |
| 3 Technicians and associate professionals | 1.279.866 | 9.3 | 1 873 | 24 628 |
| 4 Clerical support workers | 1.844.108 | 13.4 | 1 596 | 21 478 |
| 5 Service and sales workers | 1.967.966 | 14.3 | 1 099 | 13 787 |
| 6 Skilled agricultural, forestry and fishery workers | 27.524 | 0.2 | 1 172 | 14 561 |
| 7 Craft and related trades workers | 2.449.636 | 17.8 | 1 292 | 16 921 |
| 8 Plant and machine operators and assemblers | 2.353.302 | 17.1 | 1 115 | 14 544 |
| 9 Elementary occupations | 2.119.348 | 15.4 | 1 015 | 13 032 |

For the hiring process, which is named “vertical hiring process”, a person among the higher-level labor force has priority to get lower level job, if s/he is unemployed. For instance, if there is a highly skilled person who is unemployed because of the bottleneck of available highly skilled jobs, s/he has the priority to get a semi-skilled job before a semi-skilled person. In other words, it is assumed that unemployed highly skilled person prefers having lower salary instead of being unemployed.

Also for the hiring process, a firm would like to have a high skilled person even if there is room in a job that requires lower skill. This hiring process is the same in the semi-skilled labor force for securing unskilled jobs.

Salaries are also calibrated according to TURKSTAT data in 2010, which is shown in Table 5.5, with the monthly average gross salary per unskilled, semi-skilled and highly skilled employees being 1000 TL, 2000 TL and 4500 TL, respectively. The accepted skill levels of the model are provided in Table 5.6. The monthly average salary per employee at each skill level is calculated by taking an average of the monthly average gross wages, which are shown according to the three skill levels of the model (see Table 5.7).

The monthly average salary of highly skilled employee is quite higher than the value given in the TURKSTAT data. That is because, in the model, there are no own-account workers or employers who could be counted as the highly skilled employees. Therefore, the annual average salary of highly skilled employee is taken quite higher to evaluate approximately the real amount of this salary.

To analyze the vicious circle of poverty, in other words the poverty trap, annual average salaries of poor and rich are compared while evaluating the model. To clarify the comparison of the annual average salaries, the ratio of annual average salary of the rich to annual average salary of the poor is calculated. Furthermore, unemployment ratios among the poor and the rich labor forces are analyzed as well.

Table 5.6. Mapping ISCO-08 skill levels with classification and fraction of job levels of the model.

| ISCO - 08 skill levels | Classification of job levels | Fraction of job levels | Monthly avg gross salary (TL) |
|---|---|---|---|
| 4 | Highly skilled | 20% | 4 500 |
| 3 | Semi-skilled | 35% | 2 000 |
| 1+2 | Unskilled | 45% | 1 000 |

Table 5.7. Mapping of ISCO-08 major groups to skill levels of the model.

| Major occupational group ISCO-88 | The distribution of employees (%) | Monthly average gross wage (TL) | Accepted skill levels of the model |
|---|---|---|---|
| Total | 100.0 | 1 512 | |
| 1 Managers | 5.0 | 3 710 | 3+4 |
| 2 Professionals | 7.5 | 2 683 | 4 |
| 3 Technicians and associate professionals | 9.3 | 1 873 | 3 |
| 4 Clerical support workers | 13.4 | 1 596 | 2 |
| 5 Service and sales workers | 14.3 | 1 099 | 3 |
| 6 Skilled agricultural, forestry and fishery workers | 0.2 | 1 172 | 4 |
| 7 Craft and related trades workers | 17.8 | 1 292 | 3+4 |
| 8 Plant and machine operators and assemblers | 17.1 | 1 115 | 1+2 |
| 9 Elementary occupations | 15.4 | 1 015 | 1 |

### 5.2.3. Description of the Structure

The simplified stock-flow diagram of the employment sector is in Figure 5.10. There is one stock to represent the number of available total jobs in this sector. Number of available total jobs changes by the net growth rate of the labor force. There is an endogenous growth of available total jobs. The net growth fraction of available total jobs is equal to the net growth fraction of the labor force (see Figure 5.9). It should be remarked that the labor force growth fraction is calculated by a ratio of total net growth rate among all level of the labor force, to the number of people among the labor force. In other words, the net growth fraction of the labor force is endogenously calculated by the ratio of net rate of changes among the all labor forces to the all labor force. The equations for available number of jobs are given in the following formulations. As it is mentioned before, the salaried labor force is considered while building this model. So, the available total salaried jobs are shown in the Equation 5.34.

$$\text{Available Total Jobs}(t) = \text{Available Total Jobs}(t - dt) + \text{net job growth rate} * dt \tag{5.32}$$

$$\text{net job growth rate} = \text{Available Total Jobs} * \text{net job growth fr} \tag{5.33}$$

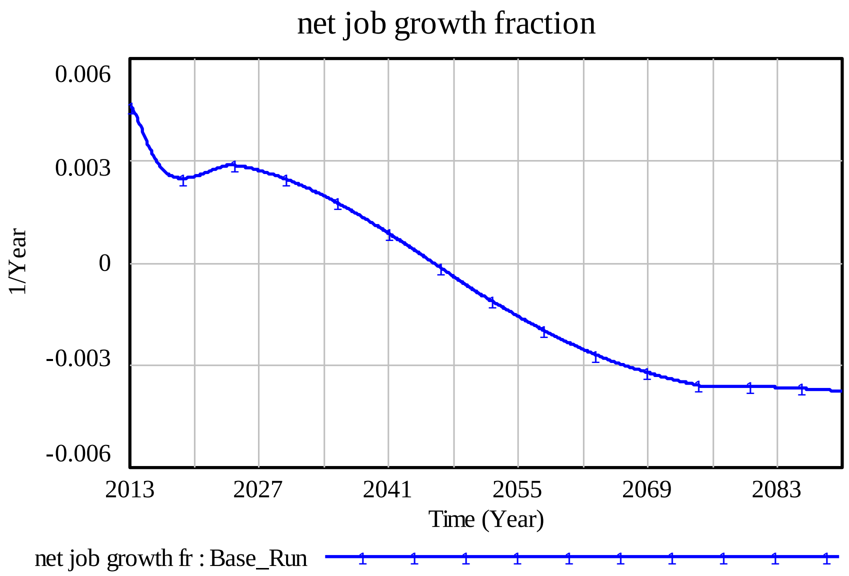


Figure 5.9. Net job growth fraction generated by the model.

$$\text{available total salaried jobs} = \text{Available Total Jobs} * \text{salaried job ratio} \tag{5.34}$$

$$\text{total UER} = \frac{\text{total UE}}{\text{total SLF}} \tag{5.35}$$

$$\text{total poor UER} = \frac{\text{total UE poor}}{\text{total poor SLF}} \tag{5.36}$$

$$\text{total rich UER} = \frac{\text{total UE rich}}{\text{total rich SLF}} \tag{5.37}$$

The algorithm behind the hiring process is set up according to the priority for highly skilled and semi-skilled labor forces as mentioned in the previous chapter. The detailed equations for this algorithm can be found in Appendix A. The total unemployment ratio is calculated for all salaried labor force populations and also for the poor and the rich labor forces separately. Formulations of total unemployment ratio (total UER) are shown in the above equations.

For the unemployment ratio among the total salaried labor force, total unemployed people are also calculated. Unemployment among poor and rich are evaluated in their own pool of labor force, in order to evaluate their positions in the employment sector. The annual average salaries of the poor and rich's calculations are similar. Therefore, formulation of the annual average salary for poor is provided in the following equation.

$$\begin{aligned}
&\text{Annual average salary for poor} = \\
&\qquad ((\text{Actual HS Employed Poor} * \text{annual avg salary per HS emp}) + \\
&\qquad (\text{Actual SS Employed Poor} * \text{annual avg salary per SS emp}) + \\
&\qquad (\text{Actual US Employed Poor} * \text{annual avg salary per US emp}))/ \\
&\qquad (\text{Total Poor SLF})
\end{aligned} \tag{5.38}$$

$$\begin{aligned}
&\text{Annual average salary for rich} = \\
&\qquad ((\text{Actual HS Employed Rich} * \text{annual avg salary per HS emp}) + \\
&\qquad (\text{Actual SS Employed Rich} * \text{annual avg salary per SS emp}) + \\
&\qquad (\text{Actual US Employed Rich} * \text{annual avg salary per US emp}))/ \\
&\qquad (\text{Total Rich SLF})
\end{aligned} \tag{5.39}$$

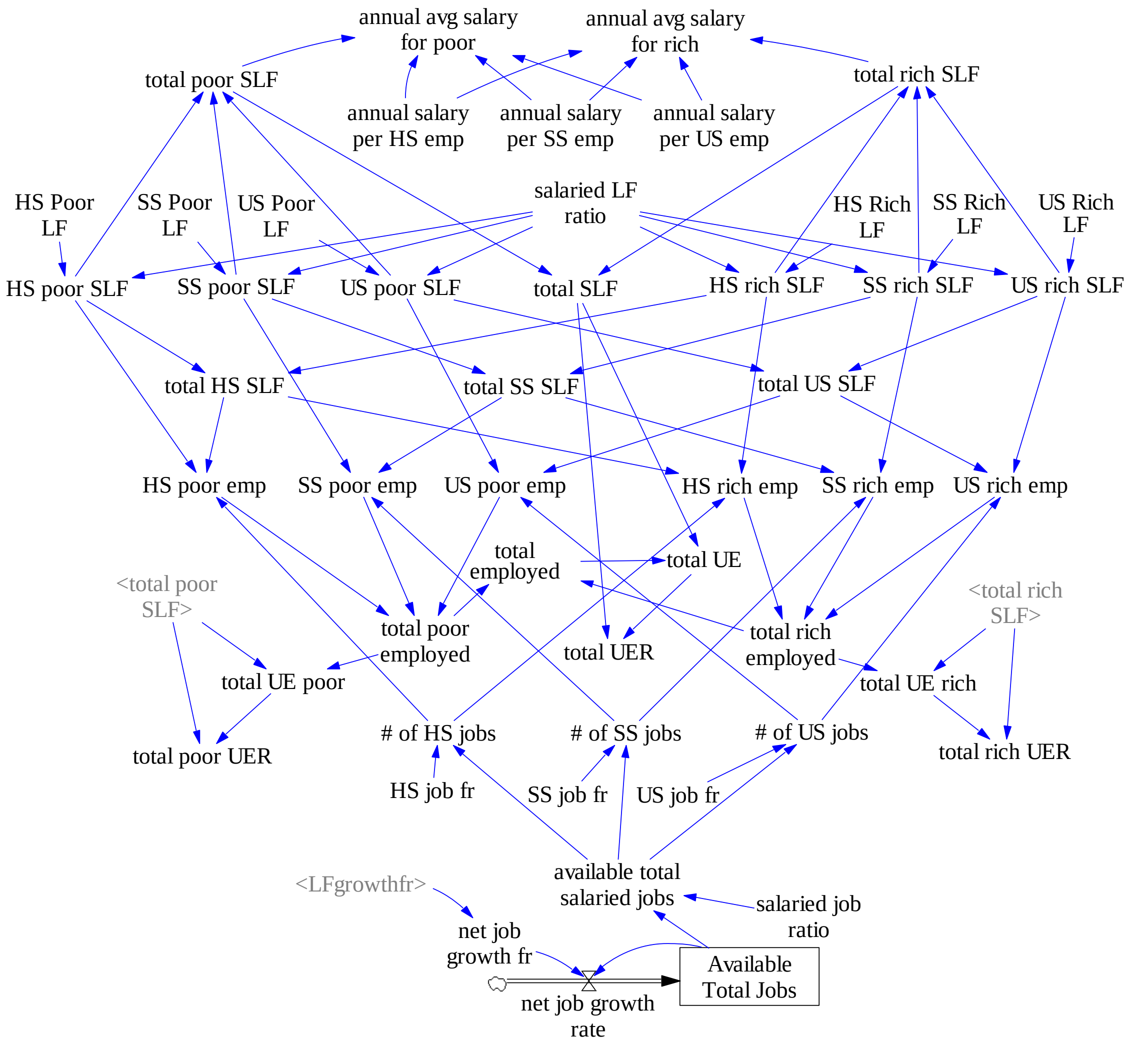


Figure 5.10. Stock-flow diagram of the employment sector.

# 6. VALIDATION AND THE ANALYSIS OF THE MODEL

The model is simulated by Vensim software. It is continuous time model and its default integration type is Euler. In this context, for all the simulation runs, the time step is selected as 0.125. This value is neither too large to give inaccurate results, nor too small to cause computer calculation problems.

The time unit of the model is one year. The time horizon of the simulations is set to 77 years, from 2013 to 2090 in order to be long enough to represent a couple of generations. Also, the horizon is proper to capture for the direct, indirect, and delayed effects of the variables and feedbacks.

In this chapter, first, the model credibility will be discussed in Section 6.1. After that, the base behavior of the model will be presented in Section 6.2.

## 6.1. Model Credibility

Model credibility is a vital process to check if the model is able to sufficiently represent the real problem inside the boundary of the modeling study. Model credibility is tested both in structural and behavioral aspects [15]. The first step is to test the credibility of the structure, and the second step is checking for behavior adequacy. To test the model credibility, two major test groups, structural and behavioral, are applied to the model. These major groups and their related sub-groups will be described in the following sections.

### 6.1.1. Structural Credibility

Structural credibility tests help to analyze the structure of the model, whether it can adequately reflect the actual relations, which exist in the real problem of interest. The behavior credibility tests should be done only after the structural credibility tests are established. This is because, if the structure of the model is invalid, then its behavior becomes automatically unreliable. Structure credibility involves two distinct tests that are direct structure tests and structure oriented behavior tests [28]. In this study, structural credibility has been tested during the whole process of the model construction.

The structure of the model aims to describe the real relations that exist in the problem. The structure credibility test consists of two main test groups, which are direct structure tests and structure oriented behavior tests. After model construction, direct structure tests and structure oriented behavior tests are established.

Direct structure tests analyze the model structure credibility by direct comparison with knowledge about the real system structure. Parameter and variable confirmation, dimensional consistency and extreme condition tests are done in the direct structure tests [15]. In the model, all parameters and variables have real counterparts. The equations and relationship are compatible with available knowledge about the real socioeconomic system. Additionally, there is dimensional consistency in the model. All of the model equations are credible under extreme conditions.

Structure oriented behavior tests analyze the credibility of the structure indirectly. There are two subgroups of structure oriented behavior tests, which are called extreme condition tests and sensitivity analysis. The results of extreme condition tests are shown in the following section. Furthermore, the results of sensitivity analysis are provided after the analysis of the base behavior.

6.1.1.1. Extreme Condition Tests. Extreme condition tests (ECTs) help to understand whether the model is reliable under extreme conditions. Independent from how extreme policies are applied to the model, the model should behave realistically [15]. Extreme condition tests with some key variables are applied in this section. In this study, extreme condition tests are done in two main steps, and three sub-parts of simulation experiments are run for each main step. For main steps, the privatization level is considered with the three sub parts in which the annual average salaries of the poor and the rich are examined. The abbreviations of the extreme condition tests are provided in Table 6.1.

Table 6.1. The abbreviations of the extreme condition tests.

| ECTs for Privatization level | MASs are high. | MASs are low. | MAS per HS emp is high, per US emp is low. |
|---|---|---|---|
| Privatization at high level | ECT_1_a | ECT_1_b | ECT_1_c |
| Privatization at low level | ECT_2_a | ECT_2_b | ECT_2_c |

*Extreme condition test 1*: The privatization level is very high in the first extreme condition test. The privatization level is set to 0.99. That means 99% of the high-quality schools are private schools.

*Extreme condition test 1_a (ECT_1_a)*: In addition to a high level of privatization, monthly average salaries (MASs) per employees at all skill levels are also set to extreme high levels in this extreme condition test. Since the annual average salary (AAS) for the poor is almost as high as it is for the rich (see Figure 6.1), the poor can afford highly privatized education among high-quality schools. Therefore, after some time, the number of poor students in high-quality education is higher than the number of rich students in high-quality education (see Figure 6.2). It is better to discuss the ratios of poor and rich students in high-quality education among all poor and rich students (see Figure 6.3).

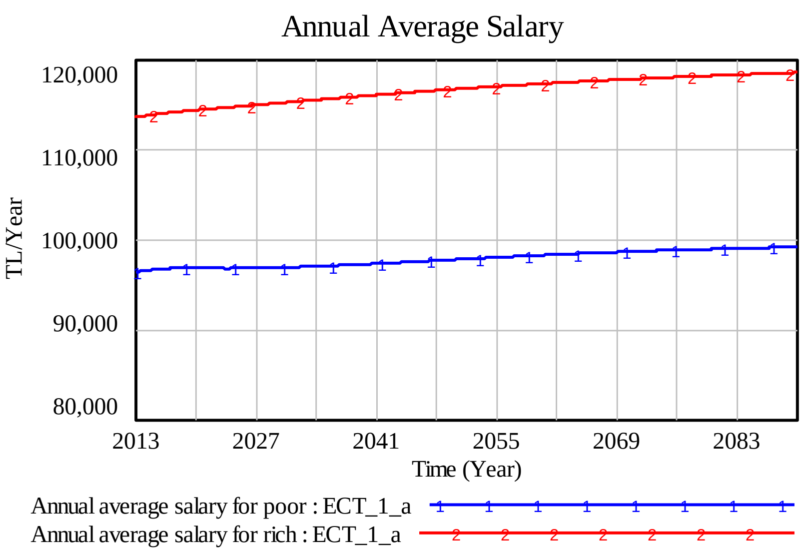


Figure 6.1. The annual average salaries of the poor and rich under the ECT_1_a.

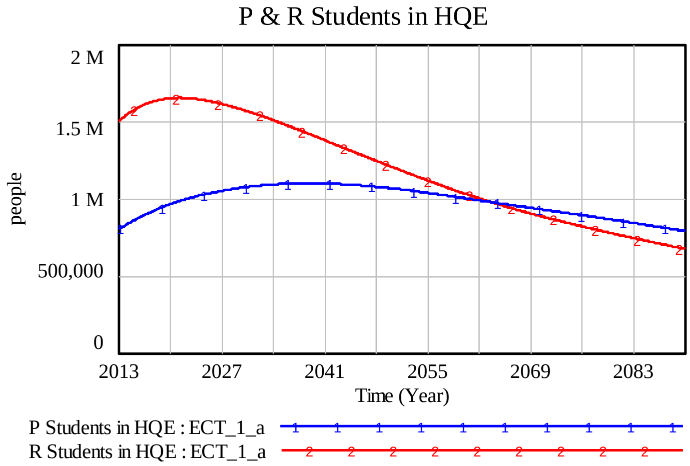


Figure 6.2. The poor and rich students in HQE under the ECT_1_a.

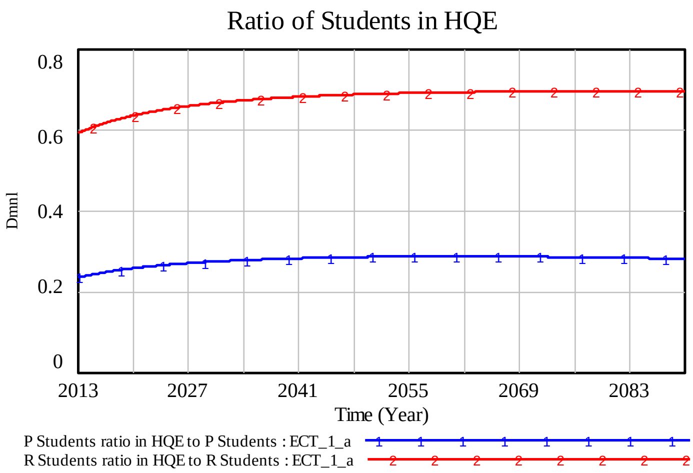


Figure 6.3. The ratio of students in HQE for the poor and rich under the ECT_1_a.

*Extreme condition test 1_b (ECT_1_b):* Besides the high level of privatization, the MASs per employees at all skill levels are also set to extreme low levels in this extreme condition test. Since the AAS of the poor and rich are too low (see Figure 6.4), both cannot afford highly privatized education among high-quality schools. The ratios of poor and rich students in high-quality education among all the poor and rich students, respectively become lower (see Figures 6.5)

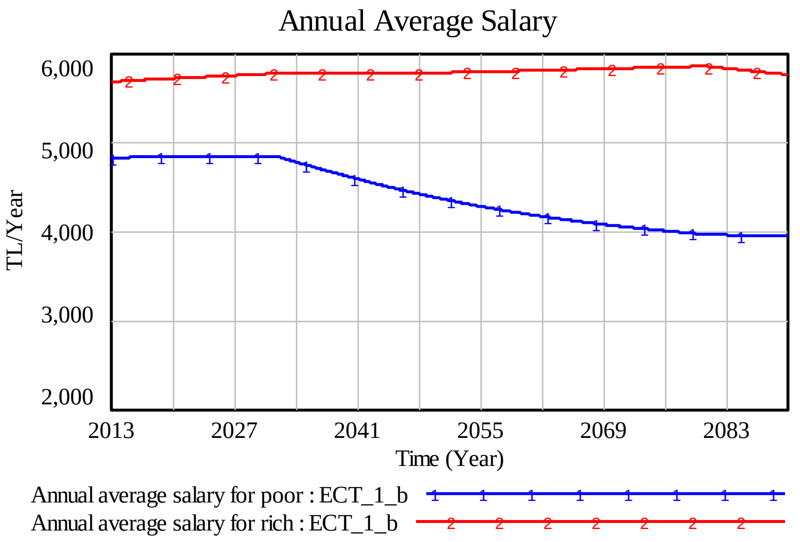


Figure 6.4. The annual average salaries of the poor and rich under the ECT_1_b.

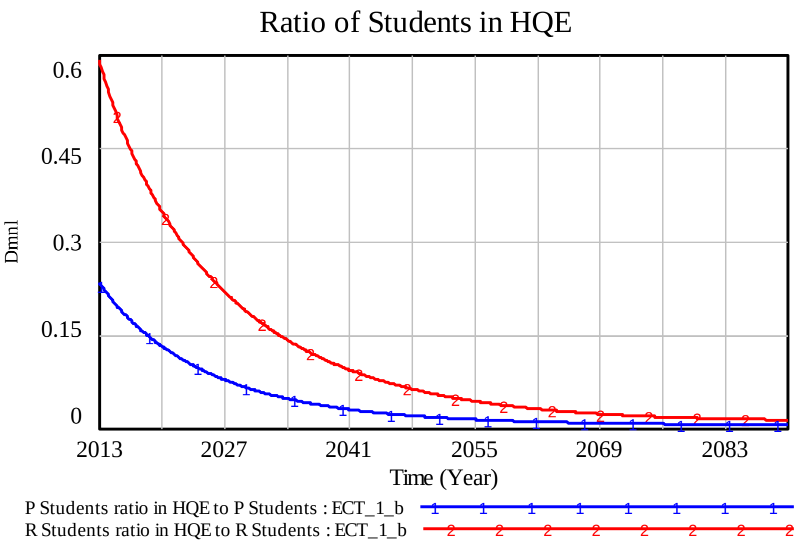


Figure 6.5. The ratio of students in HQE for the poor and rich under the ECT_1_b.

Since the number of students in high-quality education decreases, the highly skilled salaried labor forces among the poor and rich decrease. On the other hand, the semi-skilled and unskilled salaried labor forces increase among the poor and rich. This fact creates higher unemployment ratios, especially among the poor (see Figure 6.6).

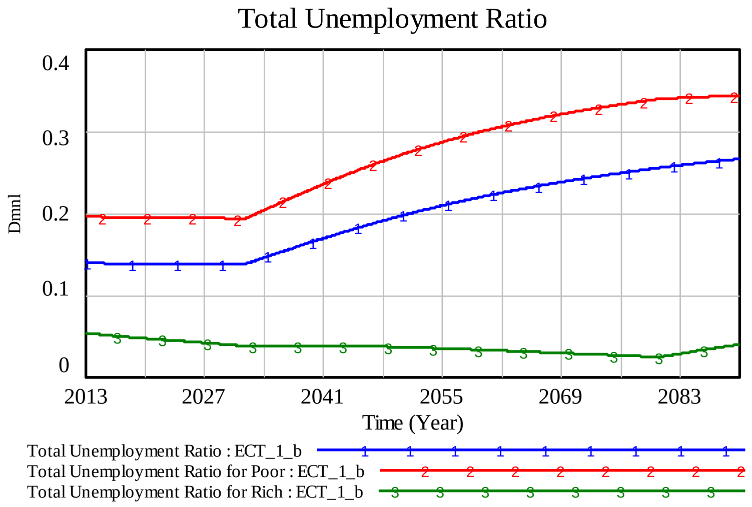


Figure 6.6. All unemployment ratios under the ECT_1_b.

*Extreme condition test 1_c (ECT_1_c):* Besides the high level of privatization, the MAS per highly skilled employee (emp) is set to extreme high-level when compared to the MAS per unskilled employee. Since the AAS of the poor is too low, the poor cannot afford highly privatized education among highly qualified schools. On the other hand, with a higher level of salary, the rich can afford the highly privatized education, as expected, their AASs increase exponentially (see Figure 6.7 and Figure 6.8).

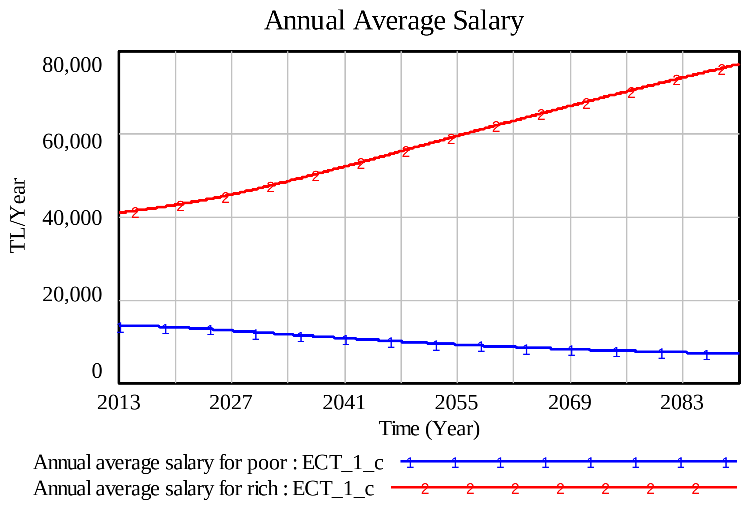


Figure 6.7. The annual average salaries of the poor and rich under the ECT_1_c.

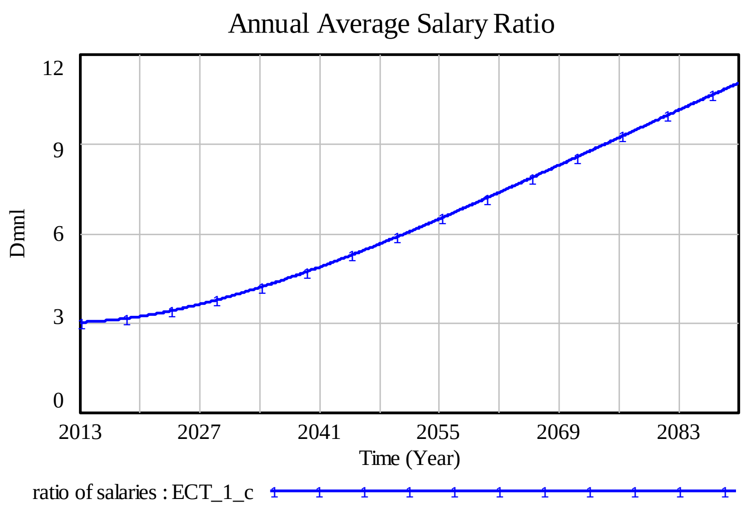


Figure 6.8. The ratio of annual average salaries under the ECT_1_c.

*Extreme condition test 2 (ECT 2)*: The privatization is at very low level in the second extreme condition test. The privatization level is set to 0.01. That means 1% of the highly qualified schools are private schools.

*Extreme condition test 2_a (ECT 2_a):* In addition to a low level of privatization, the MASs per employees at all skill levels are set to extreme high levels in this extreme condition test. Since the privatization is at a very low level, there are no salary influences on enrollment rate to high-quality education. The poor and rich can both afford high-quality education, but still; not all of the students can enter this high-quality education (see Figure 6.9 and Figure 6.10).

This extreme condition test is similar with the test under the *ECT_1_a*, since the salary effect on enrollment rate to high-quality education has disappeared. The AASs of the poor and rich are shown in Figure 6.11.

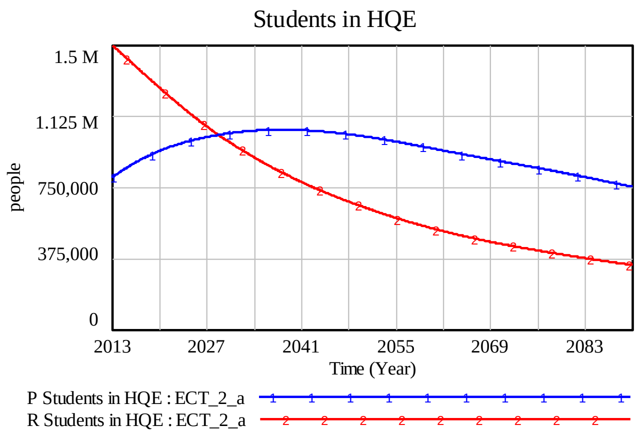


Figure 6.9. The poor and rich students in HQE under the ECT_2_a.

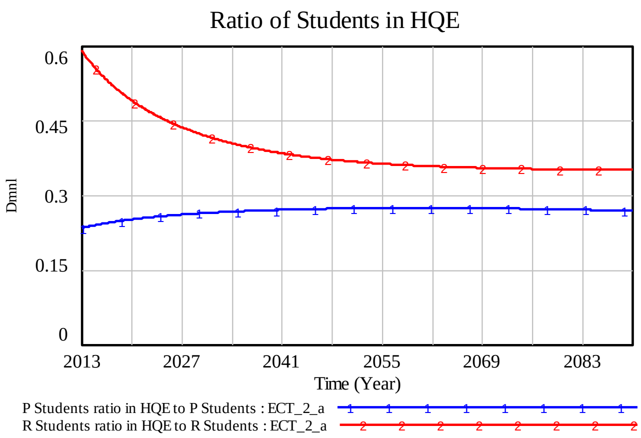


Figure 6.10. The ratio of students in HQE for the poor and rich under the ECT_2_a.

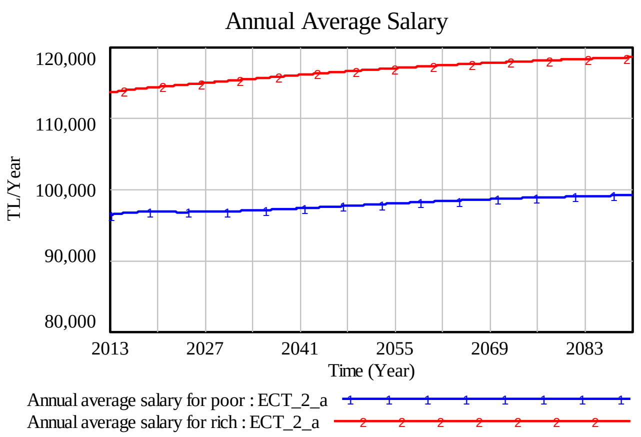


Figure 6.11. The annual average salaries of the poor and rich under the ECT_2_a.

*Extreme condition test 2_b (ECT 2_b):* In addition to the low level of privatization, the MASs per employees at all skill levels are also set to low levels in this extreme condition test. Since the privatization is at a very low level, there are no salary influences on enrollment rate to high-quality education. The results of the ECT_2_ a, and ECT_2_b are similar, as expected (see Appendix C).

*Extreme condition test 2_c (ECT 2_c):* Besides the low level of privatization, the MAS per highly skilled employee is set to extreme high-level when compared to MAS per unskilled employee. So, there is no salary effect on enrollment rate to high-quality education due to the privatization at very low level. The ratio of AASs among the poor and rich becomes smaller, since both of the poor and rich students can achieve entrance into high-quality education, then the AAS of the poor increases (see Figures 6.12 and 6.13).

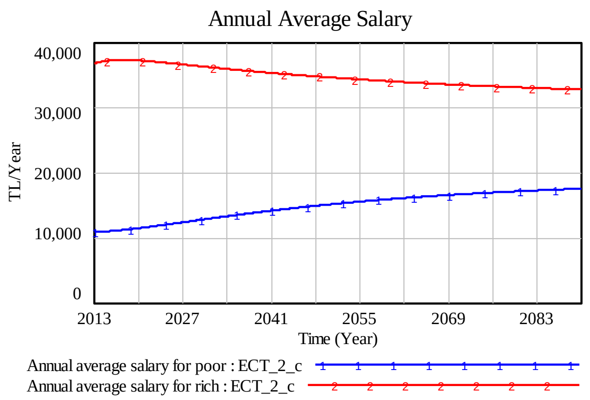


Figure 6.12. The annual average salaries of the poor and rich under ECT_2_c.

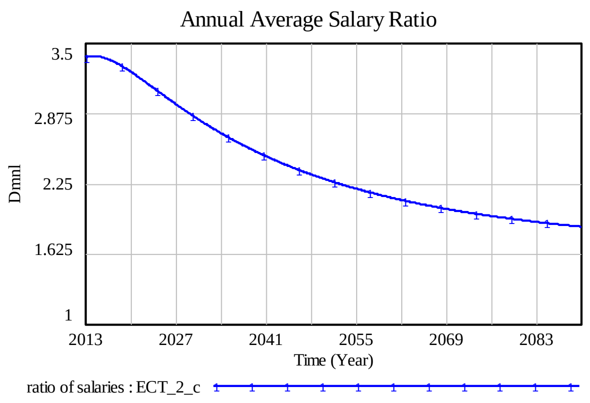


Figure 6.13. The ratio of annual average salaries under ECT_2_c.

### 6.1.2. Behavior Credibility

Once the model succeeds structural tests, behavior credibility tests are conducted to check if the model's dynamic patterns are close enough to the real patterns of concern. As mentioned before, behavior credibility tests determine pattern prediction, not point prediction. This type of credibility involves some statistical and quantitative tests like regression and trend comparison, periods and amplitude comparison, or BTS software [28].

By applying the TURKSTAT's projections for the population, behaviors generated in the model and the TURKSTAT's projections are compared 2013 to 2075. The model generates almost the same behavior patterns as TURKSTAT's projections for total population and also for each age groups in this study. The projections versus model behaviors are provided in the following subsections.

6.1.2.1. Total population. Total population represents about half of the population of Turkey in this study. The projections of TURKSTAT and behaviors of the model are compatible (see Figure 6.14 and Figure 6.15).

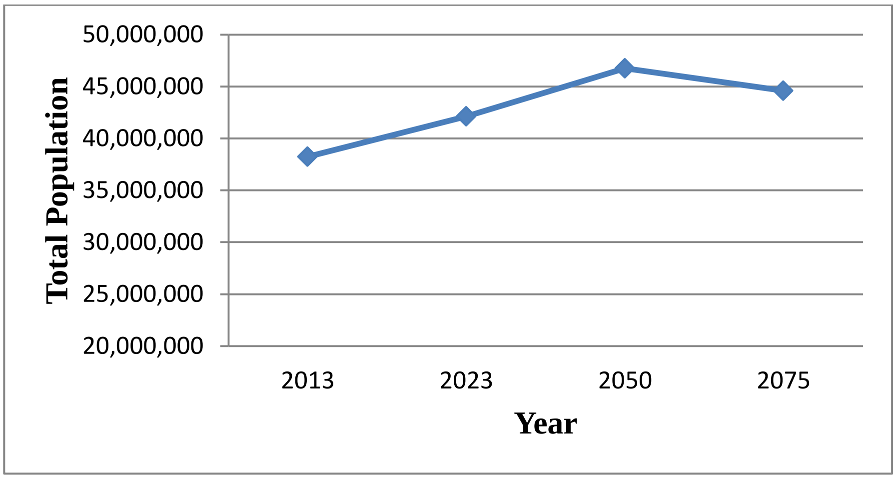


Figure 6.14. TURKSTAT population projections for half of the Turkey's population [22].

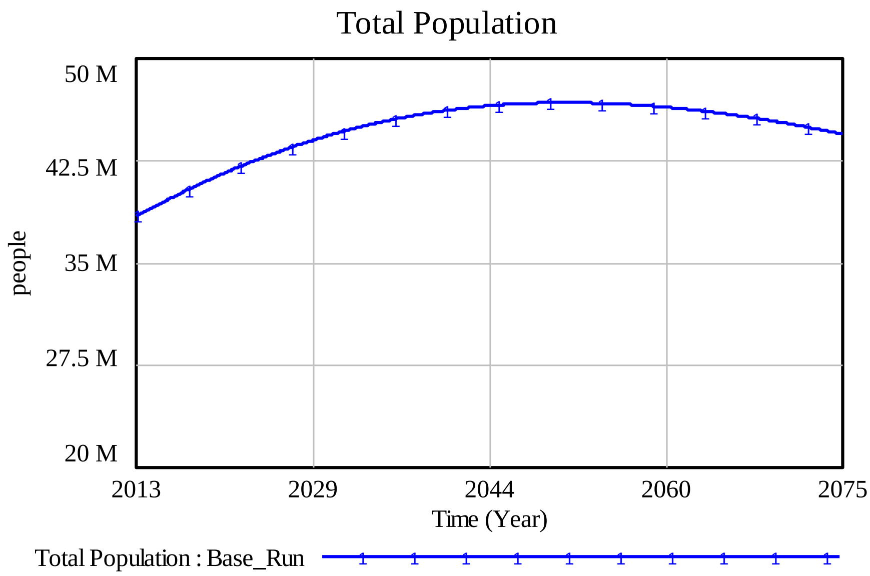


Figure 6.15. Total population generated by the model.

<u>6.1.2.2. Population of 0-14-year-old children.</u> Population of 0-14-year-old children is represented in this part. The projections of TURKSTAT and behaviors of the model are compatible (see Figure 6.16 and Figure 6.17).

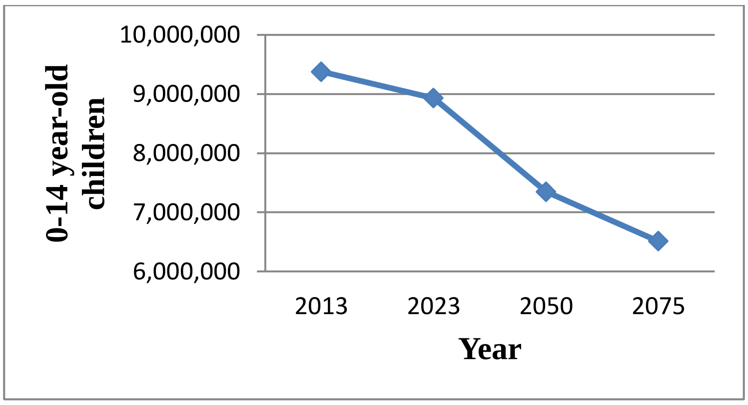


Figure 6.16. TURKSTAT projections for the population of 0-14-year-old children [22].

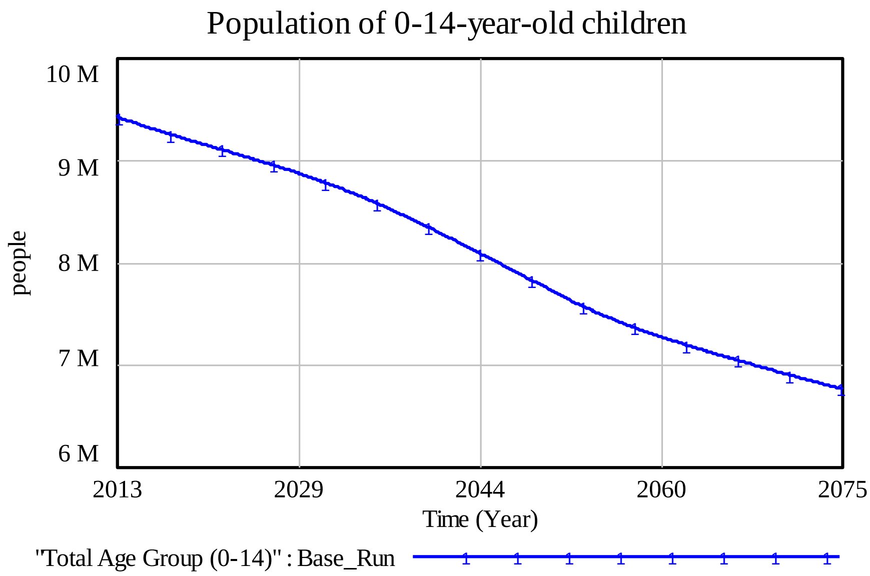


Figure 6.17. Population of 0-14-year-old children generated by the model.

6.1.2.3. Population of 15-24-year-olds. Population of 15-24-year-old people is represented in this part. The projections of TURKSTAT and behaviors of the model are compatible (see Figure 6.18 and Figure 6.19).

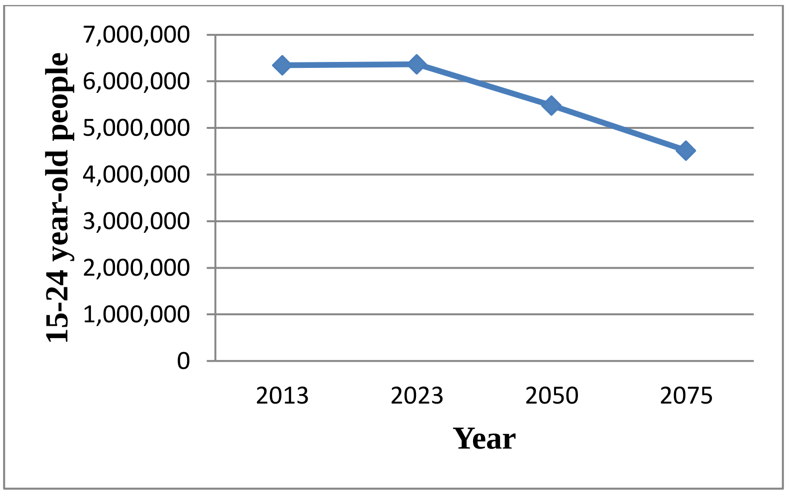


Figure 6.18. TURKSTAT projections for the population of 15-24-year-olds [22].

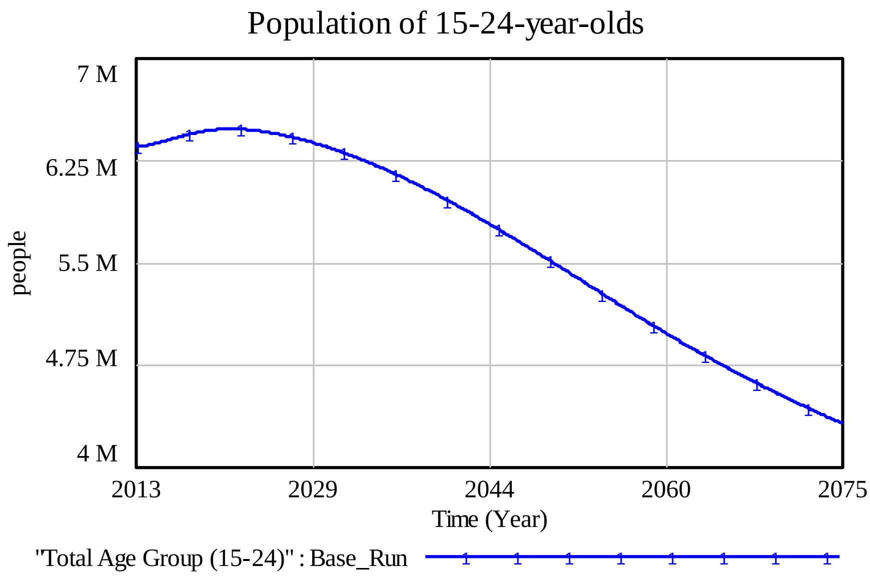


Figure 6.19. Population of 15-24-year-olds generated by the model.

6.1.2.4. Population of 25-54-year-olds. Population of 25-54-year-olds is represented in this part. The projections of TURKSTAT and behaviors of the model are compatible (see Figure 6.20 and Figure 6.21).

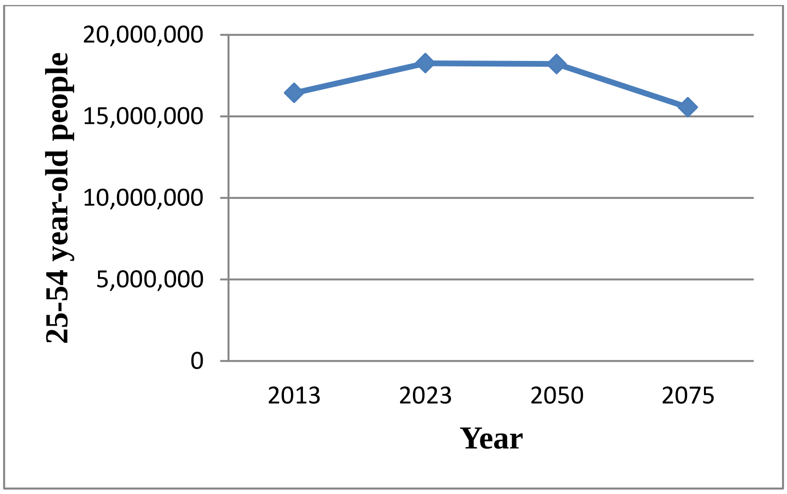


Figure 6.20. TURKSTAT projections for the population of 25-54-year-olds [22].

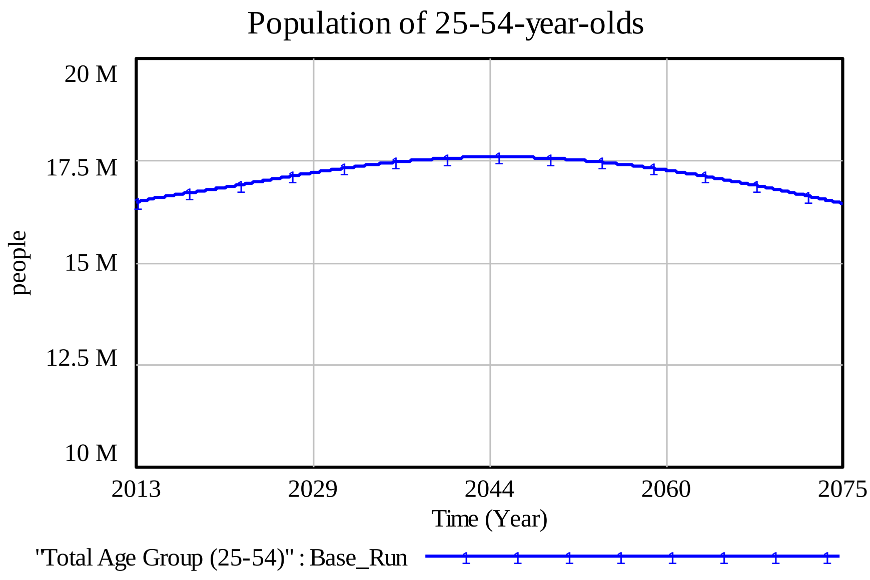


Figure 6.21. Population of 25-54-year-olds generated by the model.

6.1.2.5. Population of over 55-year-olds. Population of over 55-year-olds is represented in this part. The projections of TURKSTAT and behaviors of the model are compatible (see Figure 6.22 and Figure 6.23). The minor deviation between 2060 and 2075 in this retired age group is insignificant for the purpose of our study.

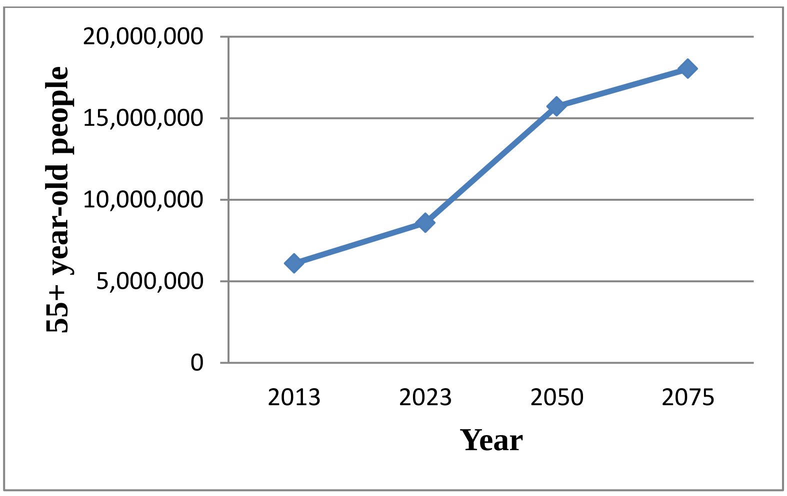


Figure 6.22. TURKSTAT projections for the population of over 55-year-olds [22].

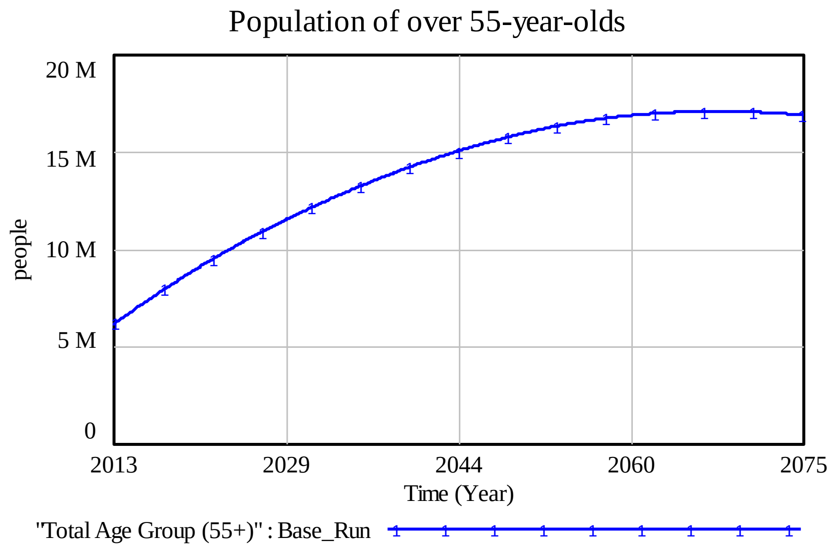


Figure 6.23. Population of over 55-year-olds generated by the model.

<u>6.1.2.6. Total unemployment ratio.</u> Total unemployment ratio is calculated by the ratio of total unemployed salaried labor force over total salaried labor force. According to TUSIAD projections the total unemployment ratio among the all labor force is given in Figure 6.24 [29]. Total unemployment ratio in the base run is shown in Figure 6.25.

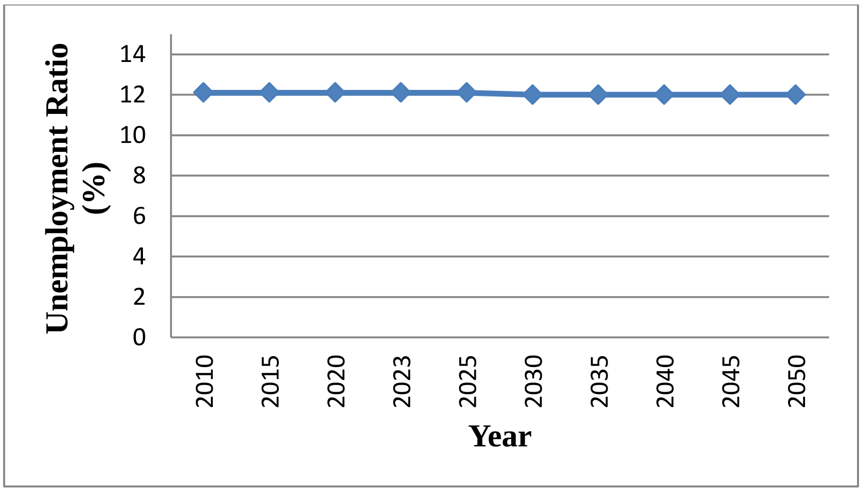


Figure 6.24. The unemployment ratio projections from TUSIAD [29].

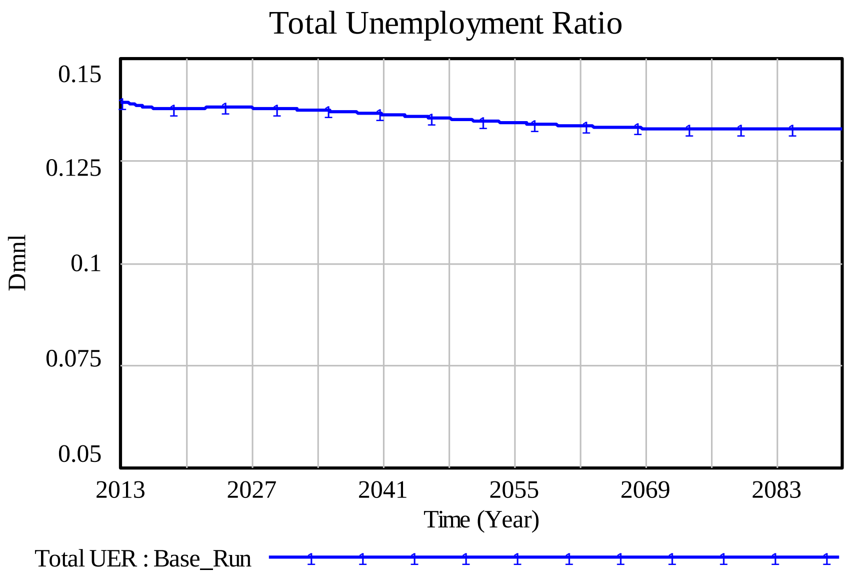


Figure 6.25. Total unemployment ratio generated by the model.

### 6.2. Analysis of the Base Behavior

The base model is a reference form of the model for comparison and evaluation of the scenarios and policies in the analysis. In the base case, the ratios of salaried employee and salaried jobs are set to 0.60, which is the reference value according to the mentioned data from TURKSTAT. In other words, 60% of the total labor force can join the employment market as salaried labor with respect to their skill levels.

As mentioned in Section 5.2.3, the net growth fraction of available total jobs is equal to the net growth fraction of the labor force. This fraction is calculated by a ratio of total net growth rate among all level of the labor force, to the number of people among the labor force.

It is assumed that privatization will likely increase smoothly from its reference value, 0.40 to 0.60 in between 2013-2050 (see Figure 6.26).

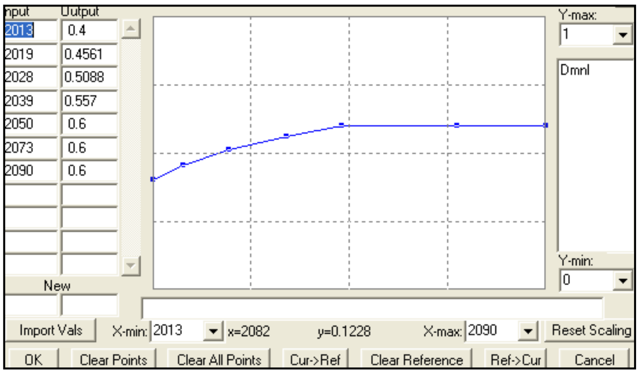


Figure 6.26. Smooth increase in privatization input in the base run.

The smooth increase in the privatization ratio has an influence on the number of students in high-quality education. The ratios of number of poor students in high-quality education, among all poor students, and the ratio of number of rich students in high-quality education, among all rich students, are compared in Figure 6.27. Rich students have a higher proportion than poor students' in high-quality education, among each students' population. The annual average salaries of poor and rich are provided in Figure 6.28. Also, the ratio of annual average salaries is given in Figure 6.29 to see the difference between them easily. There is a decrease in the ratio of rich students in high-quality education among all rich students. In addition to the increase in privatization, there is a decrease in 15-24-year-olds among rich. 15-24-year-olds rich and poor population figures are shown in Figure 6.30. Other related population figures are provided in Appendix D.

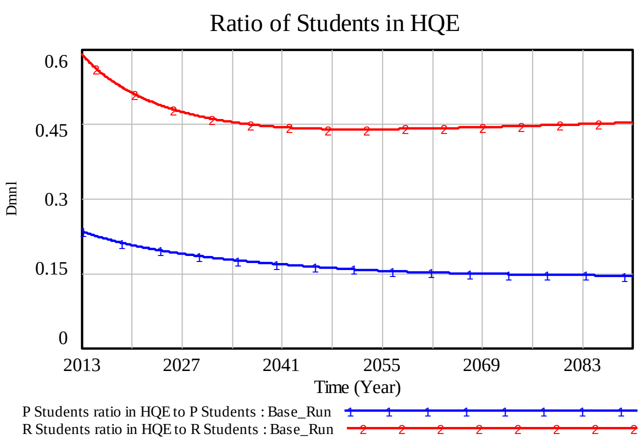


Figure 6.27. The ratio of students in HQE for the poor and rich in the base run.

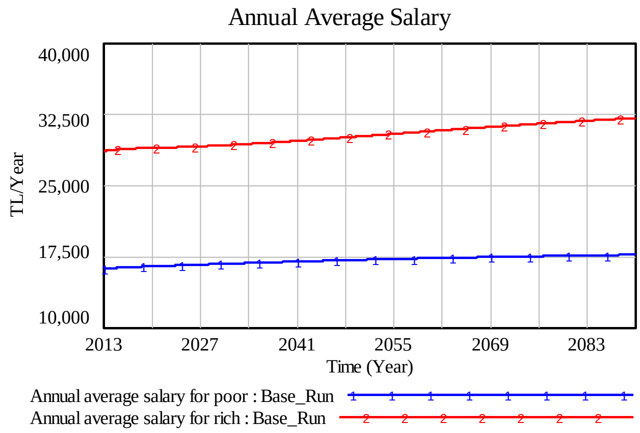


Figure 6.28. The annual average salaries of the poor and rich in the base run.

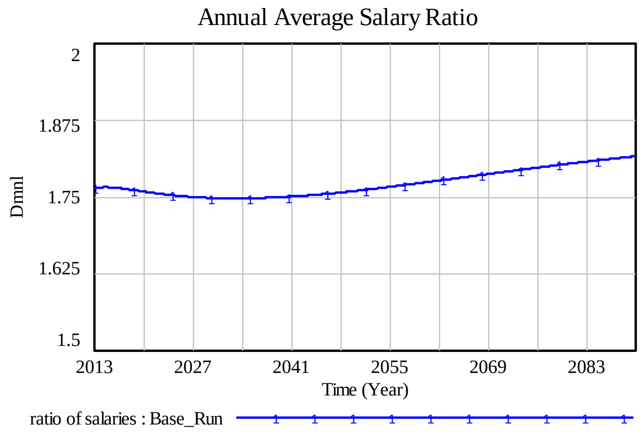


Figure 6.29. The ratio of annual average salaries in the base run.

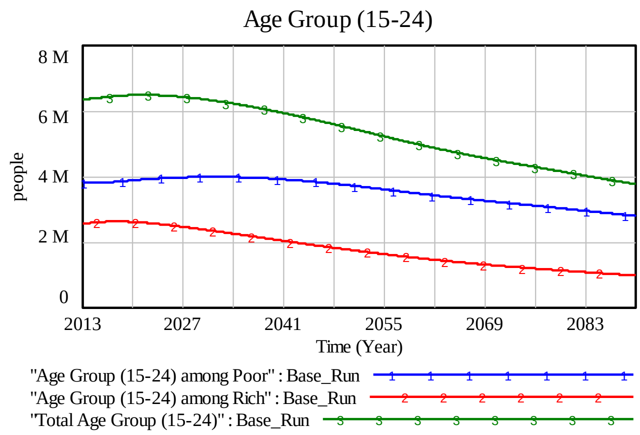


Figure 6.30. The population of 15-24-year-olds in the base run.

On the other hand, the ratio of number of poor students in low-to-average quality education among all poor students and the ratio of number of rich students in low-to-average education among all rich students are compared in Figure 6.31. Poor students receive a higher proportion than rich students do in low-to-average quality education among each students' population.

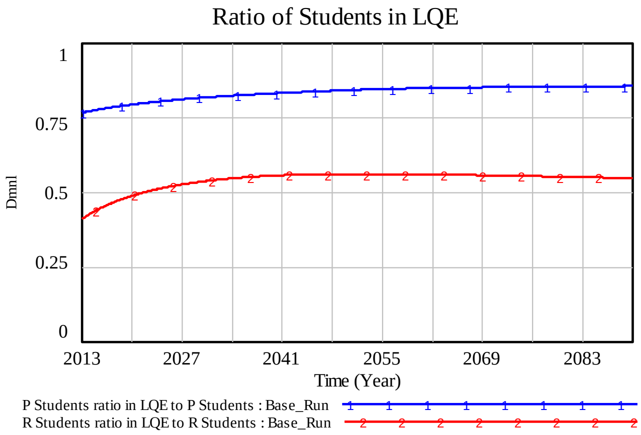


Figure 6.31. The ratio of students in LQE for the poor and rich in the base run.

Total salaried labor force and available total salaried jobs are shown in Figure 6.32 and Figure 6.33, respectively. As previously mentioned in the model description, there is a link between net growth rates of the labor force and available total salaried jobs.

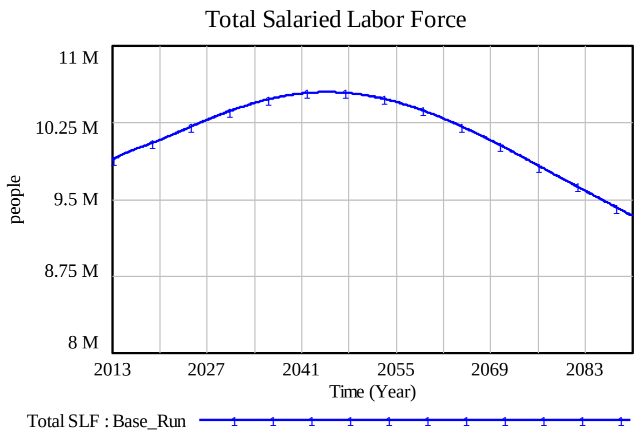


Figure 6.32. Total salaried labor force in the base run.


Figure 6.33. Available total salaried jobs in the base run.

For the employment sector, the number of the salaried labor force (SLF) with respect to all skill levels and the number of available salaried jobs for every branch are provided in the following figures. These figures display the employment market with the number of available salaried jobs for the related labor force.

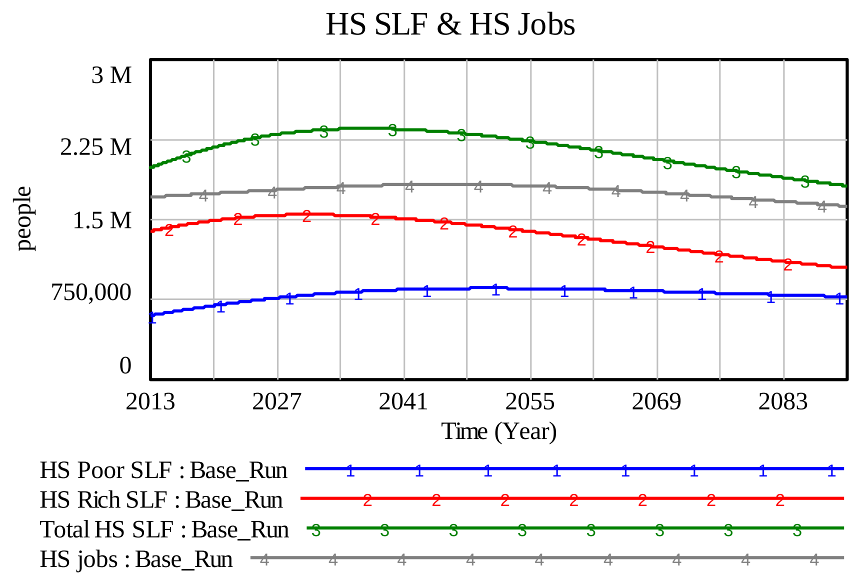


Figure 6.34. Highly skilled SLF and highly skilled jobs in the base run.

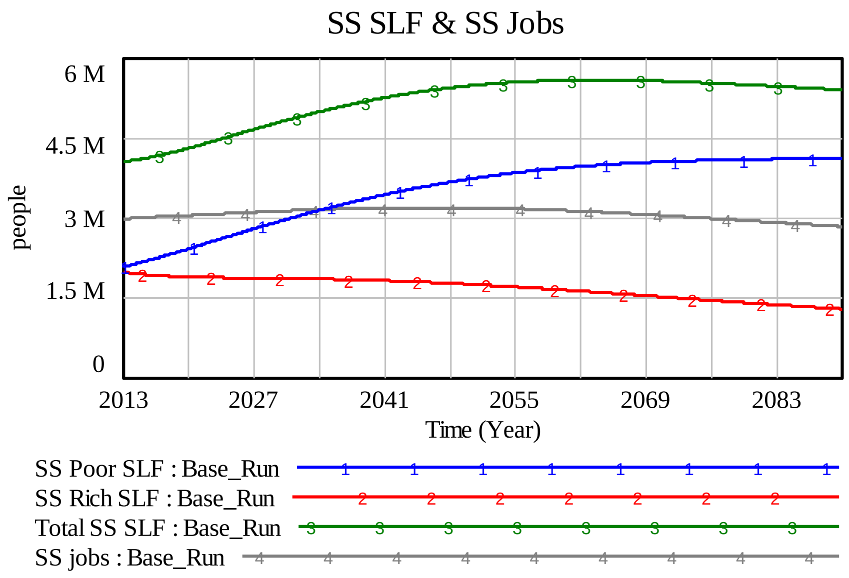


Figure 6.35. Semi-skilled SLF and semi-skilled jobs in the base run.

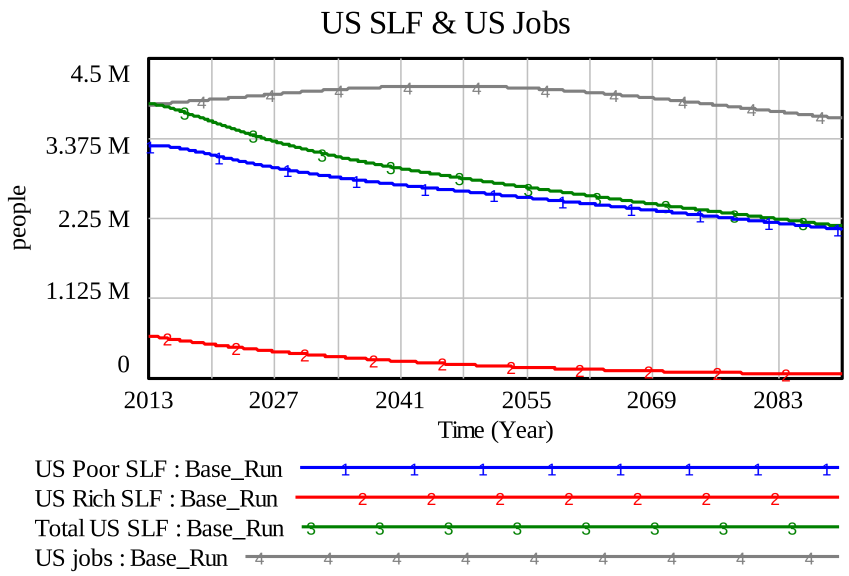


Figure 6.36. Unskilled SLF and unskilled jobs in the base run.

Total unemployment ratio for an employment sector is given with the total unemployment ratio for the poor and rich in Figure 6.37. The unemployment ratio among poor is higher than it is among the rich. It should be stated that, in the base run, the algorithm behind the employment sector causes the higher level of the labor force to be occupied. It does not allow them to be unemployed if there is room in the lower skill level jobs. In other words, if there is a highly skilled unemployed person, s/he gets the lower skilled job before the semi-skilled salaried labor force does. So, semi-skilled jobs are first open to highly skilled unemployed people. Likewise, unskilled jobs are first open to semi-skilled unemployed people. Alternatively, if there is a highly skilled unemployed person, and there is no semi-skilled jobs in the employment market, which could be counted as the extreme condition, unskilled jobs are first open to the highly skilled unemployed person. In short, there is vertical hierarchy in the base run's employment market. Therefore, since semi-skilled and unskilled salaried labor forces among the poor are higher than the ones among the rich, unemployed poor people are higher than rich people. The unemployment ratio for the poor starts at 20%, and slightly decreases; on the other hand, the unemployment ratio for the rich starts at 5% and decreases to 1% in time. For total unemployment, the ratio is almost constant at 13%.

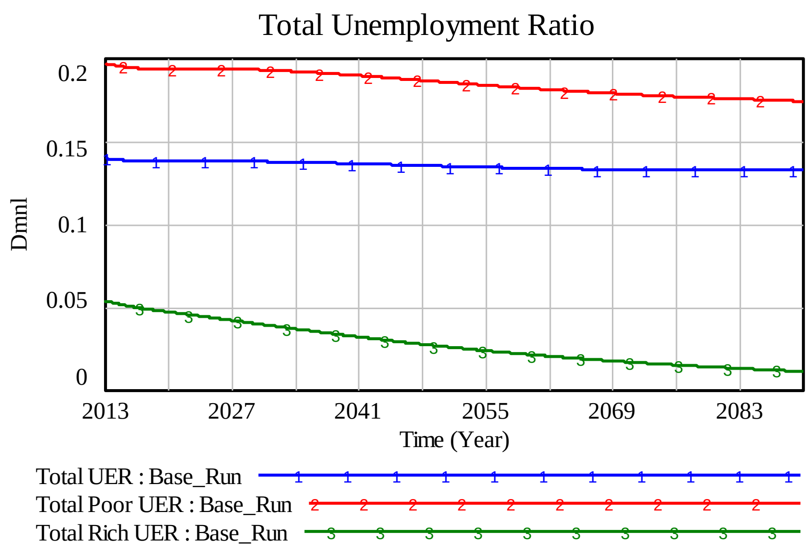


Figure 6.37. All unemployment ratios in the base run.

The skill levels of salaried labor force among the poor and rich, and the number of respective salaried jobs are provided in the next figures. Since there is an increase in poor students in low-to-average quality education, the semi-skilled salaried labor force among the poor increases. On the other hand, the ratio of number of poor students in high-quality education starts at a low level and decreases. Therefore, the proportion of a highly skilled salaried labor force among the poor is the lowest one among the other skill levels.

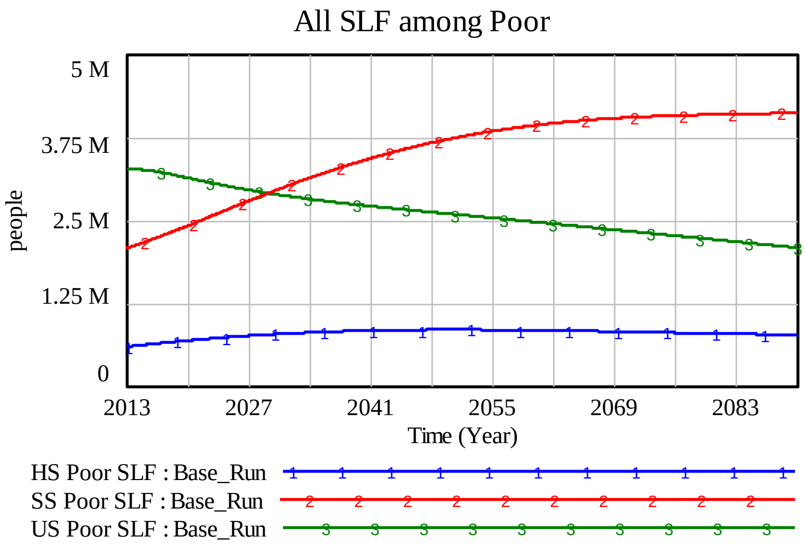


Figure 6.38. All skill levels among poor SLF in the base run.

The ratio of number of rich students in high-quality education is higher than the rich students' ratio in low-to-average quality education. Therefore, the number of the highly skilled salaried labor force initially increases then eventually decreases because of a decrease in the rich population. For the rich, the number of semi-skilled salaried labor force is slightly higher than the number of the highly skilled salaried labor force. Also, the unskilled salaried labor force has the lowest proportion among them(see Figure 6.39).

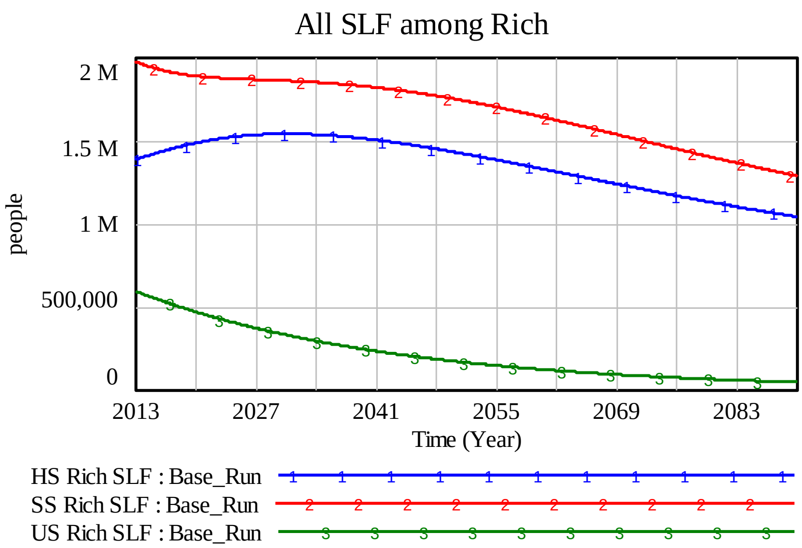


Figure 6.39. All skill levels among rich salaried labor force in the base run.

Total highly skilled, semi-skilled and unskilled salaried labor forces (HS SLF, SS SLF and US SLF) are shown in the following figures. The number of unskilled salaried jobs is higher than the number of the unskilled salaried labor force. Therefore, there are available unskilled jobs for higher skill unemployed people. As explained before; if there is a highly skilled unemployed person, s/he has the right to have an unskilled job, if there are no available semi-skilled jobs. If there is just a semi-skilled unemployed person, then s/he has right to acquire unskilled jobs before the unemployed workers in the unskilled labor force. So, there is a high unemployment ratio for the poor, because of the high number of unskilled and semi-skilled unemployed people in the labor market.

Total poor and rich salaried labor force are also given in the following figures. Where salaried labor force among rich decreases, poor salaried labor force increases and stagnates after the 2055s. Total salaried labor force among the poor is higher than the rich salaried labor force.

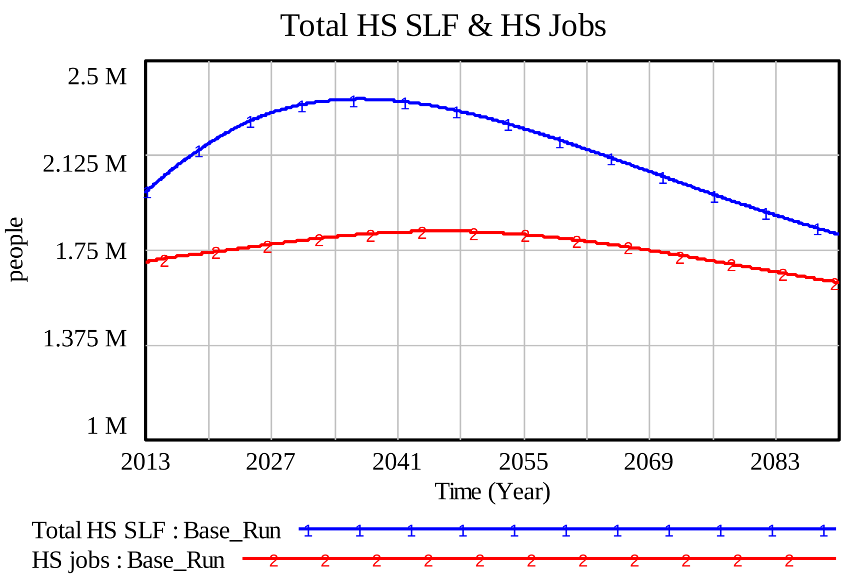


Figure 6.40. Total HS SLF and total HS salaried jobs in the base run.

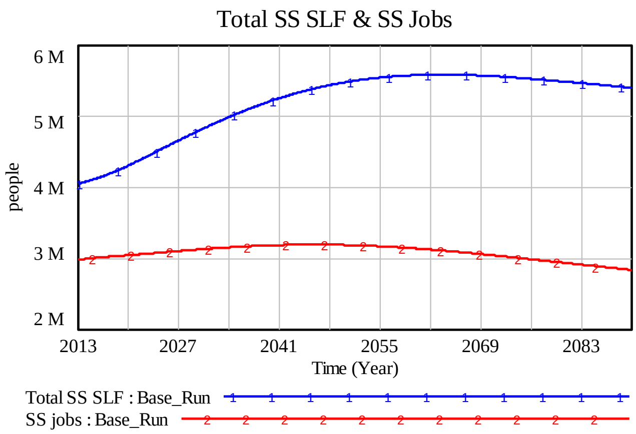


Figure 6.41. Total SS SLF and total SS salaried jobs in the base run.

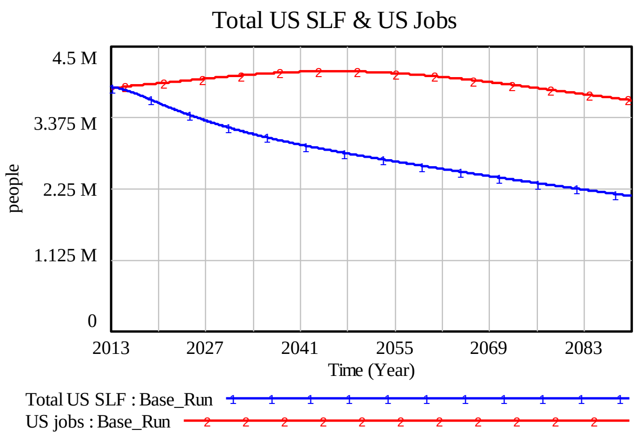


Figure 6.42. Total US SLF and total US salaried jobs in the base run.

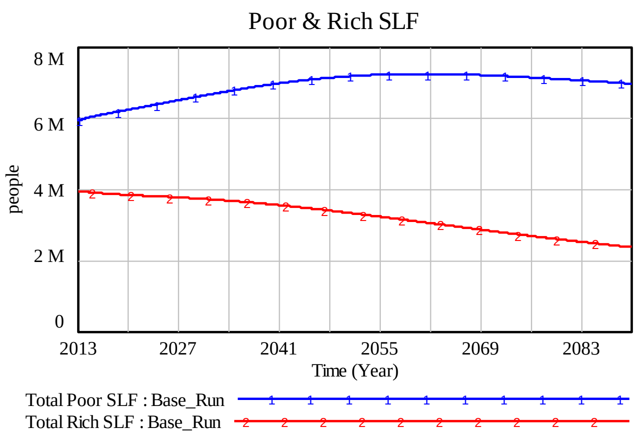


Figure 6.43. Total SLF among the poor and rich.

### 6.2.1. Sensitivity Analysis

As explained before, another sub-group of structure oriented behavior tests is sensitivity analysis. Despite being a sub-group of the structure oriented behavior tests, sensitivity analysis is given in this section in order to understand how sensitive the model is after drawing big picture of the base behavior. As it is stated in Barlas's work [28]; "Behavior sensitivity tests consist of determining those parameters to which the model is highly sensitive, and asking if the real system would exhibit similar high sensitivity to the corresponding parameters." For that manner, most of the parameters are tested to find out whether there are parameters, to which the model is highly sensitive or not. Therefore, the results of sensitivity analysis on annual average salaries per all skill levels employees are given in the following sections. Another important point is that the range of sensitivity is arranged between plus 20% and minus 20% of the base value in all tests. In other words, the minimum value of range is determined as 20% less than the base value of parameter and maximum value of range is specified as 20% higher than the base value of the same parameter in the sensitivity tests [30]. Also, the increment range is set to 2 000 TL/year in sensitivity tests of annual average salaries per all skill levels employees.

*Sensitivity analysis on annual average salary per unskilled employee*: In the model, in the light of information from TURKSTAT (which is given in Table 5.5 above), the annual average salary per unskilled employee is assumed to be 1000 TL/month, or 12000 TL/year. In the sensitivity analysis, this value is tested between the range of 800 TL/month, or 9600 TL/year and 1200 TL/month, or 14400 TL/year. The impact of this modification on the ratio of annual average salaries among the poor and rich is given in Figure 6.44.

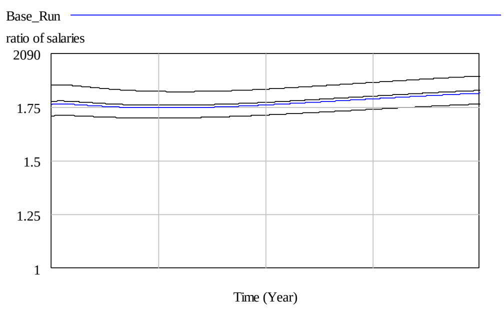


Figure 6.44. Sensitivity result for annual average salary per unskilled employee.

The Figure 6.44 shows that the ratio of annual average salaries is not strongly sensitive to the annual average salary per unskilled employee.

*Sensitivity analysis on annual average salary per semi-skilled employee*: In the model, in the light of information from TURKSTAT (which is given in Table 5.5), the annual average salary per semi-skilled employee is assumed to be 2000 TL/month, or 24000 TL/year. In the sensitivity analysis, this value is tested between the range of 1600 TL/month, or 19200 TL/year and 2400 TL/month, 28800 TL/year. The impact of this modification on the ratio of annual average salaries among the poor and rich is given in Figure 6.45.

The Figure 6.45 shows that the ratio of annual average salaries seems relatively insensitive to the annual average salary per semi-skilled employee

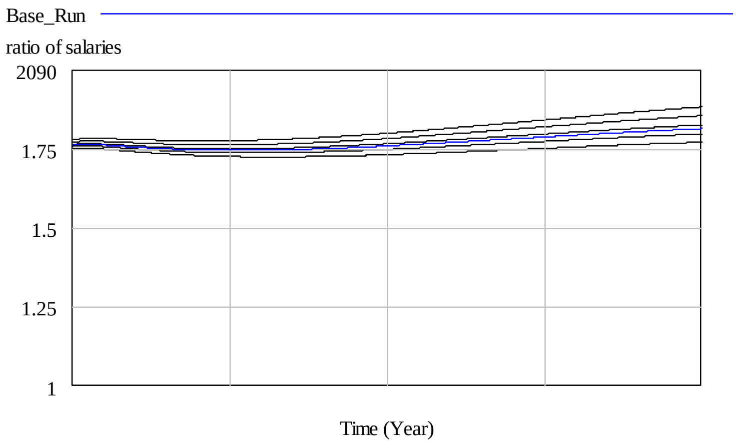


Figure 6.45. Sensitivity result for annual average salary per semi-skilled employee.

*Sensitivity analysis on annual average salary per highly skilled employee*: In the model, in the light of information from TURKSTAT (which is given in Table 5.5), the annual average salary per semi-skilled employee is assumed to be 4500 TL/month, or 54000 TL/year. In the sensitivity analysis, this value is tested between the range of 3600 TL/month, or 43200 TL/year and 5400 TL/month, or 64800 TL/year. The impact of this modification on the ratio of annual average salaries among the poor and rich is given in Figure 6.46.

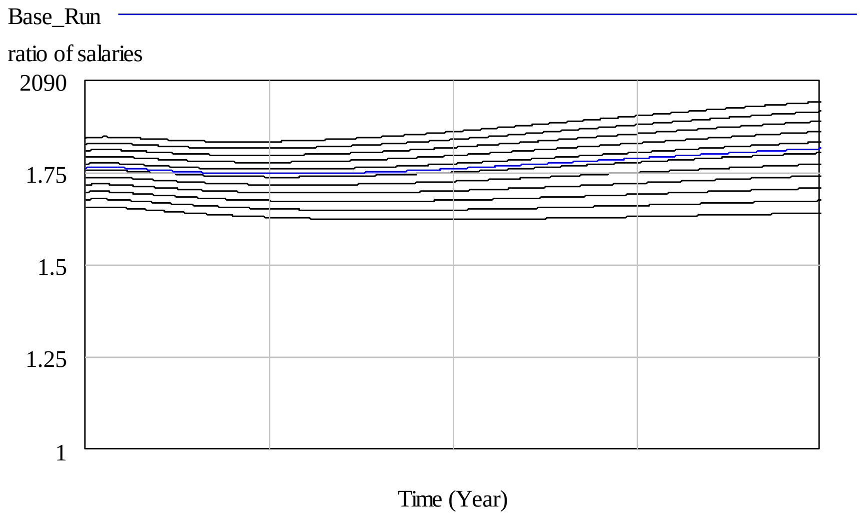


Figure 6.46. Sensitivity result for annual average salary per highly skilled employee.

The Figure 6.46 indicates that the ratio of annual average salaries is not strongly sensitive to the annual average salary per semi-skilled employee.

*Sensitivity analysis on poor high-quality private education base fraction*: In the model, the poor high-quality private education base fraction is assumed to be 0.12 (dimensionless). In the sensitivity analysis, this value is tested between the range of 0.096 and 0.144. Also, the increment range is set to 0.015.

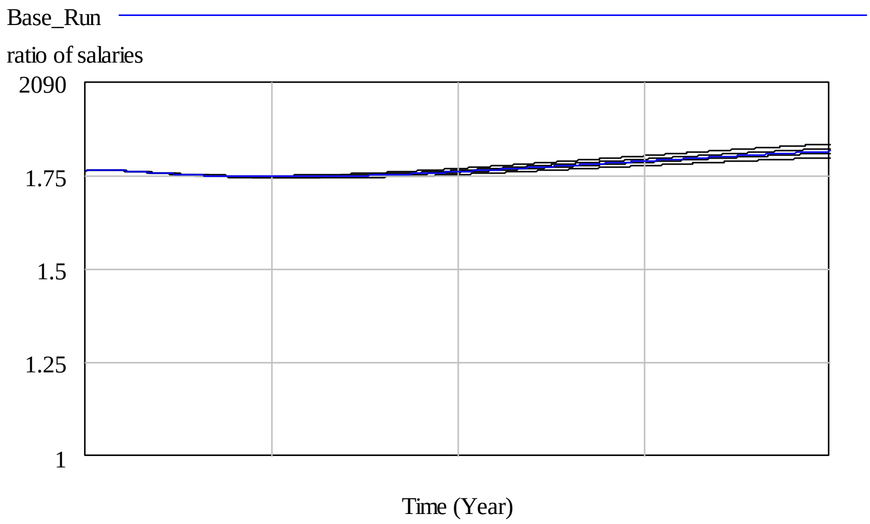


Figure 6.47. Sensitivity result for poor high-quality private education base fraction.

The Figure 6.47 shows that in given range the poor high-quality private education base fraction does not substantially vary.

*Sensitivity analysis on poor high-quality public education base fraction:* In the model, the poor high-quality public education base fraction is assumed to be 0.20 (dimensionless). In the sensitivity analysis, this value is tested between the range of 0.16 and 0.24. Also, the increment range is set to 0.02.

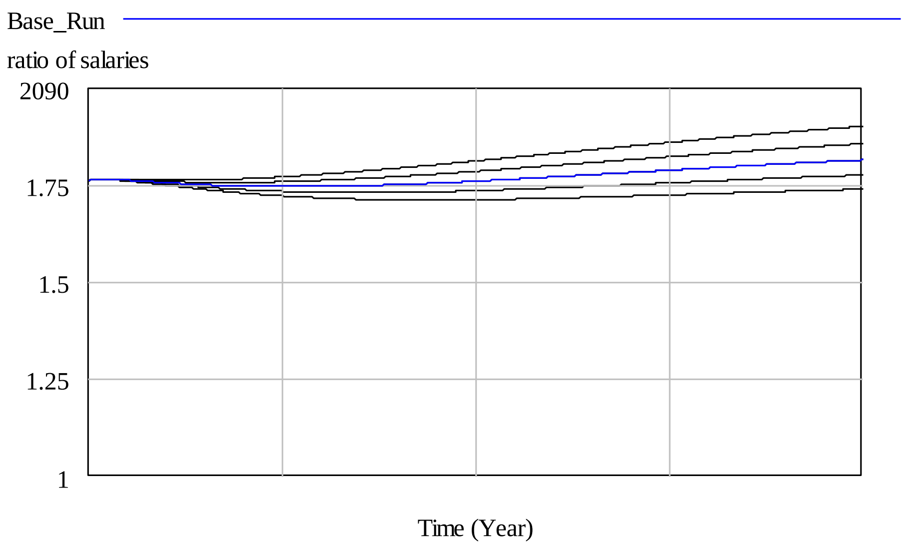


Figure 6.48. Sensitivity result for poor high-quality public education base fraction.

The Figure 6.48 shows that the ratio of annual average ratios is relatively insensitive to poor high-quality public education base fraction.

*Sensitivity analysis on rich high-quality private education base fraction:* In the model, the poor high-quality private education base fraction is assumed to be 0.40 (dimensionless). In the sensitivity analysis, this value is tested between the range of 0.32 and 0.48. Also, the increment range is set to 0.04.

The Figure 6.49 indicates that the ratio of annual average salaries is not strongly sensitive to the rich high-quality private education base fraction.

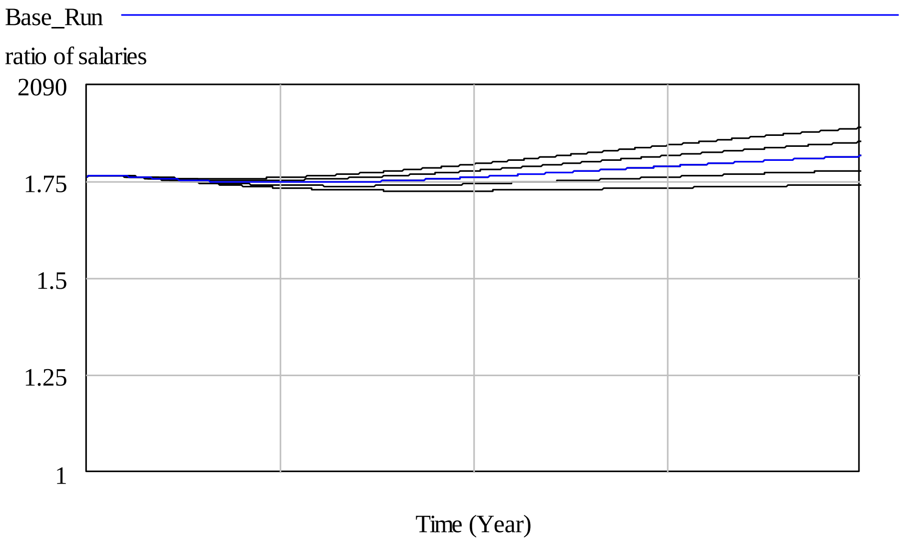


Figure 6.49. Sensitivity result for rich high-quality private education base fraction.

*Sensitivity analysis on rich high-quality public education base fraction:* In the model, the poor high-quality private education base fraction is assumed to be 0.35 (dimensionless). In the sensitivity analysis, this value is tested between the range of 0.28 and 0.42. Also, the increment range is set to 0.04.

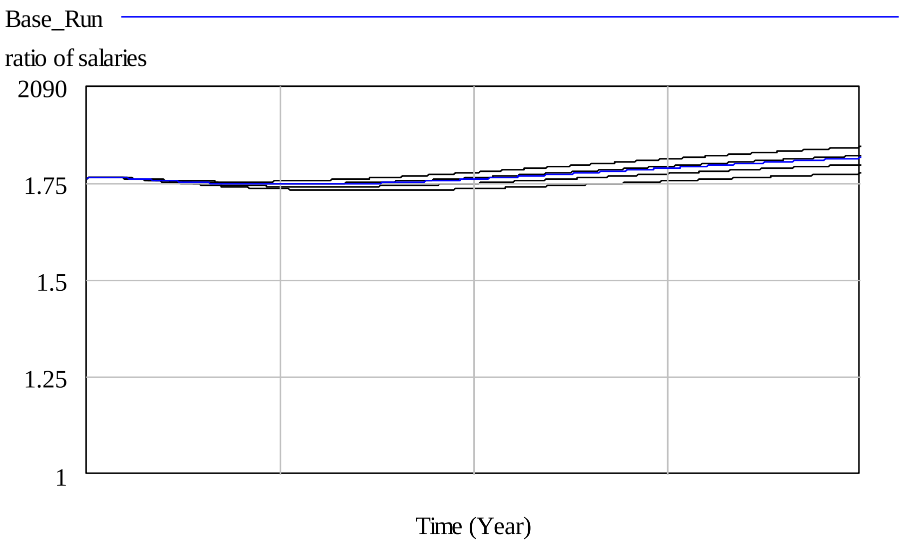


Figure 6.50. Sensitivity result for rich high-quality public education base fraction.

Figure 6.50 shows that the ratio of annual average salaries is not strongly sensitive to the rich high-quality public education base fraction.

In conclusion, all results indicate that the model is credible in terms of parameters that are annual average salaries per unskilled, semi-skilled and highly skilled employees and poor and rich high-quality private base fractions, poor and rich high-quality public base fractions. It must be stated that there may be sensitivity in precise numerical results. However, as seen in this section, the model has very low sensitivity in terms of pattern dynamics. This means that long-term behaviors of the model strongly depend on structure of the model rather than some uncertain parameter values [30].

# 7. SCENARIO AND POLICY ANALYSIS

In this section, six different scenarios, and twelve policies are evaluated to explore how they influence annual average salary of both the poor and rich, as well as how they impact the gap between their salaries. Additionally, their influence on the unemployment ratio of the poor and rich are analyzed for the salaried working classes in Turkey. Each scenario and policy will be explained in detail below.

## 7.1. Scenario Analysis

In the scenario analysis section, seven different scenarios are examined to capture plausible changes in the context. The topics of these scenarios are about horizontal employment hierarchy in hiring processes in the employment market, net job growth rates, salaried employee ratios, and birth fractions for the poor and rich. To provide better understanding for analysis, the results of these scenarios will mostly be presented comparing them with the base run.

### 7.1.1. Scenario 1: Horizontal Employment Priority in Hiring Process

In the employment sector of this study, there is a vertical employment hierarchy in the hiring process for the base run. In other words, a person among the higher-level labor force has priority to get lower level jobs, if s/he is unemployed. For instance, if there is a highly skilled person who is unemployed because of a bottleneck of available highly skilled jobs, s/he has the priority to get a semi-skilled job before a semi-skilled person. However, in this scenario, the hiring process is called the horizontal job hierarchy, which means all skill levels of the labor force can get a respective level of jobs at first. If there is room in the lower level of jobs, then the unemployed people among the higher-level labor force can obtain these lower level jobs.

It should be remembered that, the algorithm of the base run behind the employment sector makes the higher level of labor force occupied. Now, the new algorithm of this scenario makes all skill levels of the salaried labor force occupied, if there are available respective jobs.

The annual average salary of the rich is still significantly higher than the poor's salary. However, in this scenario, as shown in Figure 7.1, the annual average salary of the poor is higher than it is in the base run. To better compare, the annual average salary ratio is provided in Figure 7.2. There is still a gap between the poor and the rich's salaries, but this gap is smaller than it is in the base run.

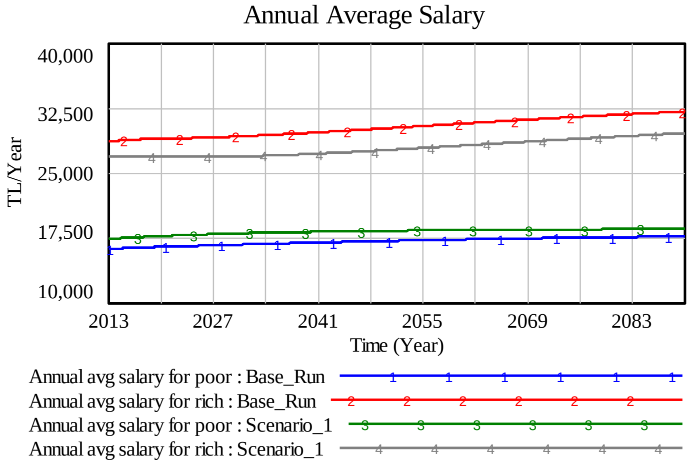


Figure 7.1. The annual average salaries of the poor and rich under the Scenario_1.

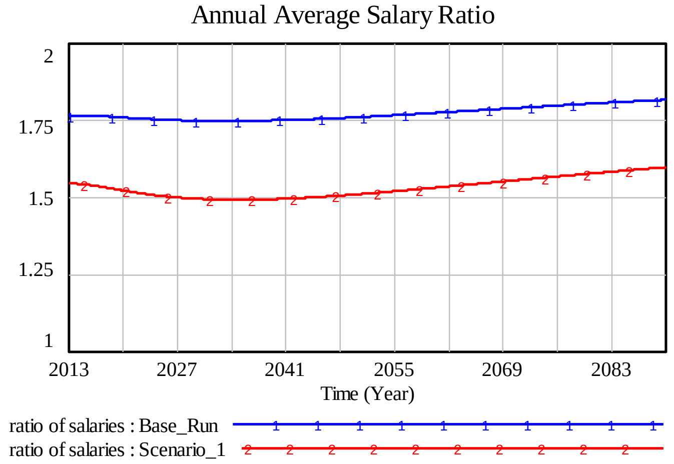


Figure 7.2. The ratio of annual average salaries under the Scenario_1.

As mentioned, the new algorithm for this scenario makes all the skill levels of salaried labor force occupied, if there are available respective jobs. Here, the total unemployment ratio of the rich is higher than the unemployment ratio of the poor (see Figure 7.3). There is a huge difference in the unemployment ratios between the base run and the first scenario. In the base run, the unemployment ratio of the poor is almost four times higher than the unemployment ratio of the rich (see Figure 7.4 below). However, in this scenario, the unemployment ratio of the rich is almost two times higher than the poor's unemployment ratio. The gap between unemployment ratios of the poor and rich are decreasing in the long run, but still, the unemployment ratio of the rich is higher than the poor's in the first scenario.

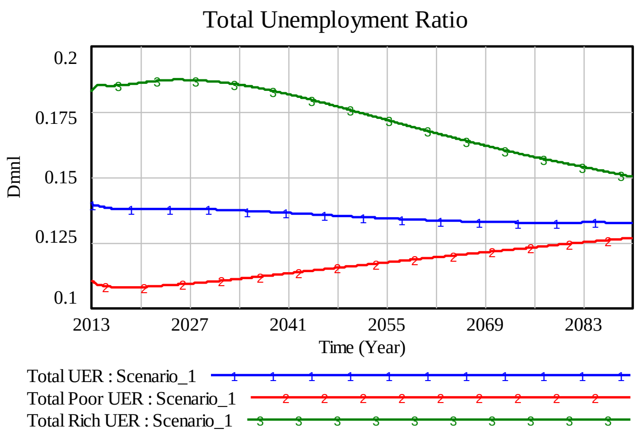


Figure 7.3. All unemployment ratios under the Scenario_1.

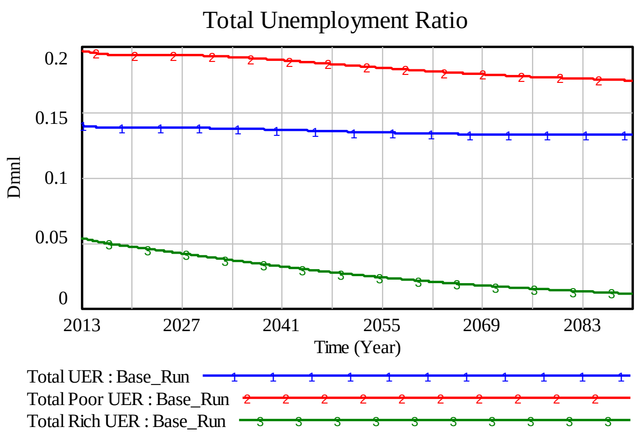


Figure 7.4. All unemployment ratios in the base run.

The reason behind this huge difference among unemployment ratios is the change in the hiring process. In other words, in this scenario, all unskilled and semi-skilled salaried labor forces acquire their respective jobs at first. If there are unemployed semi-skilled people, they can obtain residual unskilled jobs. Highly skilled unemployed people remain unemployed, since there is no room for them in semi-skilled jobs. There is a systematic hiring process here. If there is room for unskilled jobs, the semi-skilled unemployed can acquire it before the highly skilled unemployed. This is because of the sake of realization; it is assumed that highly skilled unemployed people do not prefer obtaining unskilled employment.

To display the labor force market, the following figures are provided (see Figure7.5, Figure 7.6 and Figure 7.7). The labor force market is the same as the base run. However, as explained before, the mechanism behind the hiring process is different from the base run.

Although the total highly skilled salaried labor force increases until the 2030s, after that it almost constantly decreases; but still, the total highly skilled salaried labor force is higher than its respective job level. Additionally, the total semi-skilled salaried labor force at first increases and then stagnates after the 2050s. Its behavior could be called goal seeking. On the other hand, the unskilled salaried labor force is lower than its respective number of jobs.

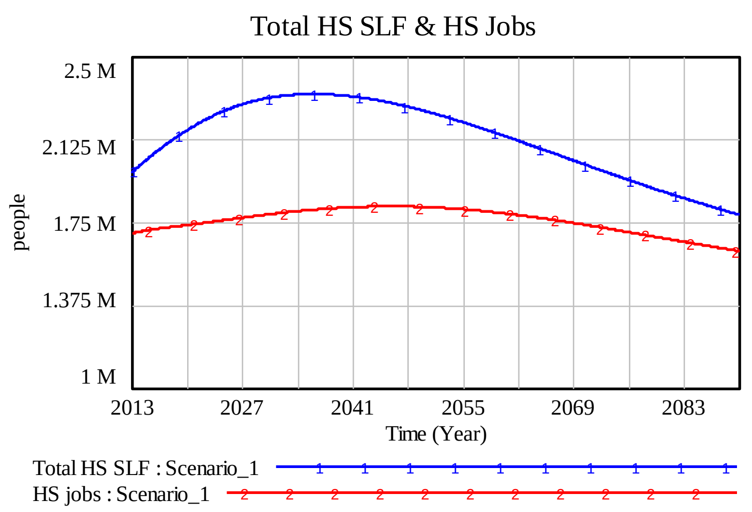


Figure 7.5. Total HS SLF and total HS jobs under the Scenario_1.

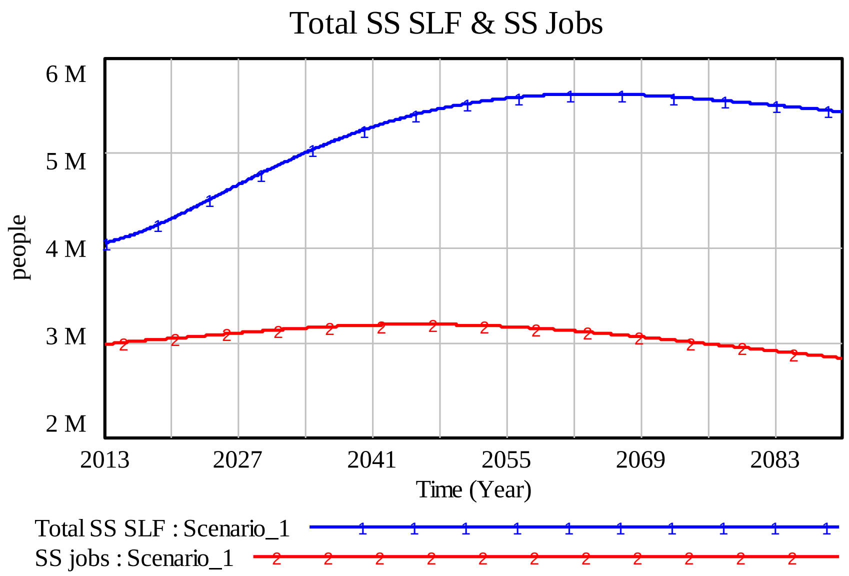


Figure 7.6. Total SS SLF and total SS jobs under the Scenario_1.

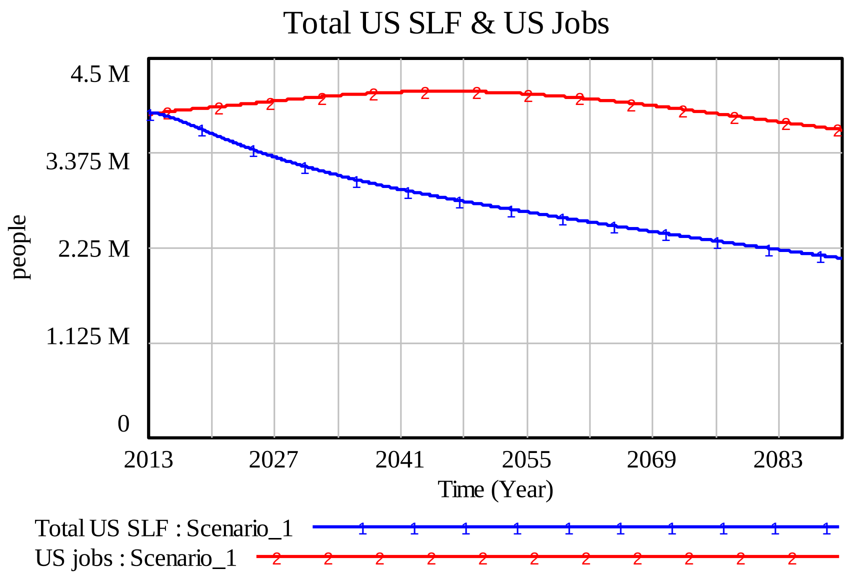


Figure 7.7. Total US SLF and total US jobs under the Scenario_1.

### 7.1.2. Scenario 2: Relation between Salaried Labor Force Population and Number of Available Jobs

Before analyzing the sub-parts of the Scenario 2, the net job growth fraction should be recalled. The net job growth fraction is equal to the growth fraction of total salaried labor force.

<u>7.1.2.1. Scenario 2_a: Increase in Net Job Growth Rate.</u> In order to decrease the unemployment ratio, there has been debate on creating jobs for employment market [31]. In this scenario, annual increases to the percentage of the job growth rate are assumed to be constant at 20%. In other words, the net job growth fraction is equal to the growth fraction of total labor force so, there is 20% increase in this fraction.

There is a decrease in all unemployment ratios until around 2050; after that the unemployment ratios of the poor and the total population start to increase (see Figure 7.8). However, in the base behavior, the unemployment ratio of the total populations is constant, and the ratio of the poor decreases (see Figure 7.9 below).

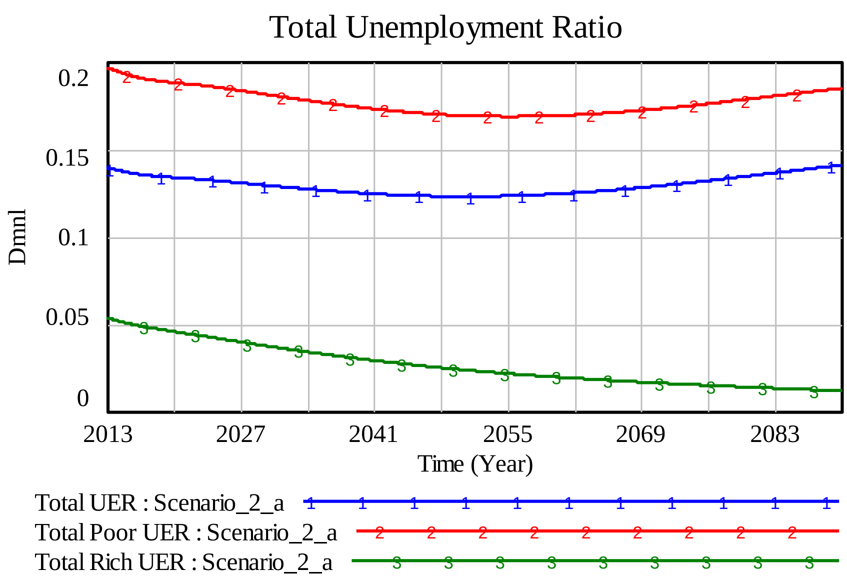


Figure 7.8. All unemployment ratios under the Scenario_2_a.

Even though there is an increase in the net job growth rate, and the highly skilled poor salaried labor force is constant while the unskilled poor salaried labor force decreases after the 2050s (see Figure 7.10), the unemployment ratio increases still after the 2050s (see Figures 7.8 above and 7.11). That is because of the increase in the semi-skilled salaried labor force among the poor after 2050 to the 2070s (see Figure 7.12).

It should be recalled; with the increase in job growth rate, the employment market changes. However, the salaried labor force dynamics are the same with the base run.

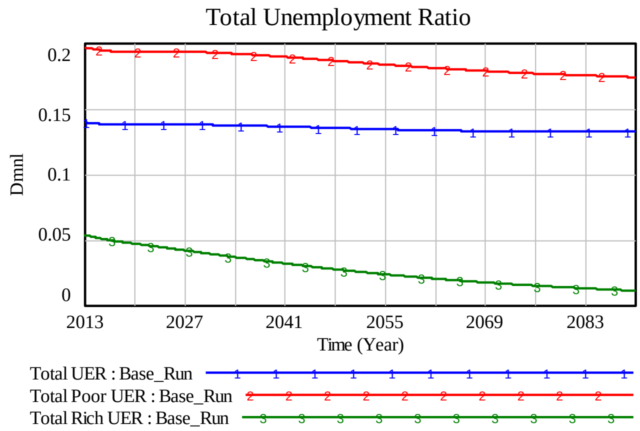


Figure 7.9. All unemployment ratios in the base run.

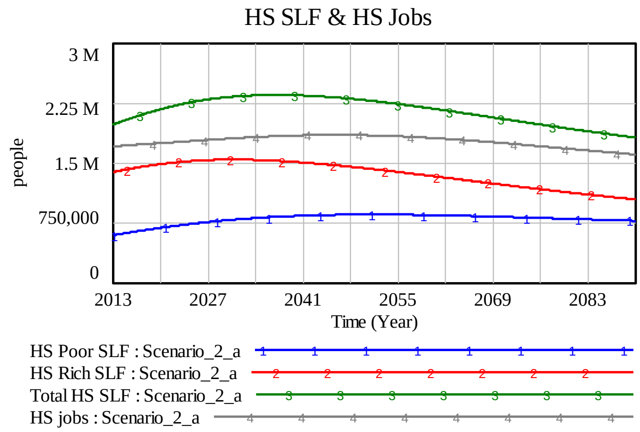


Figure 7.10. HS SLF and total HS jobs under the Scenario_2_a.

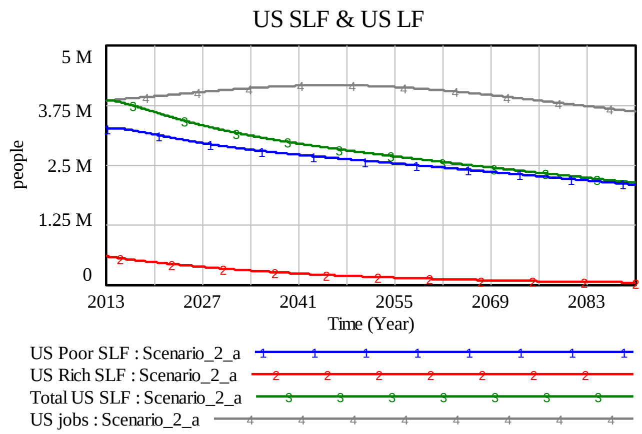


Figure 7.11. US SLF and total US jobs under the Scenario_2_a.

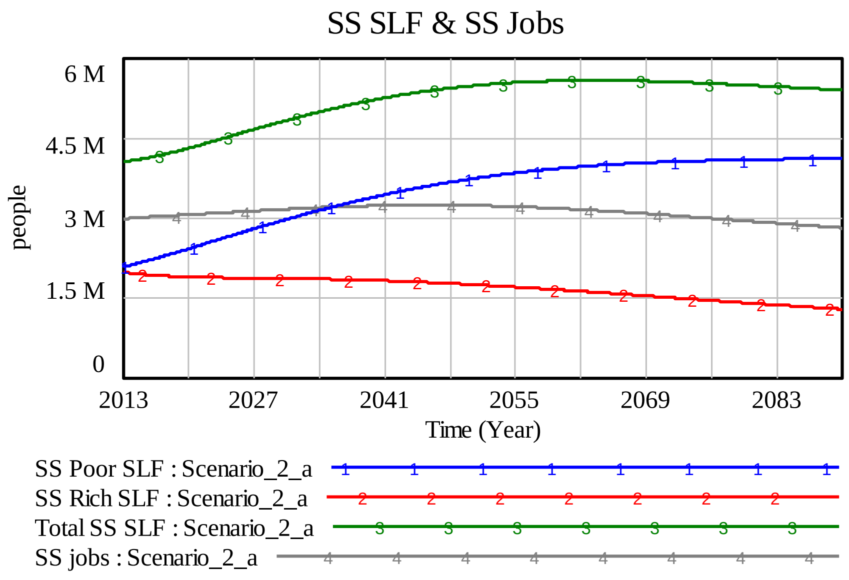


Figure 7.12. SS SLF and total SS jobs under the Scenario_2_a.

There is no difference in annual average salaries compared to the base run (see Figure 7.13). The gap between the annual average salaries of the poor and rich is still concerned.

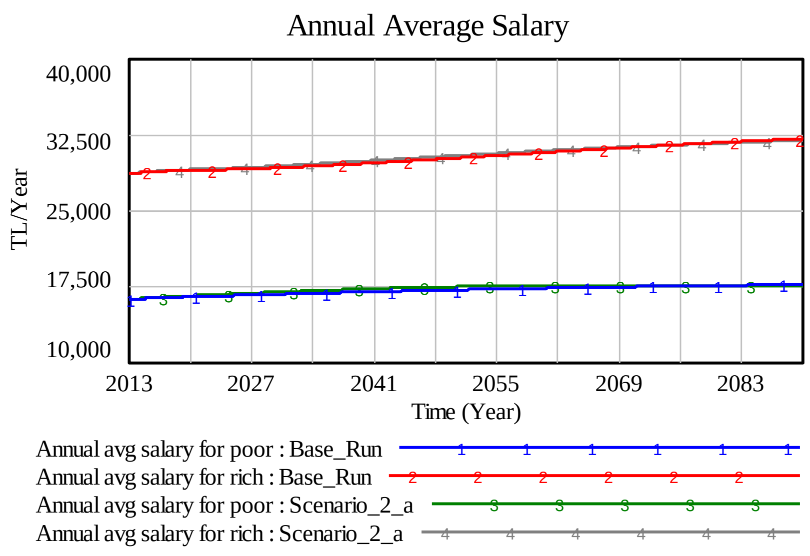


Figure 7.13. The annual average salaries of the poor and rich under the Scenario_2_a.

7.1.2.2. Scenario 2_b: Increase in Salaried Labor Force Population and Increase in Net Job Growth Rate. In this scenario, in addition to the annual increase, the percentage of the job growth rate is assumed to be constant and 20%, there is an increase in the salaried employee ratio from 60% to 80% until 2050. The 20% annual increase percentage of job growth rate is not adequate compared to the increase in employee ratio. Therefore, all of the unemployment ratios increase, and after around 2050s they stagnate (see Figure 7.14).

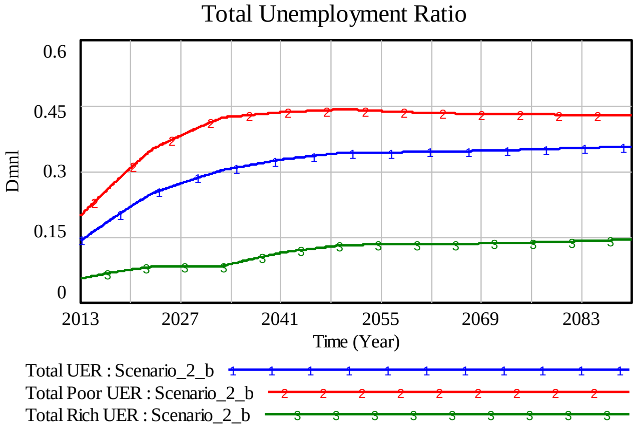


Figure 7.14. All unemployment ratios under the Scenario_2_b.

The annual average salaries of the poor and rich decrease compared to the values in the base run (see Figure 7.15). For the comparison of their annual average salaries, the ratio of salaries is provided in Figure 7.16.

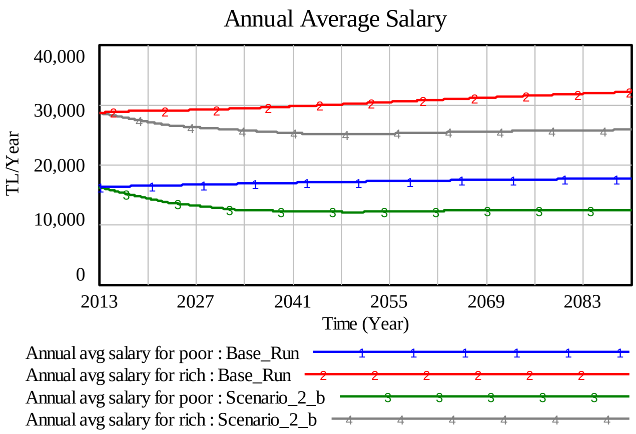


Figure 7.15. The annual average salaries of the poor and rich under the Scenario_2_b.

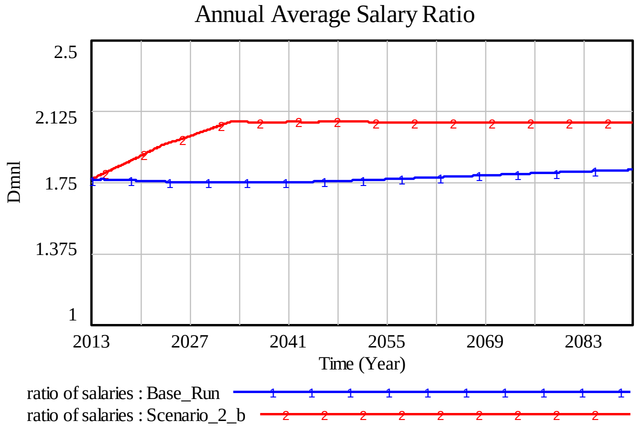


Figure 7.16. The ratio of annual average salaries under the Scenario_2_b.

<u>7.1.2.3. Scenario 2_c: Increase in Salaried Labor Force Population while Decrease in Net Job Growth Rate</u>. In this scenario, in addition to the increase in the salaried employee ratio from 60% to 80% until 2050, there is an annual decrease percentage for the net job growth rate and it is assumed to be constant at 20%. Compared to the Scenario_2_b, there is a 20% annual decrease percentage for the job growth rate. As expected, there are no adequate jobs for the increasing salaried labor force. Therefore, all of the unemployment ratios increase, and after the 2050s they stagnate; as in the Scenario_2_b. However, compared to the Scenario_2_b, the unemployment ratios of all are higher than they are in the Scenario_2_b (see Figure 7.17). Still, the unemployment ratio of the rich is still higher than it is for the poor.

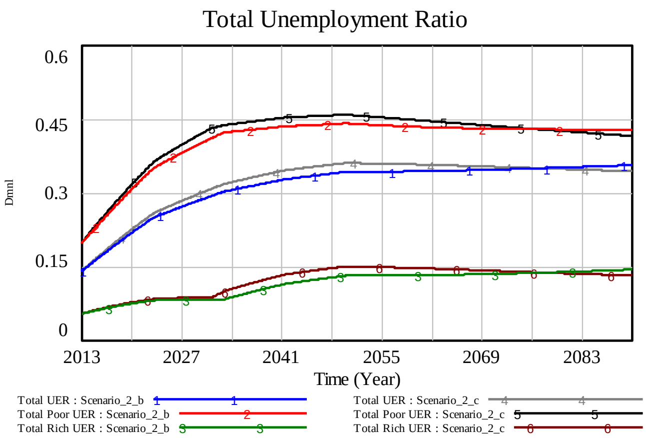


Figure 7.17. All unemployment ratios under the Scenario_2_b and Scenario_2_c.

The annual average salaries of the poor and rich decreases compared to the values in the base run. Also, the annual average salaries of the poor and rich under Scenario_2_c are the same as they are under the Scenario_2_b. For the comparison of their annual average salaries, the ratio of salaries is provided in Figure 7.18.

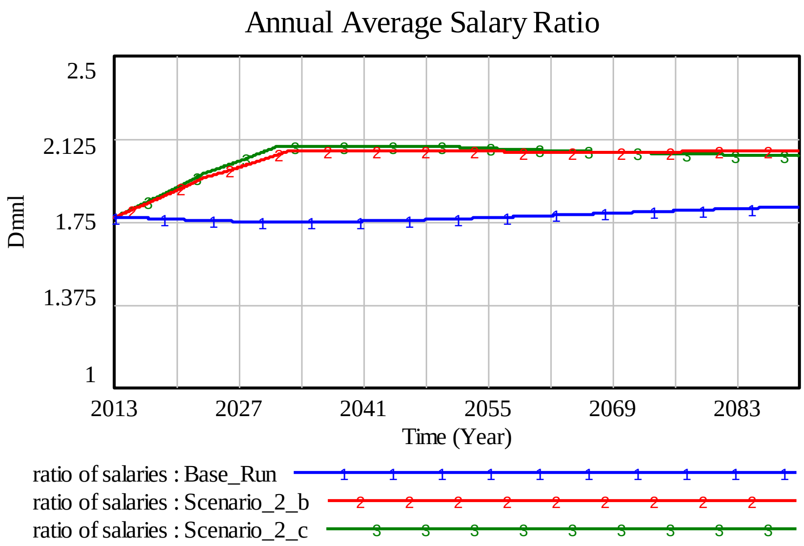


Figure 7.18. The ratio of annual average salaries under the Scenario_2b and Scenario_2_c.

### 7.1.3. Scenario 3: Birth fraction of the Poor and the Rich

In Turkey, there is an ongoing debate about making policies to increase the average number of children per household. The background aim of this discussion is to increase the population. According to 2013-2075 projections for Turkey's population, there is a decrease in population growth rate and after the 2050s, the total population decreases in Turkey (see Figure 6.17) [22]. To regenerate the net growth rate of Turkey's population, Erdoğan, who has been the Prime Minister (PM) of Turkey for eleven years, wants the citizens to have more than three children [32]. He often calls out when he takes a stage: "Have at least three children!" [33] Moreover, his most recent perspective: "One or two children mean bankruptcy. Three children mean we are not improving but not receding either. At least three children are necessary in each family, because our population risks aging."[34]

In order to discuss the perspective of Turkey's PM, while analyzing the average number of children per different income-level households, the third scenario is established. In all subsections of this scenario, the aim is to investigate the number of children per household, and its effect upon the poverty equilibrium. It should be stated that the death fraction is not modified in these scenarios; only the birth fractions for the poor and the rich are modified according to the questions of each sub-scenario. Therefore, even though the population dynamics among the poor and rich are changed in this scenario, there is no significant difference in total population dynamics.

7.1.3.1. Scenario 3_a: Equal Birth Fractions for the Poor and the Rich. There is a question behind this scenario: What happens to the annual average salaries of the poor and rich, if there is equal birth fractions for the poor and the rich? As stated, there is no significant difference in the number of total population (see Figure 7.19).

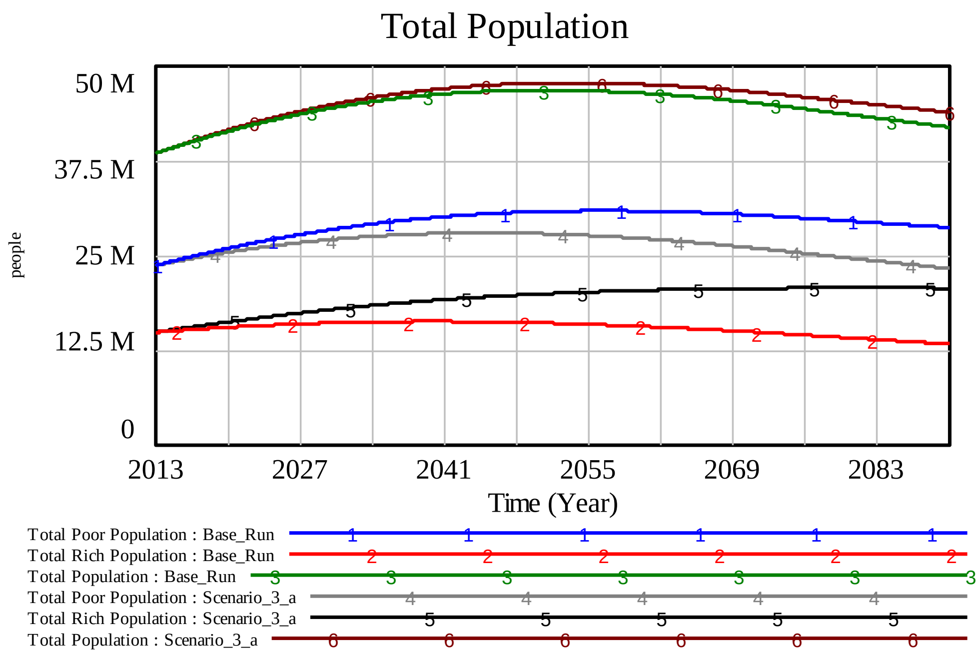


Figure 7.19. Total population under the Scenario_3_a.

To understand the differences in population dynamics among the age groups, the population dynamics among different age groups are also provided in the following figures. The populations among poor and rich children are higher compared to the base run. Besides, while 15-24-year-olds among the poor population increases until 2050s, this age group among the rich population does not change its behavior dynamics compared to the base run. Again, that is why the assumption behind the scenario; being that there is no modification to the death fractions.

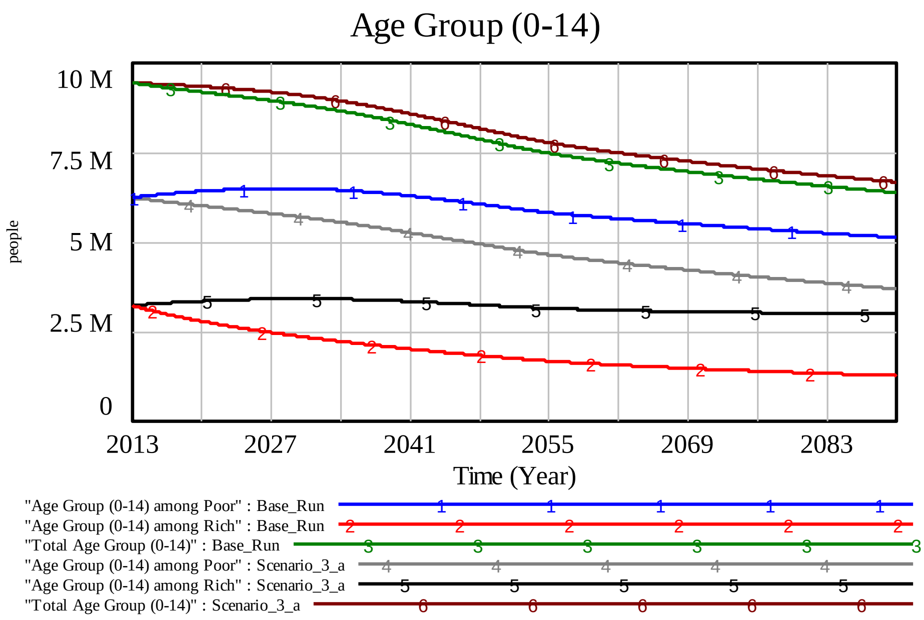


Figure 7.20. Population among 0-14-year-old children under the Scenario_3_a.

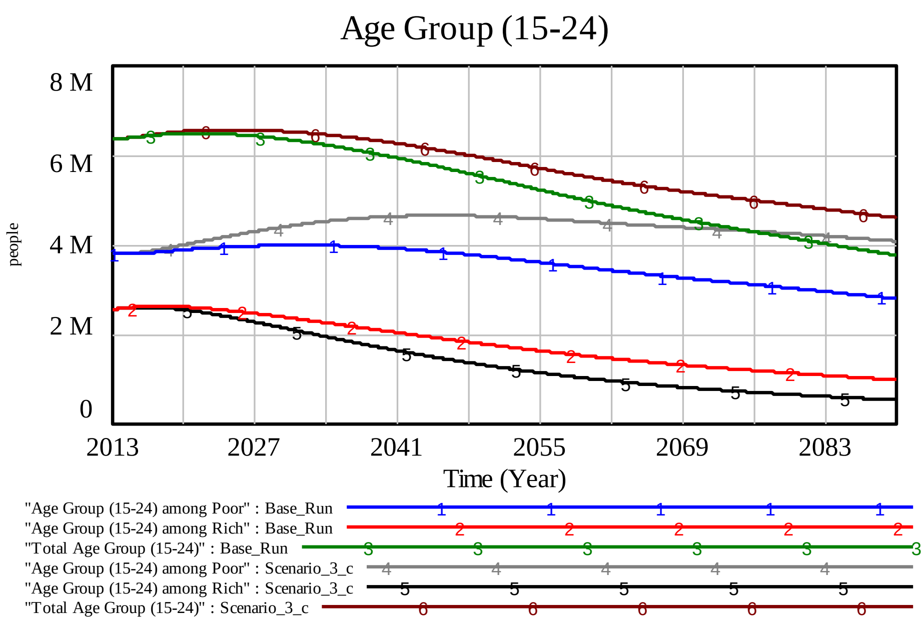


Figure 7.21. Population among 15-24-year-olds under the Scenario_3_a.

The total populations among 25-54-year-olds and over 55-year-olds do not differ compared to how they are in the base run. The dynamics of these age groups are provided in Figure 7.22 and Figure 7.23.

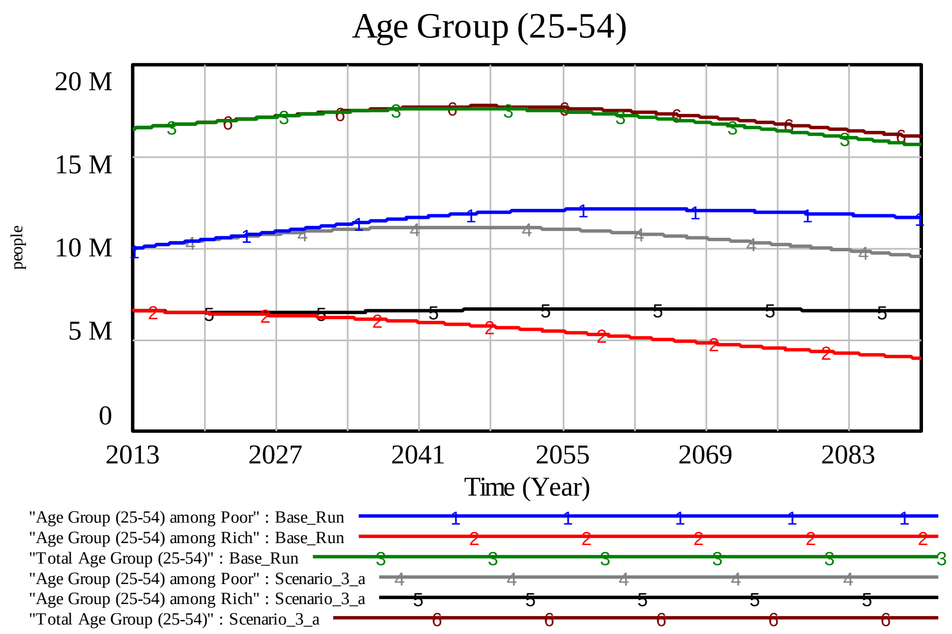


Figure 7.22. Population among 25-54-year-olds under the Scenario_3_a.

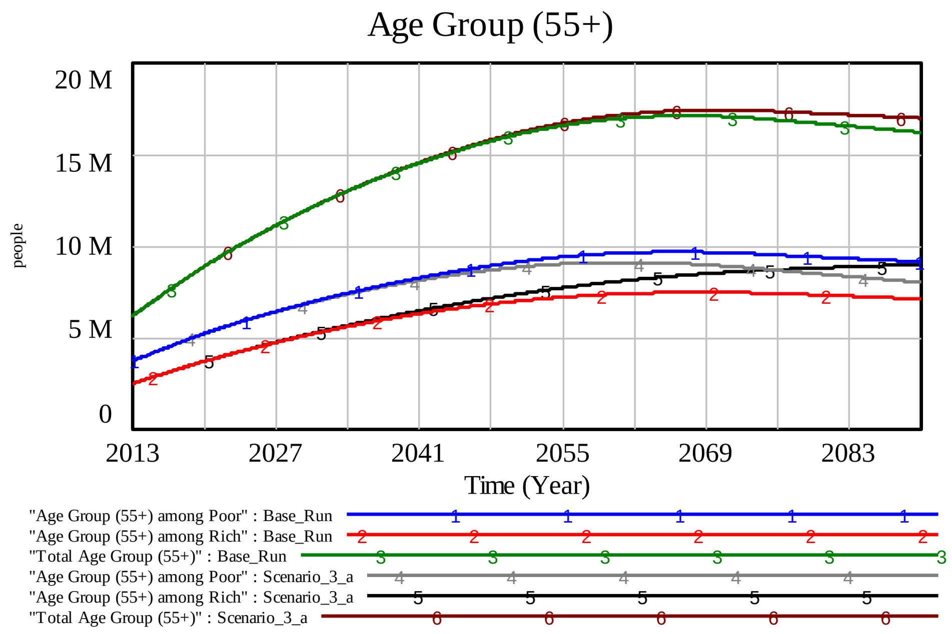


Figure 7.23. Population among over 55-year-olds under the Scenario_3_a.

The annual average salaries of the poor and rich slightly decrease after the 2040s (see Figure 7.24), but these decreases do not change the ratio of these salaries (see Figure 7.25).

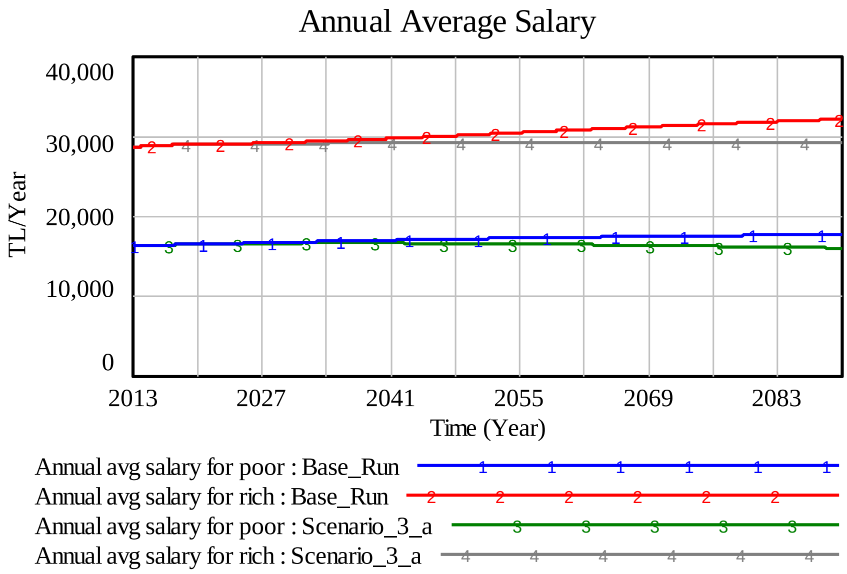


Figure 7.24. The annual average salaries of the poor and rich under the Scenario_3_a.

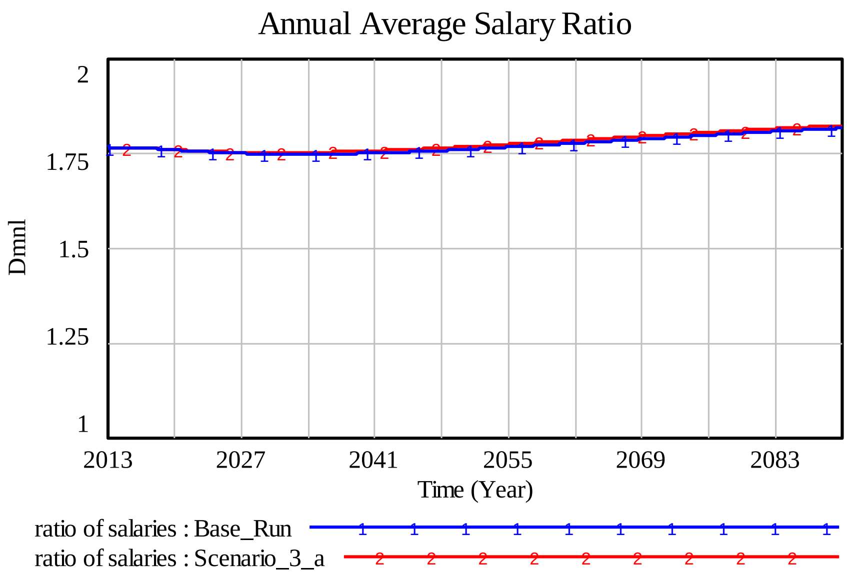


Figure 7.25. The ratio of annual average salaries under the Scenario_3_a.

While the unemployment ratio of the total population is the same as it is in the base run, the unemployment ratio of the poor slightly increases after the 2050s. All unemployment ratios are provided in Figure 7.26. The reason behind the increase in the unemployment ratio of the poor is due to the changes in salaried labor force dynamics among the poor and rich. Semi-skilled and unskilled poor salaried labor forces are also higher than the rich ones in this scenario.

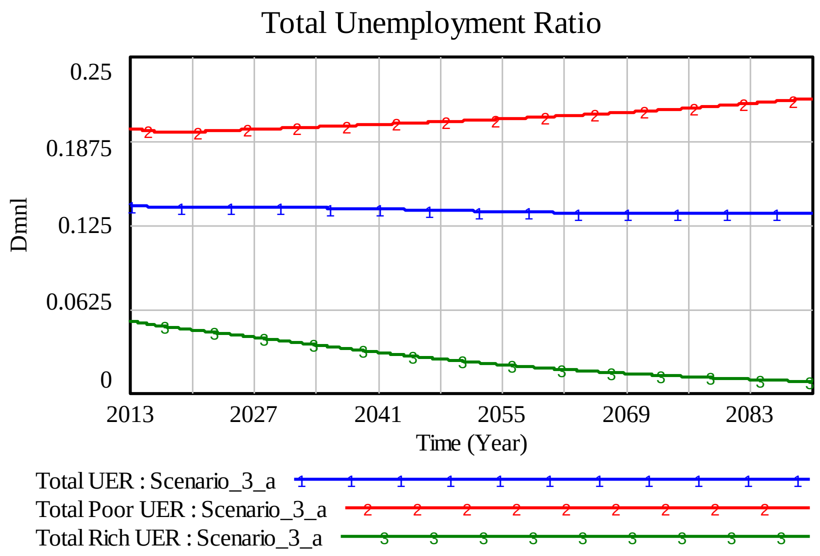


Figure 7.26. All unemployment ratios under the Scenario_3_a.

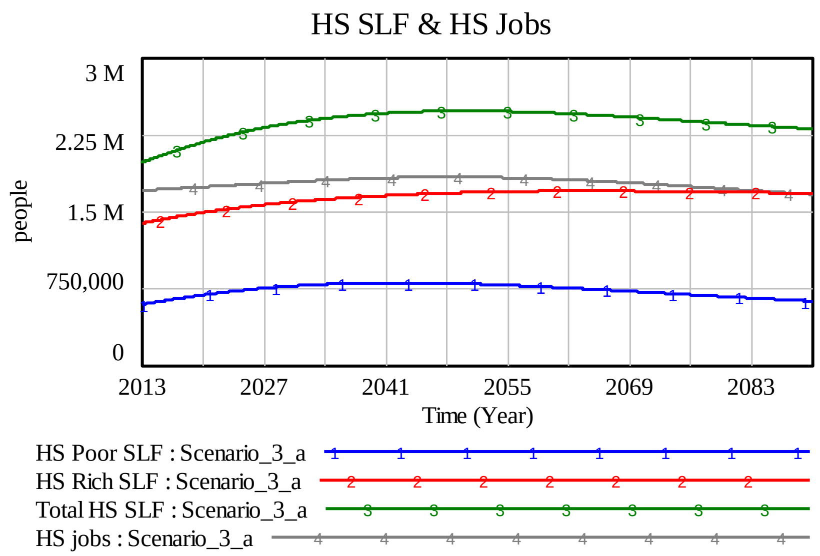


Figure 7.27. HS SLF and total HS jobs under the Scenario_3_a.

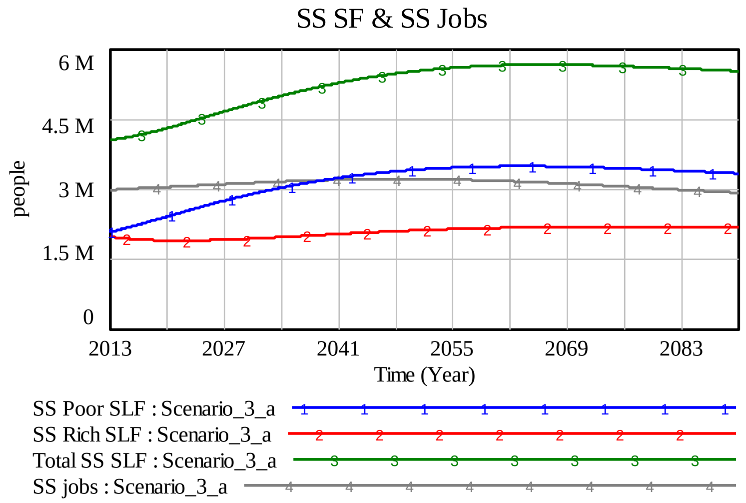


Figure 7.28. SS SLF and total SS jobs under the Scenairo_3_a.

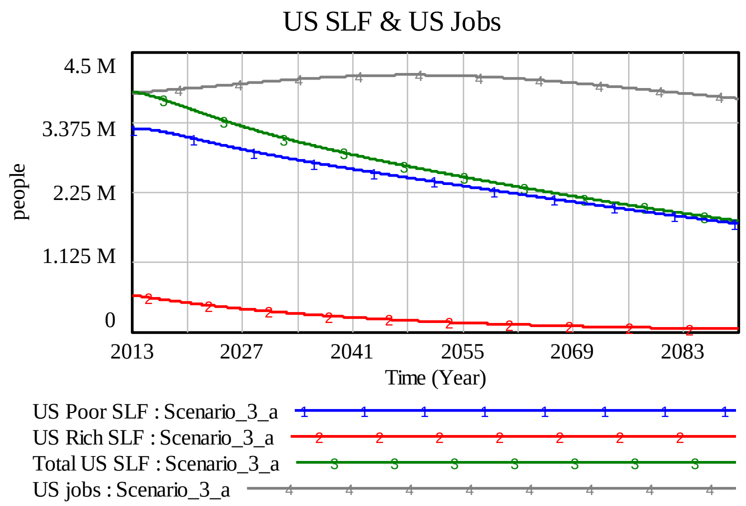


Figure 7.29. US SLF and total US jobs under the Scenario_3_a.

<u>7.1.3.2. Scenario 3_b: Birth fraction of the poor is 4 times higher than it is for the rich.</u> In this scenario, there is a slight increase in total population after the 2050s, but this does not create a significant change in total population behavior (see Figure 7.30). There is an increase in the poor population compared to the rich population. The figures of age groups among the population are provided in Appendix C.

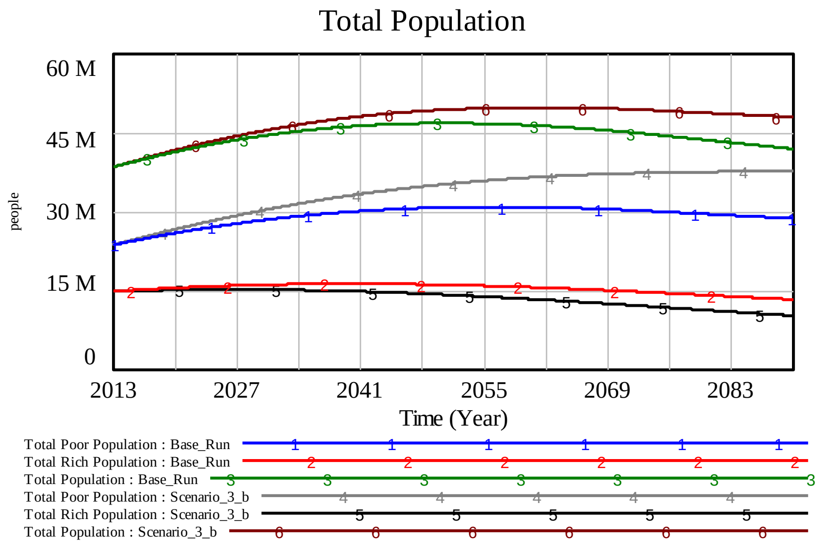


Figure 7.30. Total population under the Scenario_3_b.

After the 2050s, there is a slight increase in the annual average salary for the poor; whereas the annual average salary of the rich increases more (see Figure 7.31). Still, the ratio of these salaries increases slightly (see Figure 7.32). It could be said that, having a higher number of children per poor household does not increase the poor's annual average salary. The two following figures are shown to compare the annual average salaries of the poor and rich.

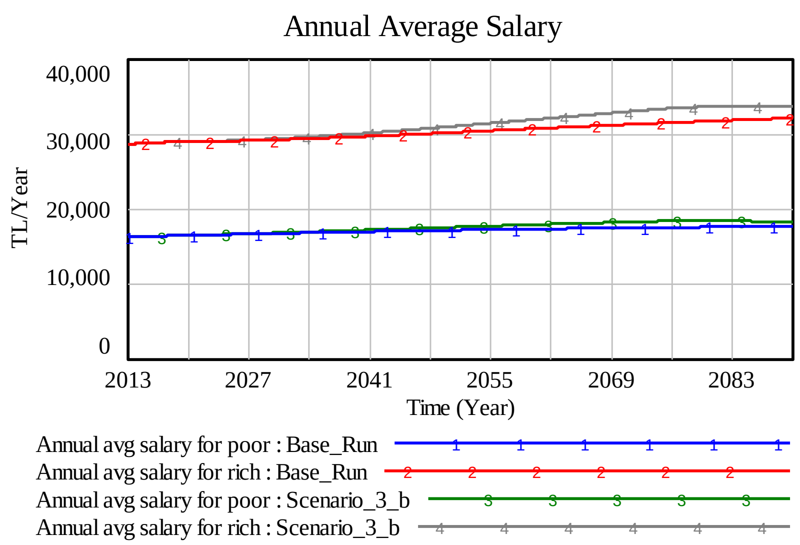


Figure 7.31. The annual average salaries of the poor and rich under the Scenario_3_b.

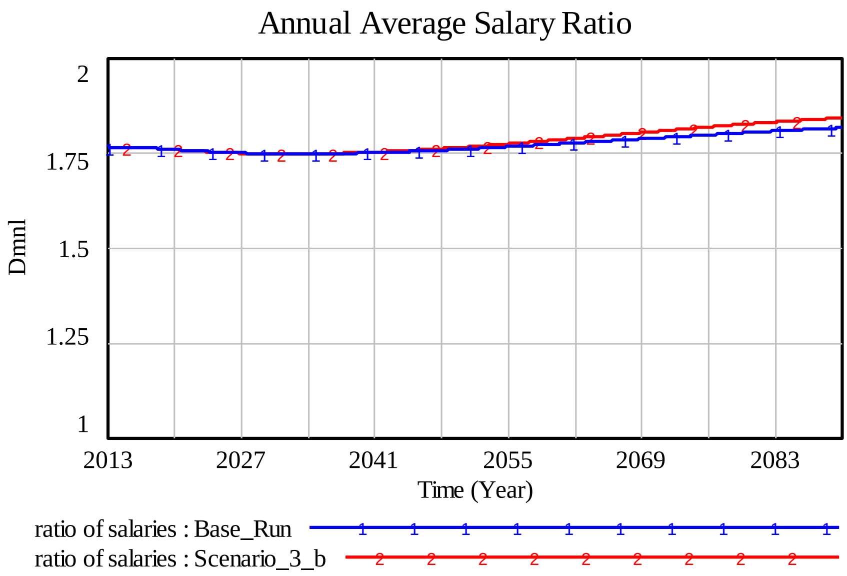


Figure 7.32. The ratio of annual average salaries under the Scenario_3_b.

The unemployment ratio of the poor decreases compared to the base run after the 2030s, but still, it is much higher than the unemployment ratio of rich (see Figure 7.33).

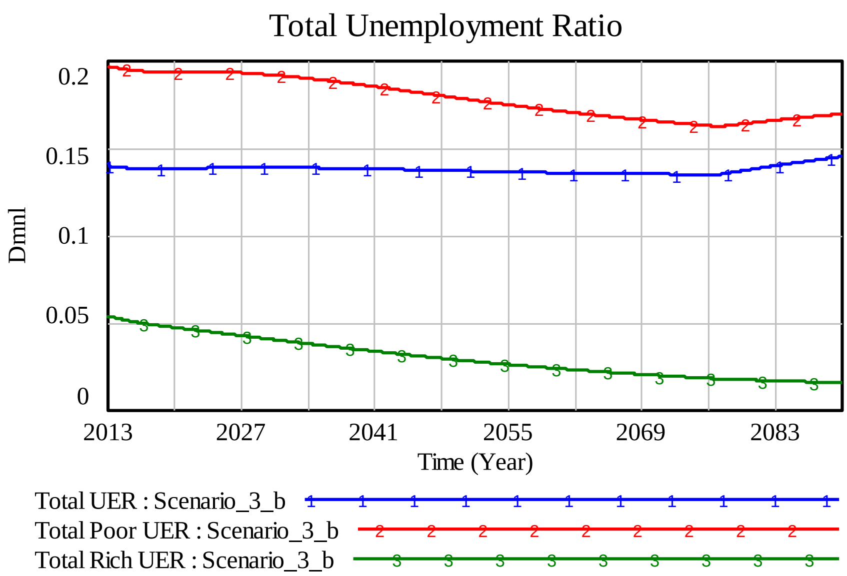


Figure 7.33. The unemployment ratios under the Scenario_3_b.

## 7.2. Policy Analysis

As previously mentioned, highly educated people tend to have higher life standards with regard to their statuses in the employment market. Moreover, education is seen as an important tool to reach economic achievement for the countries [35]. Hence, many governments try to succeed in the education sector, by trying to develop it. For this purpose, governments make policies to improve the standards of providing education for all, by increasing the quality of education at schools [36]. Developing countries are especially faced with major difficulties in reaching such goals. In many countries, governments strive to enable better education for their citizens [37]. With their inadequate resources, they sometimes come up against growing populations and limited schools, deficient and low qualified teachers and poor educational environments because of the high costs of education services [36]. While many governments were suffering from such problems, privatization policies came in and appeared to provide a solution [38]. For instance, the Minister of National Education in Turkey stated in 2013 that crammed schools were closed and they have started to convert these institutions into private schools [39]. It is believed that, this could increase the privatization in high-quality education in Turkey. Some authors agree that if governments can deliver the education services through the private sector, the burden on the national budget can be reduced and the quality of education can become higher. Private schools can be pro-profit or non-profit and these would have distinct effects on the education system [37].

In the policy analysis chapter of this study, we will seek to evaluate whether privatization is a beneficial policy for the poor and rich. Therefore, mostly, the annual average salaries of the poor and rich are analyzed according to the privatized education modification. Also, the ratios of students in high qualified and low-to-average quality education among their own pool are evaluated to show the privatization effect on enrollment rates to high and low-to-average quality education.

There are four main experiments for education policies in this part, such as modification in the amount of privatized education, funding for education fees and some quota proposals for the poor. In other words, the quota proposals are like privilege for the poor, in order to increase their chance to have high-quality education. In addition to the education policies, there will be a one more policy, which is like a hybrid education policy under the horizontal employment hierarchy. For providing a better insight, the results of the policies will be presented mostly compared to the base run. All policies will be explained in the following sections.

### 7.2.1. Policy 1: Privatization in Education

7.2.1.1. Policy 1_a: Constant Privatization. In this policy analysis, compared to the base run there is a 40% privatization ratio, at a constant level until the end of the simulation run. It should be remembered that in the base run, there is an increase in the privatization ratio from 40% to 60% until 2050.

While the annual average salary of the rich decreases, there is a slight increase in the annual average salary of the poor. This change makes a downward move in the ratio of annual average salaries but still, the annual average salary of the poor is lower than the rich's annual average salary. The related figures are provided in Figure 7.34 and Figure 7.35.

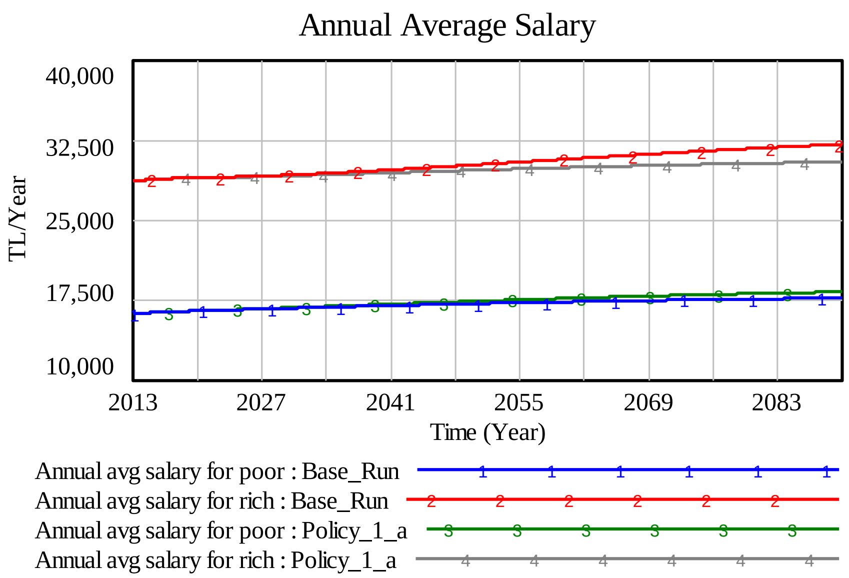


Figure 7.34. The annual average salaries of the poor and rich under the Policy_1_a.

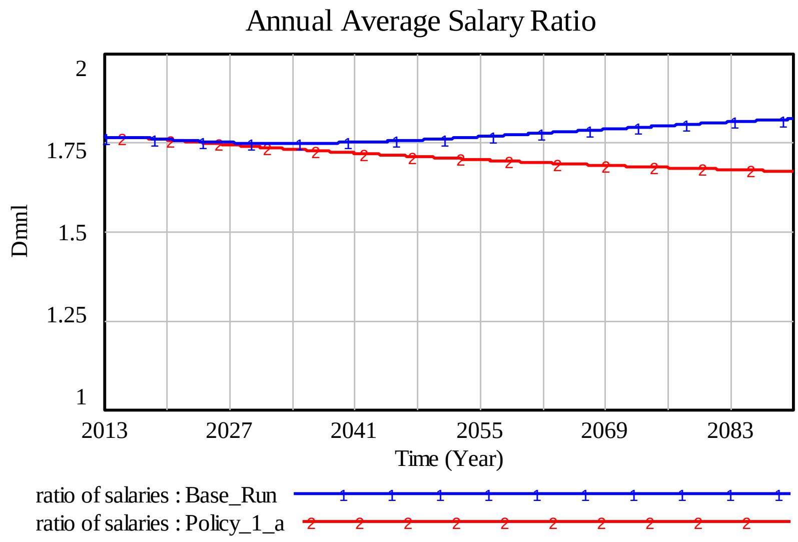


Figure 7.35. The ratio of annual average salaries under the Policy_1_a.

The ratios of students in high and low-to-average quality education are provided in Figure 7.36 and Figure 7.37, respectively. There is a decrease in rich students' ratio among all rich students, whereas there is a slight increase in poor students' ratio among all poor students. Conversely, the ratio of students in low-to-average quality education is also provided to show the counterpart effect of enrollment rates to high-quality education on enrollment rates to low-to-average quality education.

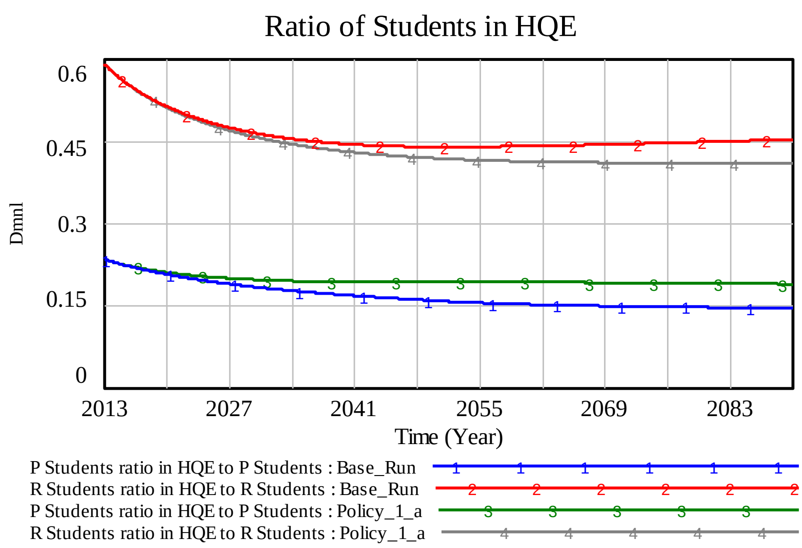


Figure 7.36. The ratio of students in HQE for the poor and rich under the Policy_1_a.

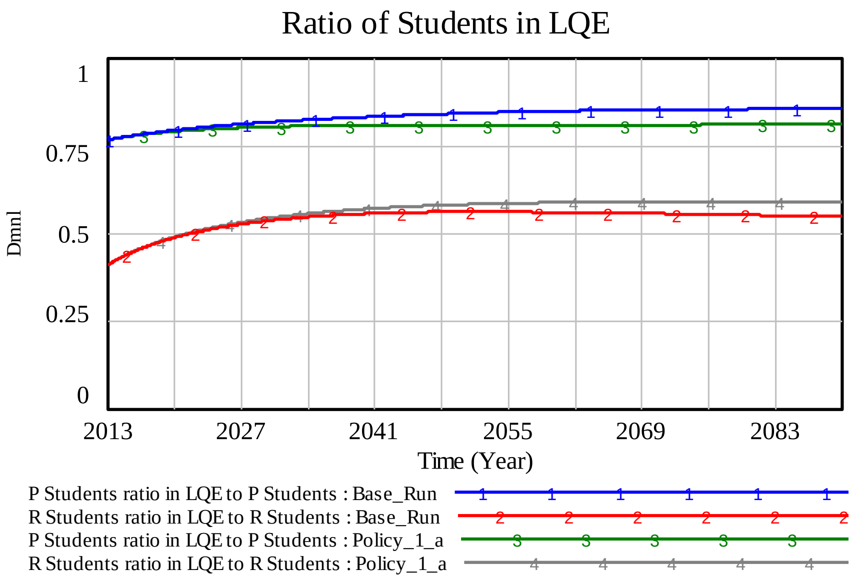


Figure 7.37. The ratio of students in LQE under the Policy_1_a.

The all salaried labor forces among the poor and the rich are shown in the following figures. In this policy analysis, the most significant difference compared to the base run is; the number of highly skilled salaried labor force among the poor increases due to the constant privatization ratio. Poor students can achieve entrance to the high-quality education more than they do in the base run.

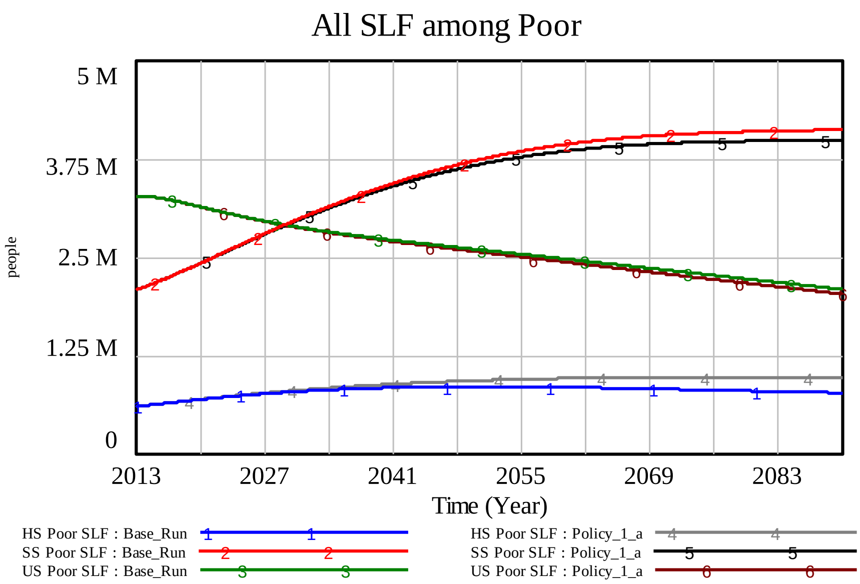


Figure 7.38. All SLF among the poor under the Policy_1_a.

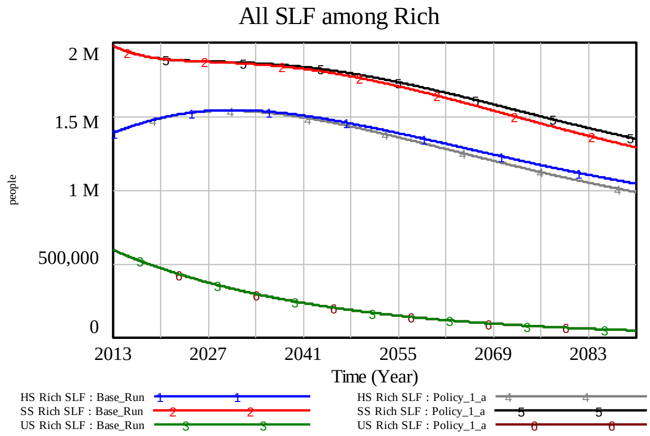


Figure 7.39. All SLF among the rich under the Policy_1_a.

7.2.1.2. Policy 1_b: Decrease in Privatization. In this policy analysis, there is a decrease in the privatization ratio from 40% to 10% until 2040. The decrease in privatization increases the ratio of poor student in high-quality education. The ratios of students in high-quality and low-to-average quality education are provided in Figure 7.40 and Figure 7.41. There is a decrease in rich students in high-quality education ratio among all rich students, whereas there is an increase in poor students in high-quality education ratio among all poor students. Nevertheless, this ratio for the rich is still higher than it is for the poor. Conversely, the ratio of students in low-to-average quality education is also provided to show a counterpart effect of enrollment rate to high-quality education on the enrollment rate to low-to-average quality education.

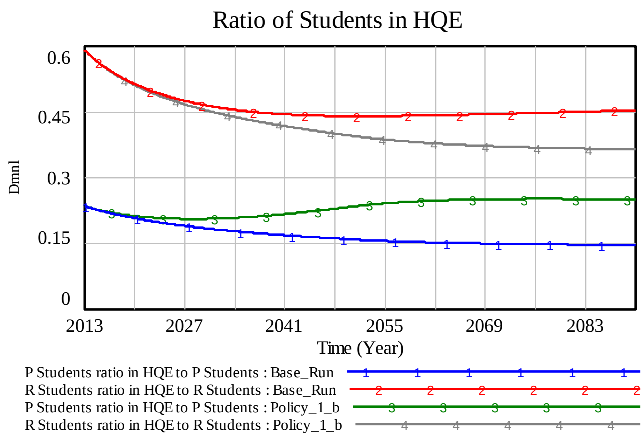


Figure 7.40. The ratio of students in HQE for the poor and rich under the Policy_1_b.

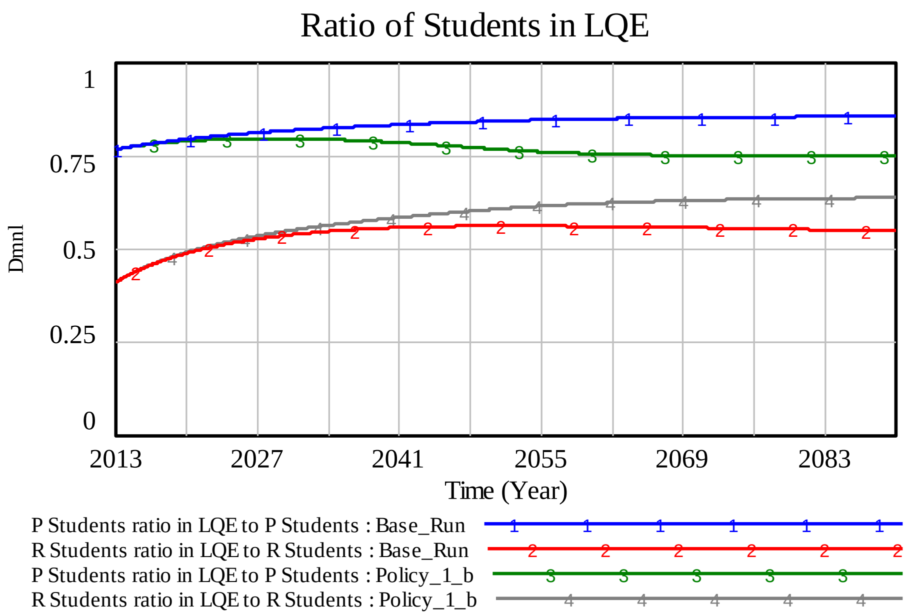


Figure 7.41. The ratio of students in LQE for the poor and rich under the Policy_1_b.

According to the increase in the ratio of poor students in high-quality education to all poor students (see Figure 7.40 above), there is an increase in highly skilled salaried labor force among the poor. The salaried labor force among the poor and the rich are provided in Figure 7.42 and Figure 7.43. There is an increase with the decrease in privatized education for the highly skilled poor salaried labor force after the 2030s.

On the other hand, the highly skilled salaried labor force among the rich decreases after the 2040s due to the decrease in the annual average salary of the rich, whereas the semi-skilled salaried labor force increases (see Figure 7.42 and Figure 7.43). After the 2040s, there is a slight increase in the annual average salary of the poor whereas the annual average salary of the rich decreases. The gap between their salaries becomes smaller (see Figures 7.44 and 7.45). The important reason behind this, there is higher number of highly skilled salaried labor force among the poor, who may obtain highly skilled jobs, compare to how it is in the base run. Therefore, the annual average salary of the rich decreases. After the 2040s, the highly skilled salaried labor force among the rich decreases because of the decrease in the annual average salary of the rich, whereas the semi-skilled rich salaried labor force increases.

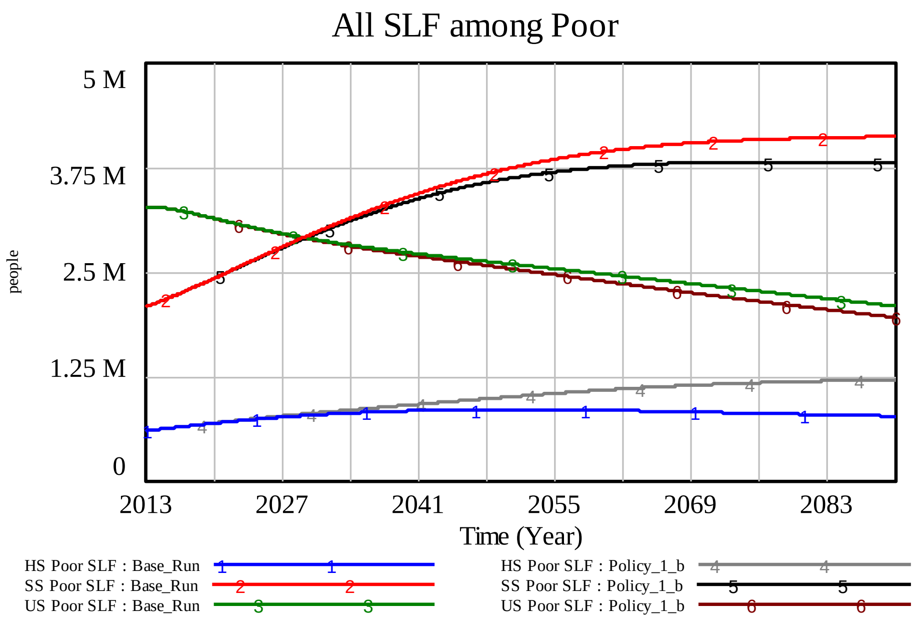


Figure 7.42. All SLF among the poor under the Policy_1_b.

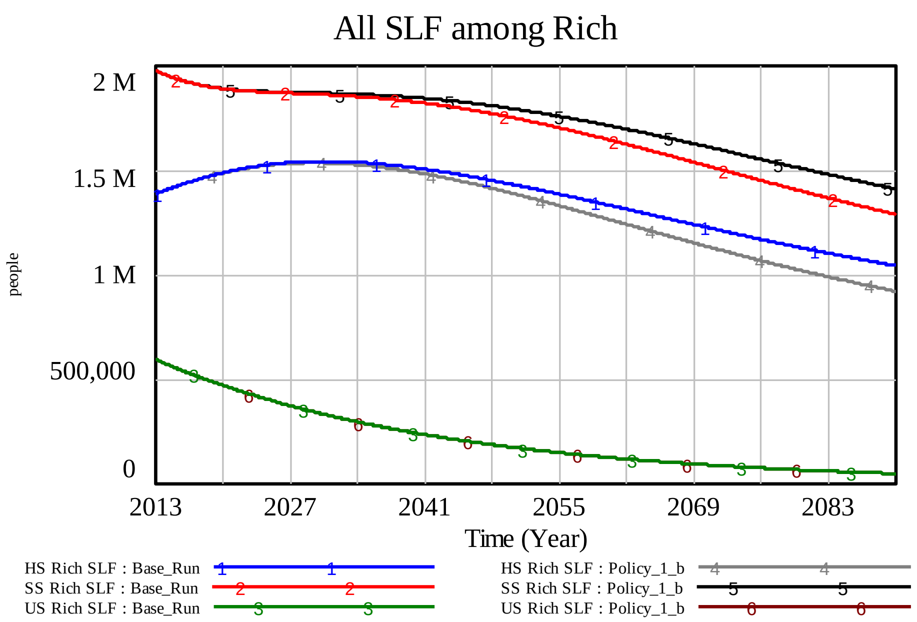


Figure 7.43. All SLF among the rich under the Policy_1_b.

Besides, there is a decrease in poor semi-skilled salaried labor force after the 2040s, whereas highly skilled poor salaried labor force increases. It could be said that, there is a switch between semi-skilled and highly skilled salaried labor force among the poor since, the change in unskilled poor salaried labor force is insignificant. Although there is an increase in highly skilled salaried labor force among the poor, the poor's annual average salary slightly increases. Also, there is a bottleneck of the jobs for the highly skilled salaried labor force. Note that, there is a vertical employment hierarchy. Therefore, the unemployed highly skilled salaried labor force among the poor gets the semi-skilled jobs. Furthermore, to compare the highly skilled salaried labor force among the poor and rich, Figure 7.44 is provided. Until the 2070s, the highly skilled salaried labor force among the rich is higher than it is among the poor. The number of salaried labor force among the respected skill level is indicative through an occupation process for the poor and rich.

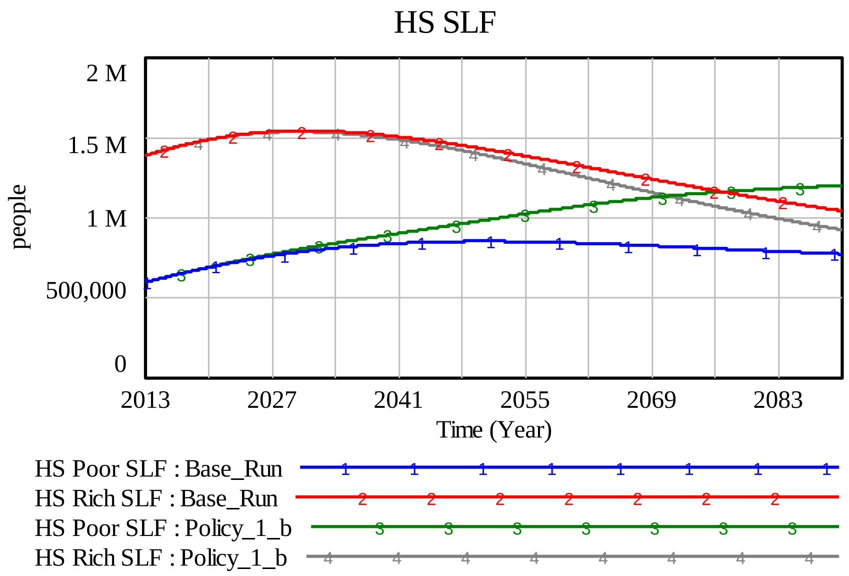


Figure 7.44. Highly skilled SLF among the poor and rich under the Policy_1_b.

As explained, there is a slight increase in the annual average salary of the poor (see Figures 7.45 and 7.46). It should be recalled that, the number of total salaried labor force among the poor is higher than the rich's salaried labor force. Also, the annual average salary is calculated by dividing the total earnings of employed people to total salaried labor force. According to this calculation, since the salaried labor force among poor is higher than the rich's salaried labor force, the increase in annual average salary of the poor is slight. Again, there is no difference in the unemployment ratios compared to how they are in the base run. There is also no change in total salaried labor force among the poor and rich compared to the base run.

The related figures are shown in Appendix C.

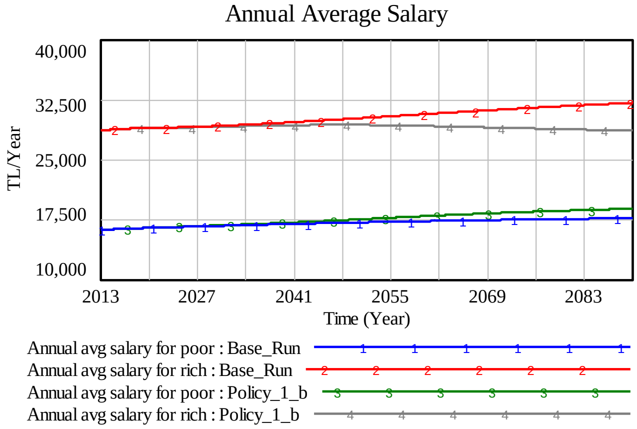


Figure 7.45. The annual average salaries of the poor and rich under the Policy_1_b.

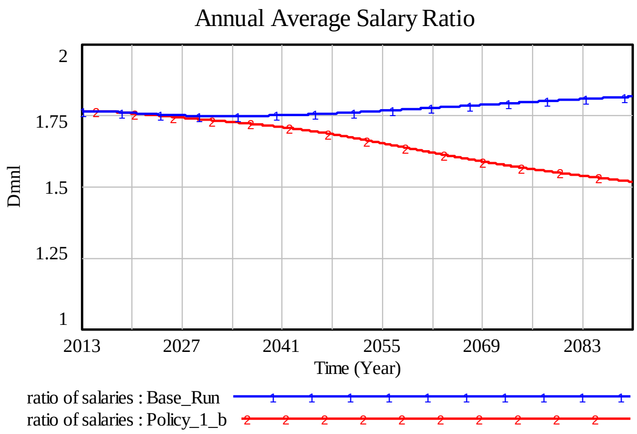


Figure 7.46. The ratio of annual average salaries under the Policy_1_b.

*Policy_1_b_i: Increase in Privatization*: If there is an increase in privatization from 40% to 90% in the privatization ratio until 2050. There are slight changes in all skill levels among the poor and rich salaried labor forces. The annual average salary of the poor slightly decreases; conversely, there is an increase in the annual average salary of the rich, which is quite significant. Related figures are provided in Appendix D.

<u>7.2.1.3. Policy 1_c: 25% Quota Proposal for the Poor in Privatized Education.</u> In this policy, there is a 25% quota proposal for the poor, which means to reserve the proportion

of the quota in high-quality education for the poor. This policy has a realization with the following equations:

$$\text{Poor HQ public edu fr} = (1 - ((1 - \text{quota}) * \text{Privatization})) * \text{Poor HQ public edu base fr} \quad (7.1)$$

$$\text{Poor HQ priv edu fr} = (1 - \text{quota}) * \text{Privatization} * \text{eff of poor aff} * \text{Poor HQ priv edu base fr} \quad (7.2)$$

The quota is the percentage of quotas for all students in privatized high-quality education. In this policy, the quota for the poor is set to 25%. The ratios of the students in high-quality education are shown in Figure 7.47. There is a minor increase in the ratio of poor students in high-quality education among all poor students. The counterpart of the ratio of students in high-quality education, which is this ratio in low-to-average quality education, is shown in Figure 7.48.

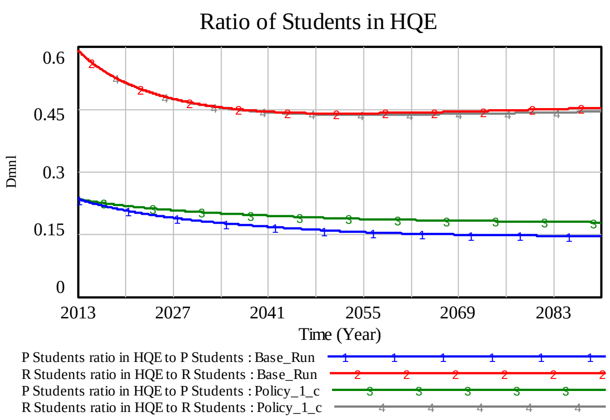


Figure 7.47. The ratio of students in HQE for the poor and rich under the Policy_1_c.

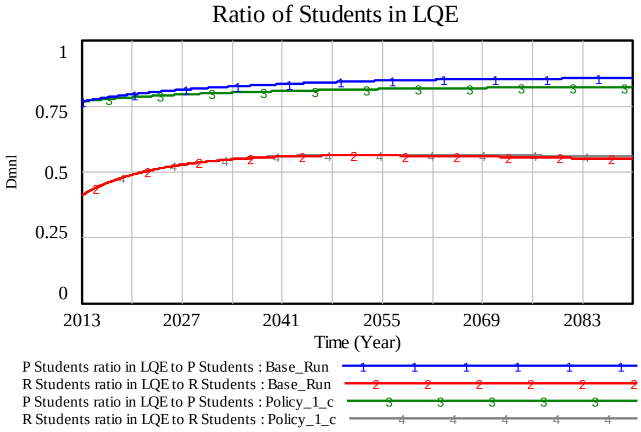


Figure 7.48. The ratios of students in LQE under the Policy_1_c.

There is a slight increase in the highly skilled salaried labor force among the poor, whereas semi-skilled poor salaried labor force slightly decreases compared to the base run (see Figure 7.49). It could be said that, there is a switch between semi-skilled and highly skilled salaried labor force among the poor. However, this switch is insignificant to change the annual average salary of the poor (see Figures 7.51 and 52 below). Also, there are no differences in the rich's salaried labor forces at all skill levels (see Figure 7.50). Again, there is no difference in the unemployment ratios compared to the base run. The 25% quota proposal has not a significant influence on highly skilled salaried labor force among the poor. As mentioned, there is a slight increase in highly skilled salaried labor force among the poor.

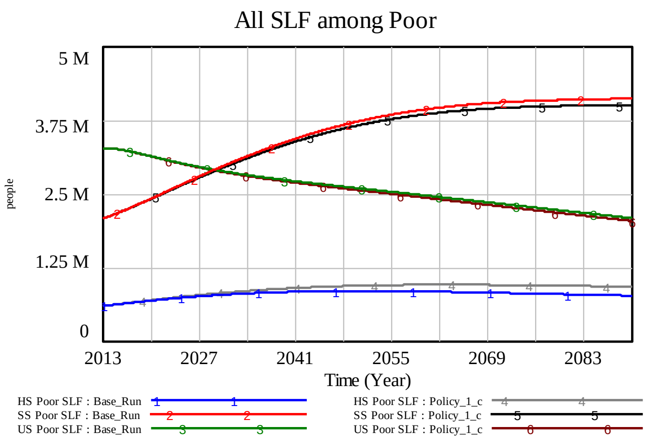


Figure 7.49. All SLF among the poor under the Policy_1_c.

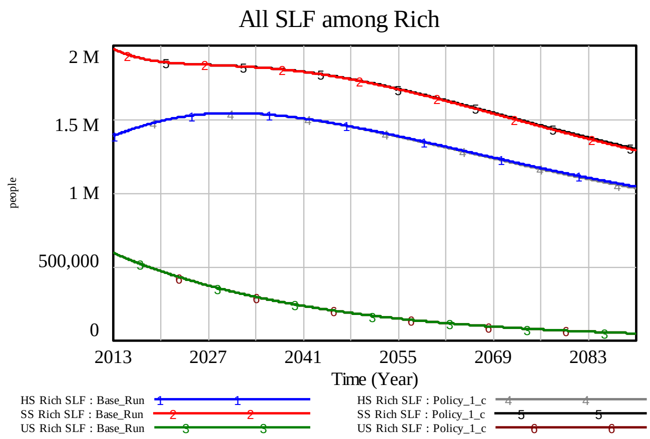


Figure 7.50. All SLF among the rich under the Policy_1_c.

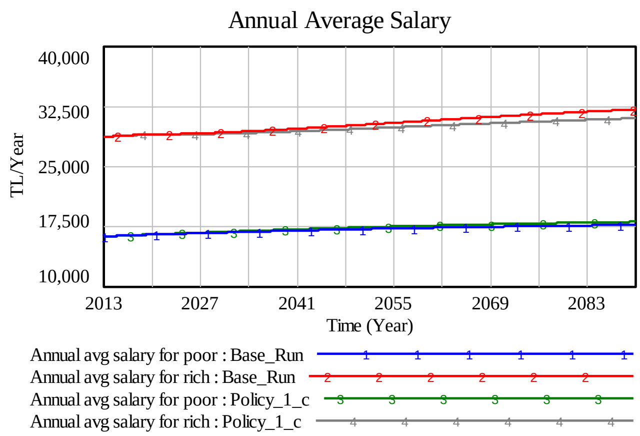


Figure 7.51. The annual average salaries of the poor and rich under Policy_1_c.

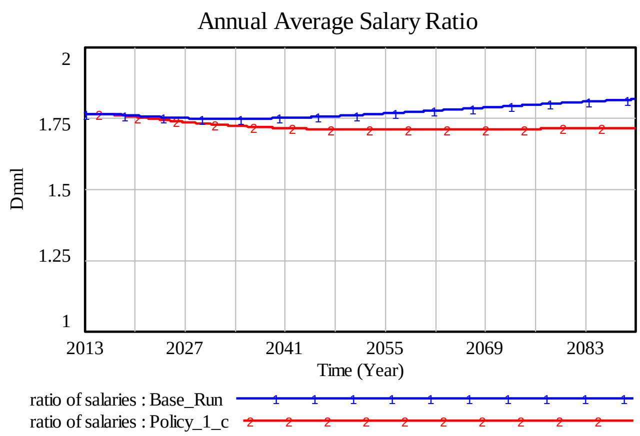


Figure 7.52. The ratio of annual average salaries under the Policy_1_c.

<u>7.2.1.4. Policy 1_d: 50% Quota Proposal for the Poor in Privatized Education.</u> In this policy analysis, there is a 50% quota for the poor in high-quality privatized education. The significant results of this policy are analyzed to consider the difference compared to the base run.

The ratio of poor students in high-quality education among all poor students stagnates at higher level than it is in the base run. That means there is a decrease in the ratio of poor students in low-quailed education among the poor students (see Figure 7.53 and Figure 7.54).

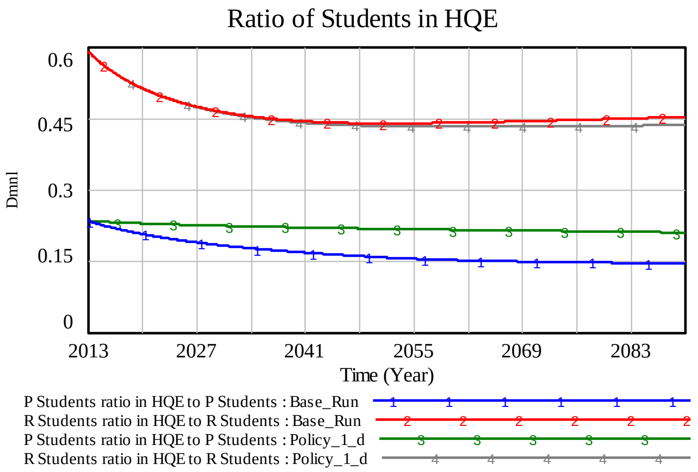


Figure 7.53. The ratio of students in HQE for the poor and rich under the Policy_1_d.

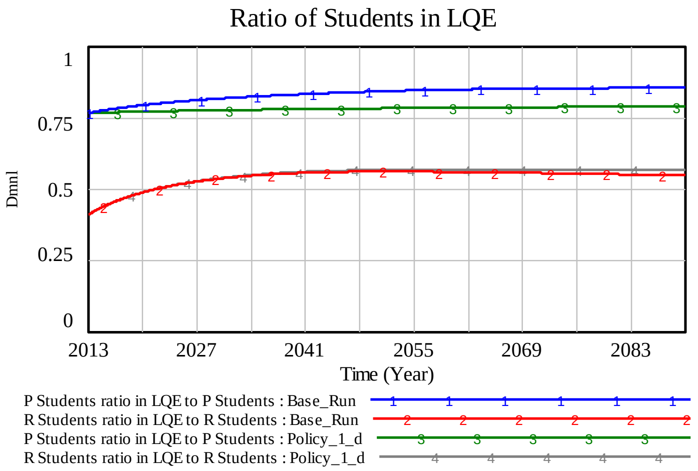


Figure 7.54. The ratios of students in LQE under the Policy_1_d.

There is an increase in the highly skilled salaried labor force among the poor, whereas the semi-skilled poor salaried labor force slightly decreases compared to the base run (see Figure 7.55). Again, it could be said that, there is a switch between semi-skilled and highly skilled salaried labor force among the poor (since there is a minor decrease in the unskilled poor salaried labor force). However, this switch is not very significant to change the annual average salary of the poor. There are no differences in the rich's salaried labor forces at all skill levels compared to the base run (see Figure 7.56). Again, there is no discrepancy in the unemployment ratios compared to the base run.

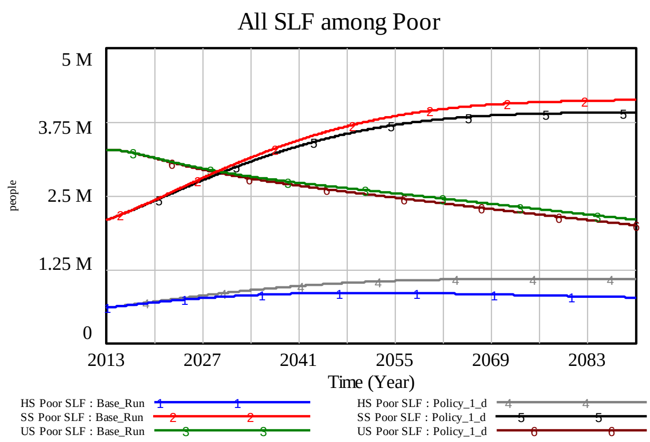


Figure 7.55. All SLF among the poor under the Policy_1_d.

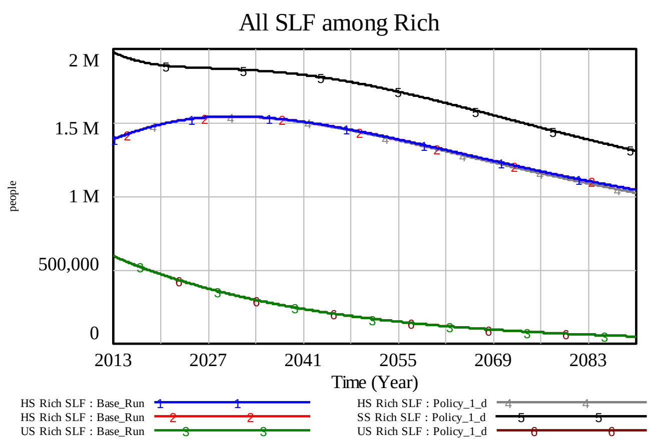


Figure 7.56. All SLF among the rich under the Policy_1_d.

On the other hand, there is a decrease in the annual average salary of the rich. According to this, the gap between the annual average salaries of the poor and rich decreases (see Figure 7.57 and Figure 7.58). Compare to the base run, there is a higher number of highly skilled salaried labor force among the poor, who may have highly skilled jobs. However, there is a bottleneck of the jobs for the all highly skilled salaried labor force. So, there is a slight increase in the annual average salary of the poor. As mentioned before, the number of total salaried labor force among the poor is higher than the rich's salaried labor force. According to this, the increase in annual average salary of the poor is slight due to the increase in denominator of the annual average salary formulation. Therefore, this policy cannot help the poor to alleviate stagnation at a low level of salary.

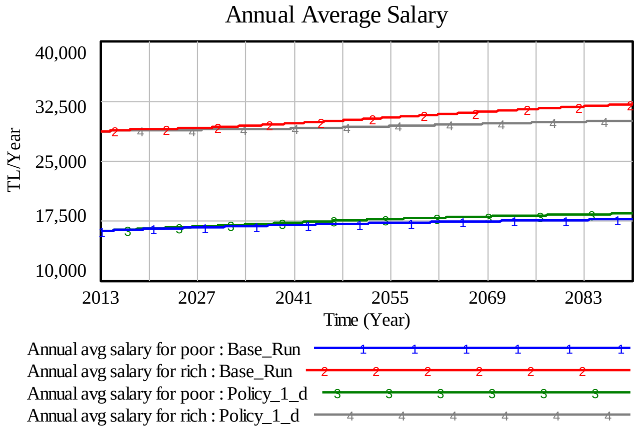


Figure 7.57. The annual average salaries of the poor and rich under Policy_1_d.

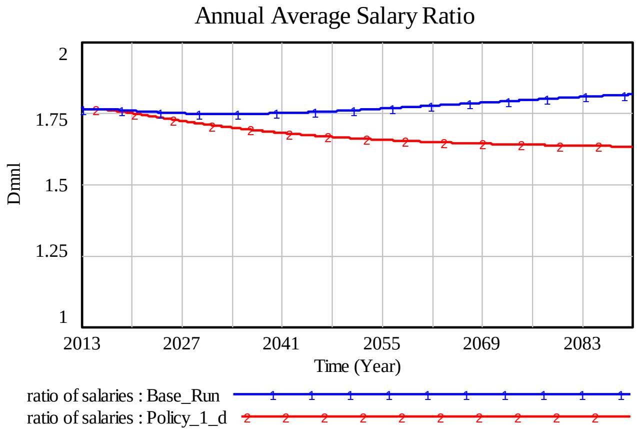


Figure 7.58. The ratio of annual average salaries under the Policy_1_d.

### 7.2.2. Policy 2: Privatized Education Fees

There are an annual average privatized education fees for both the poor and rich. The amount of that cost is assumed to be 20 000 TL/year. In the following sections, first, decrease or increase in these education fees will be considered.

There are many recent education policies and strategies, such as in Ghana, to increase access to education and reforming educational management structures in country funding for the education to the poor [40]. In order to evaluate the funding of privatized education fees effect on the poverty equilibrium, 50% funding for education fees to the poor will be tested in the following sections. As mentioned, the annual average salaries of the poor and rich are analyzed.

7.2.2.1. Policy 2_a: Decrease in Privatized Education Fees. In this policy, there is a 50% decrease in the annual average education fees for both the poor and rich in 2023. After the decrease in the education fees in 2023, the ratios of poor and rich students in high-quality education increase (see Figure 7.59).

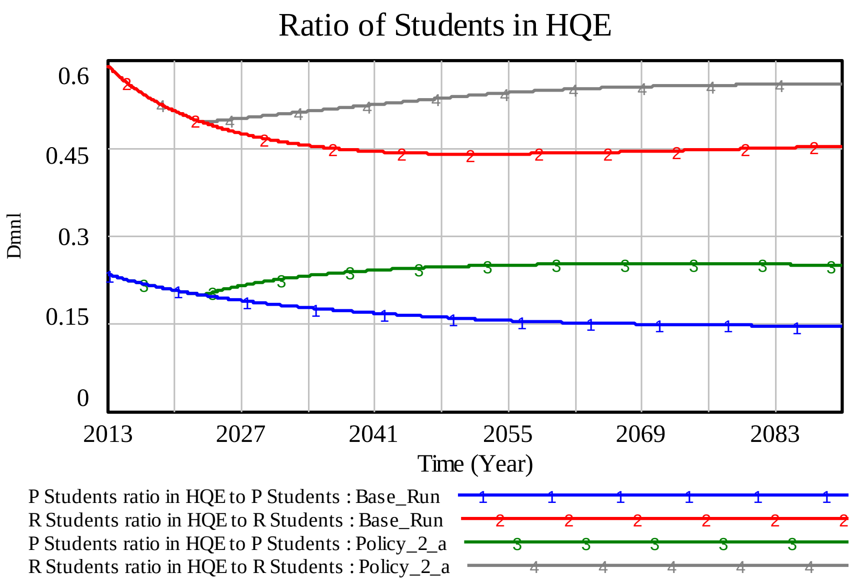


Figure 7.59. The ratio of students in HQE for the poor and rich under the Policy_2_a.

According to the increase in the ratio of poor students in high-quality education among all poor students, there is an increase in highly skilled salaried labor force among the poor. The salaried labor forces among the poor and rich are provided in the Figures 7.60 and 7.61. There is an increase with the decrease in education fees for the highly skilled poor and rich salaried labor forces, after the 2030s.

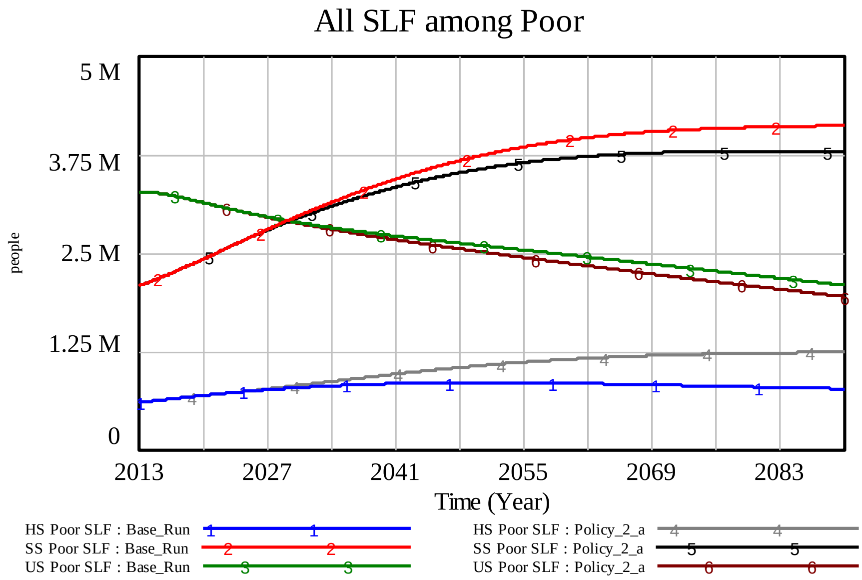


Figure 7.60. All SLF among the poor under the Policy_2_a.

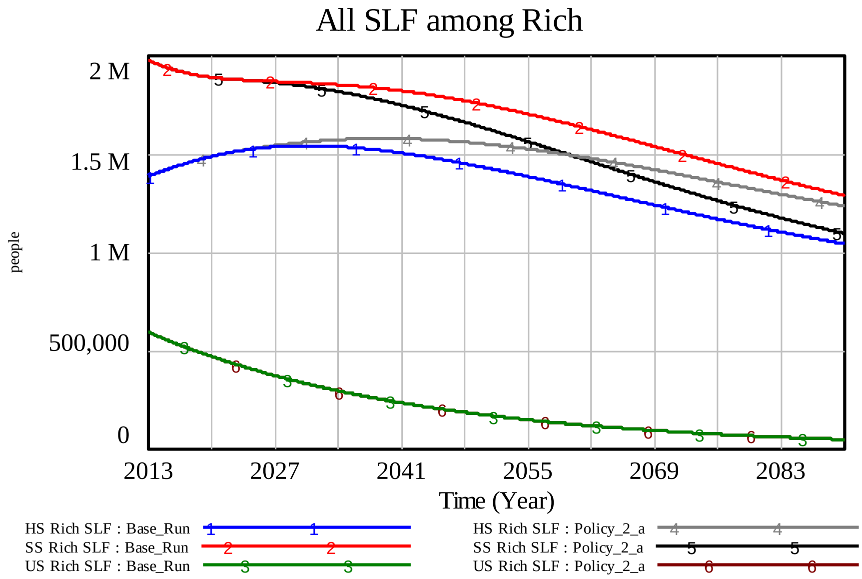


Figure 7.61. All SLF among the rich under the Policy_2_a.

After the 2050s, there is a slight decrease in the annual average salary of the rich, whereas the annual average salary of the poor is still at a low level. The gap between their salaries becomes smaller (see Figures 7.62 and 7.63). The important reason behind this; after the 2030s, compare to the base run, there are higher numbers of highly skilled salaried labor forces among the poor and rich, who can obtain highly skilled jobs. However, there is a bottleneck of the high-skilled jobs for the highly skilled salaried labor force. Therefore, they get the semi-skilled jobs instead of being unemployed. In this policy, the switch between skill levels among the poor salaried labor force is insignificant. So, the annual average salary of the poor stagnates at low level.

In addition, as explained previously, the number of total salaried labor force among the poor is higher than the rich's salaried labor force. According to this, the increase in annual average salary of the poor is modest due to the increase in denominator of the annual average salary formulation. Again, there is no difference in the unemployment ratios compared to the base run. The related figures are provided in Appendix D.

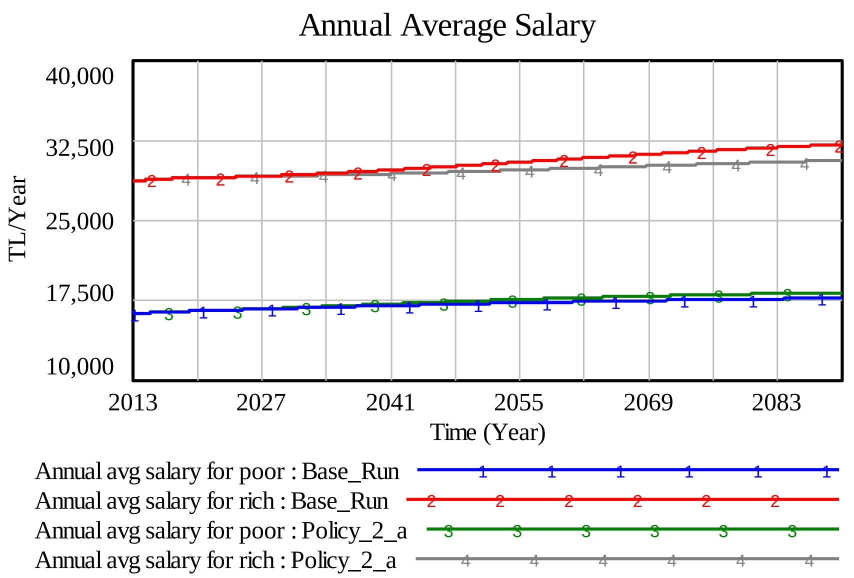


Figure 7.62. The annual average salaries of the poor and rich under Policy_2_a.

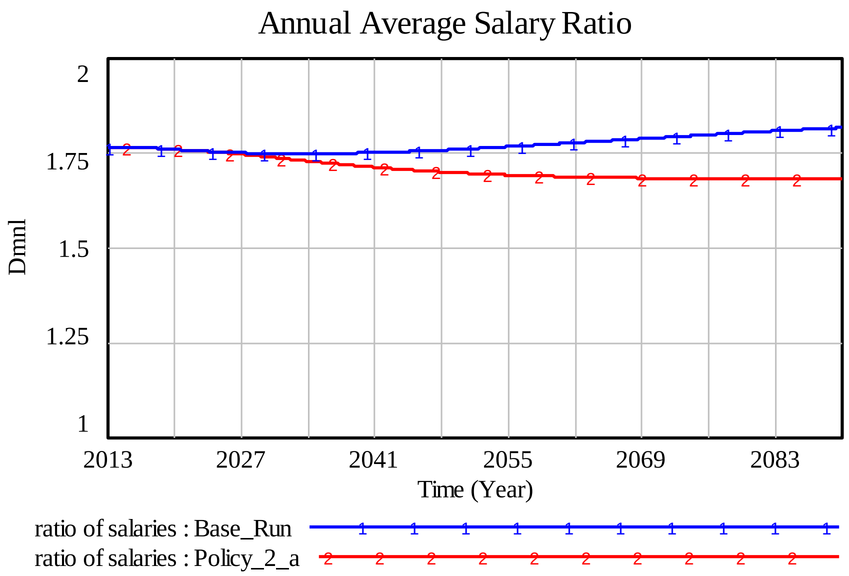


Figure 7.63. The ratio of annual average salaries under the Policy_2_a.

7.2.2.2. Policy 2_b: Increase in Privatized Education Fees. In this policy, there is a 50% increase in the annual average privatized education fees in 2023. Here, because of the increase in privatized education fees, the rich cannot afford the privatized high-quality education. Due to the increase in the privatized education fees, the highly skilled salaried labor force among the rich significantly decreases, whereas the decrease in the poor's highly skilled salaried labor force is very slight.

This policy has major influence on the semi-skilled and highly skilled salaried labor forces among the rich. Following this, when the highly skilled salaried labor force among the rich significantly decreases, the semi-skilled salaried labor force among the rich increases compared to the base run.

The annual average salary of the rich stagnates at its initial value until the 2060s, then it slightly decreases compared to the base run. On the other hand, there is an increase in semi-skilled salaried labor force among the rich. The related figures are provided in Appendix D.

7.2.2.3. Policy 2_c: Funding for Privatized Education Fees to the Poor. In the Policy_2_c, funding for privatized education fees to the poor is analyzed. The funding to the poor is assumed to be 50% of annual average privatized education fees in 2023. After the funding for the privatized education fees to the poor, the ratio of poor students in high-quality education significantly increases (see Figure 7.64).

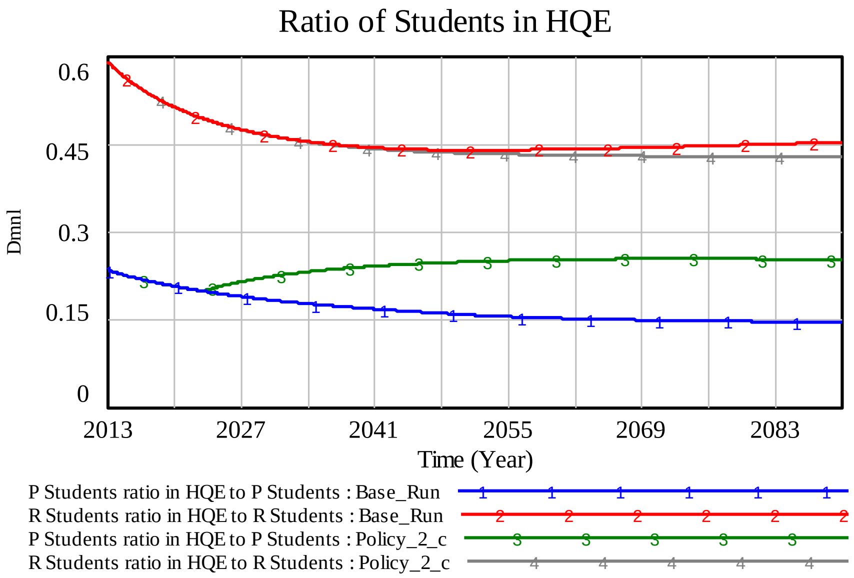


Figure 7.64. The ratio of students in HQE for the poor and rich under the Policy_2_c.

The labor force markets among the poor and rich are given in the following figures. With the help of funding for the privatized education fees to the poor, the highly skilled salaried labor force population almost doubled compared to the base run (see Figure 7.65). On the other hand, as expected, there is no difference in the rich’s labor force market (see Figure 7.66). To compare the number of highly skilled salaried labor forces among the poor and rich, Figure 7.67 is provided. After the 2072s, the number of highly skilled salaried labor force among the poor becomes higher than it is among the rich.

There is an increase in the highly skilled poor salaried labor force, who shares the highly skilled employment market with the rich. This share decreases the annual average salary of the rich compared to the base run. On the other hand, the increase in the annual average salary of the poor is modest due to the horizontal employment hierarchy and the high number of total poor salaried labor force (see Figure 7.68). The ratio of the salaries starts to decrease after the 2025s (see Figure 7.69). This decrease is a result of the decrease in the annual average salary of the rich. The funding for the privatized education fees to the poor is not an adequate solution to break the poverty cycle. This education policy needs to be supported by other policies of education opportunities and/or employment sector.

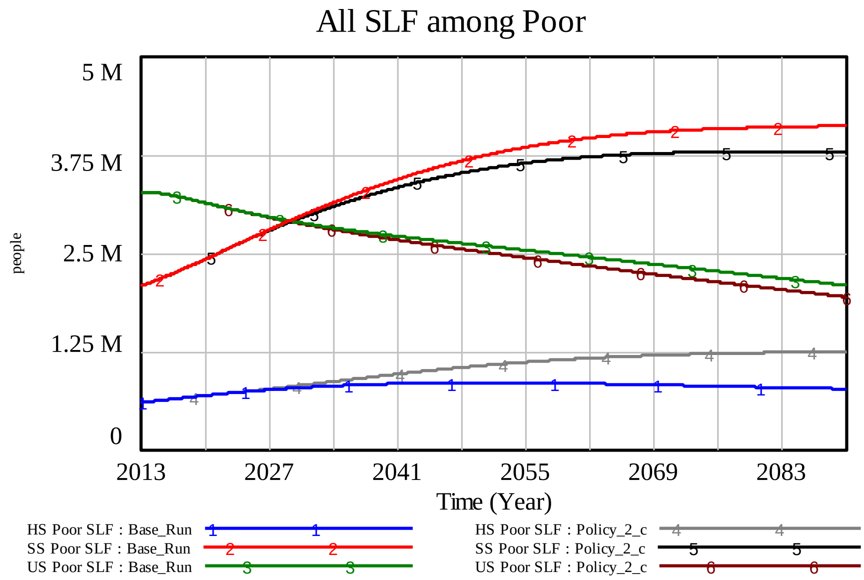


Figure 7.65. All SLF among the poor under the Policy_2_c.

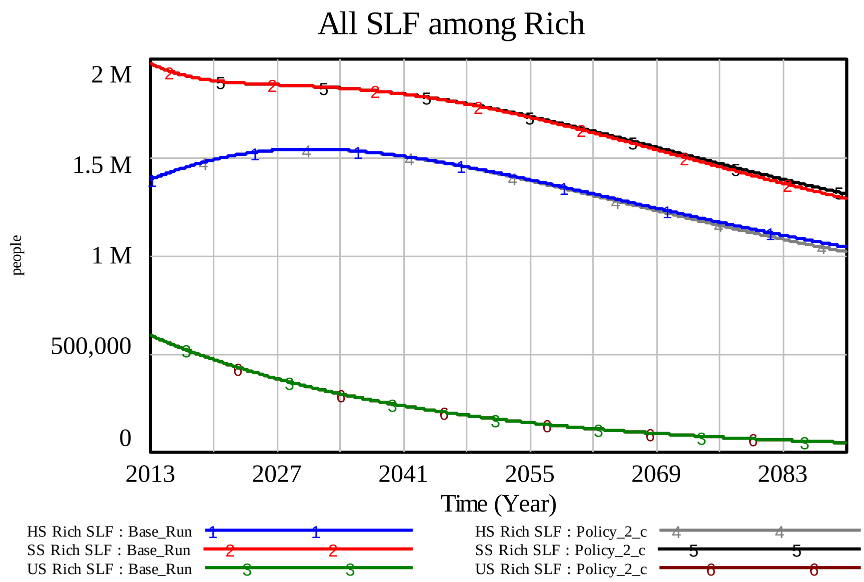


Figure 7.66. All SLF among the rich under the Policy_2_c.

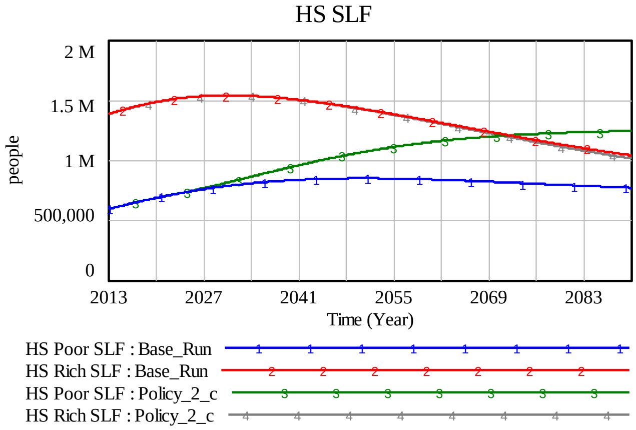


Figure 7.67. Highly skilled SLF among the poor and rich under the Policy_2_c.

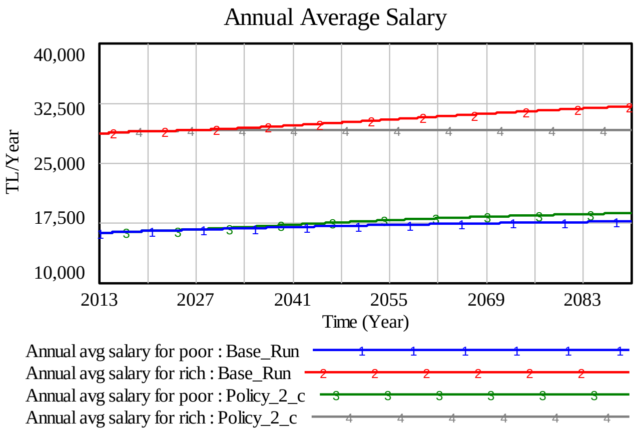


Figure 7.68. The annual average salaries of the poor and rich under the Policy_2_c.

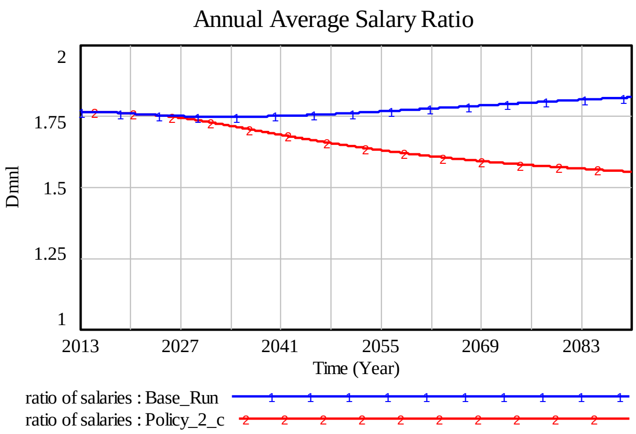


Figure 7.69. The ratio of annual average salaries under the Policy_2_c.

### 7.2.3. Policy 3: Quota Proposal for the Poor in Privatized Education and Funding for Privatized Education Fees for the Poor

In this part of the policy analysis, in addition to the quota proposals, the funding for privatized education fees for the poor is analyzed. As explained before, the quota proposals are like a privilege for the poor, in order to increase their chances to obtain high-quality education. In addition to the quota proposals, the funding for the privatized education fees to the poor is assumed to be 50% of annual average privatized education fees in 2023.

7.2.3.1. Policy 3_a: 25% Quota Proposal for the Poor in Privatized Education and Funding for Privatized Education Fees for the Poor. In this policy, as explained before, there is a 25% quota proposal for the poor, which means to reserve 25% of the quota in high-quality education for the poor. In addition to the quota proposal, there is funding for the privatized education fees for the poor in 2023, which is assumed to be 50% of the annual average of privatized education fees.

With the help of this policy, the poor students' ratio in high-quality education increases after 2023 (see Figure 7.70).

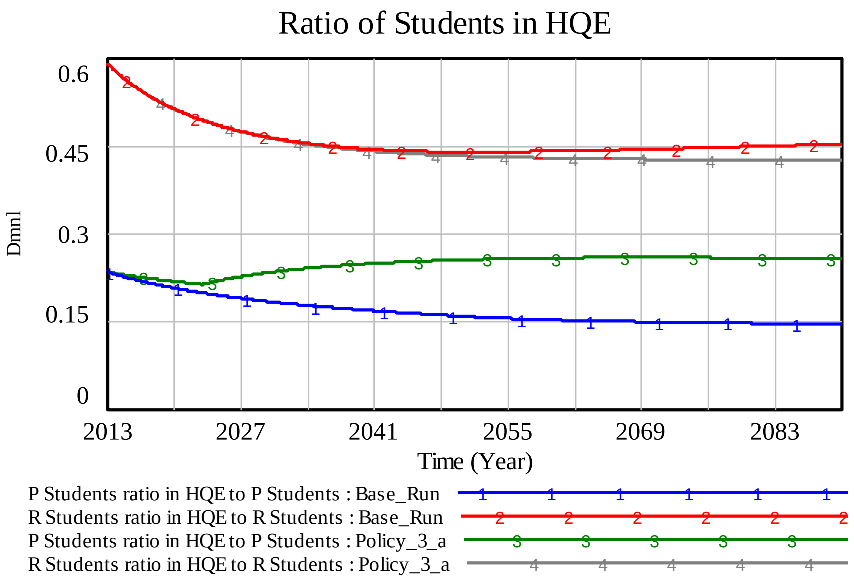


Figure 7.70. The ratio of students in HQE for the poor and rich under the Policy_3_a.

On the other hand, there is a slight decrease in the ratio of rich students in high-quality education because of the decrease in the annual average salary of the rich (see Figure 7.74 below). The reason behind the decrease in the rich's annual average is the increase in the high-quality education. With the help of educational policies, the poor has higher advantages than

The labor force markets among the poor and rich are given in the Figures 7.71 and 7.72. With the help of funding for the privatized education fees and quota proposal to the poor, the highly skilled salaried labor force population almost doubled compared to the base run. On the other hand, as expected, there is no difference in the rich's labor force market compared to the base run.

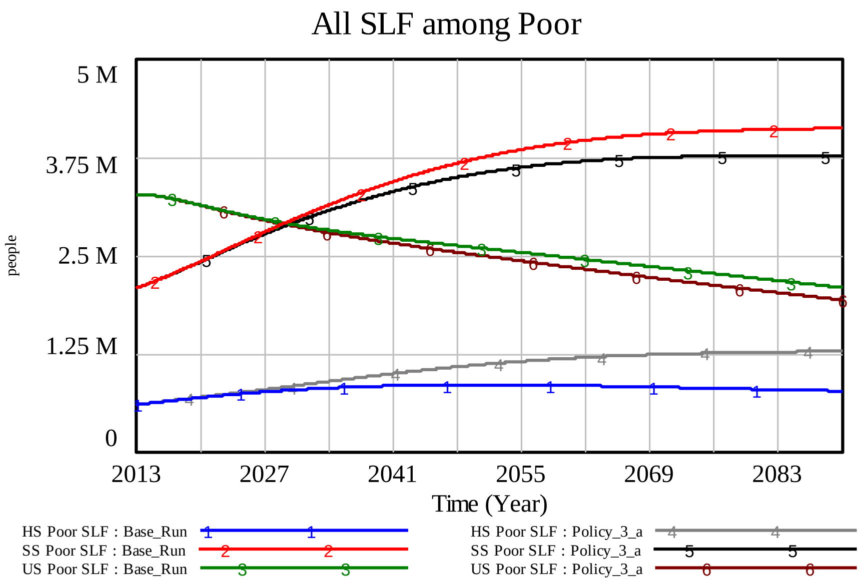


Figure 7.71. All SLF among the poor under the Policy_3_a.

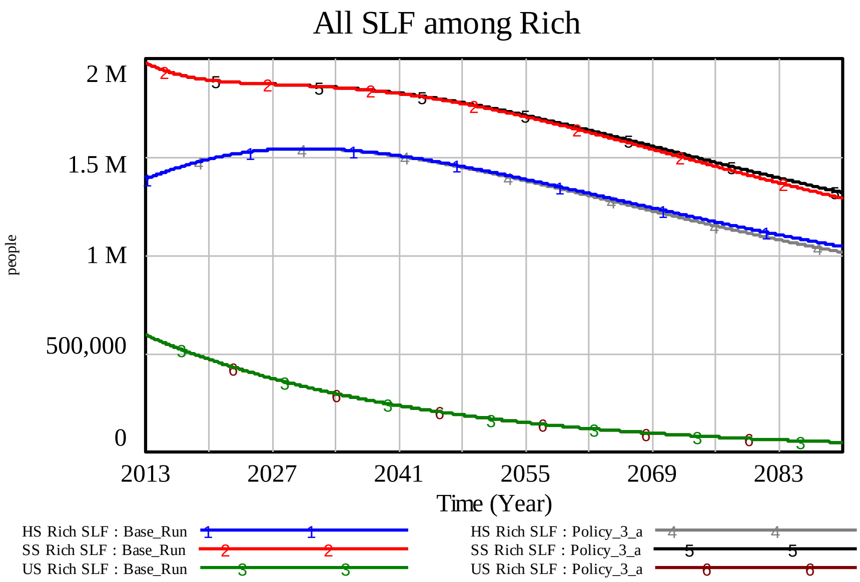


Figure 7.72. All SLF among the poor under the Policy_3_a.

To compare the number of highly skilled salaried labor force among the poor and rich, Figure 7.73 is provided. After 2069, the number of highly skilled salaried labor force among the poor becomes higher than it is among the rich but still, the annual average salary of the poor is lower than the rich's annual average salary. This is because of the difference between the number of total salaried labor force among the poor and rich.

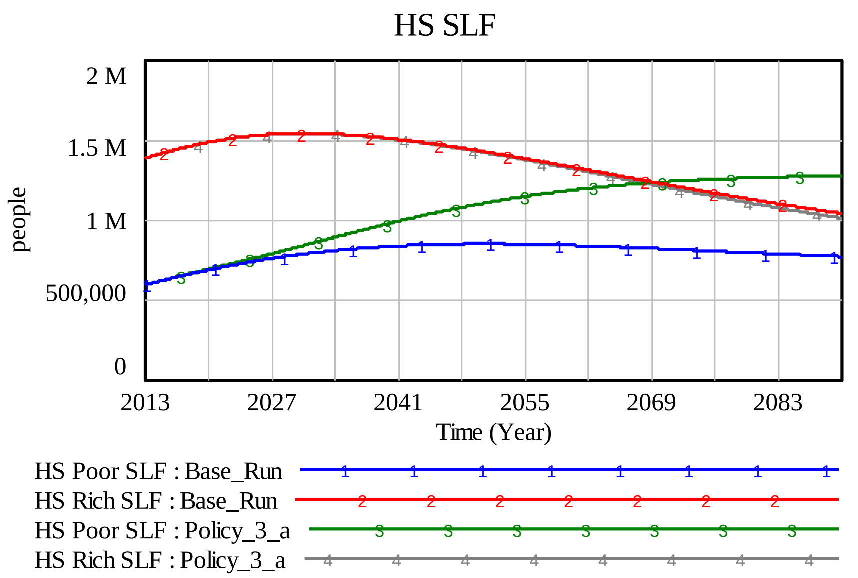


Figure 7.73. Highly skilled SLF among the poor and rich under the Policy_3_a.

According to this policy results, as mentioned, there is an increase in the highly skilled salaried labor force among the poor, but this increase does not lead to significant increase in the annual average salary of the poor (see Figure 7.74). The gap between their salaries starts to decrease after the 2023s (see Figure 7.75) since, there is an increase in the highly skilled poor salaried labor force, who shares the highly skilled employment market with the rich. However, there is a bottleneck of the high-skilled jobs for the highly skilled salaried labor force. Therefore, they get the semi-skilled jobs instead of being unemployed.

As explained before, the number of total salaried labor force among the poor is higher than the rich's salaried labor force. According to this, the increase in annual average salary of the poor is slight due to the increase in denominator of the annual average salary formulation. So, the increase in the annual average salary of the poor is not very significant due to the number of total poor salaried labor force.

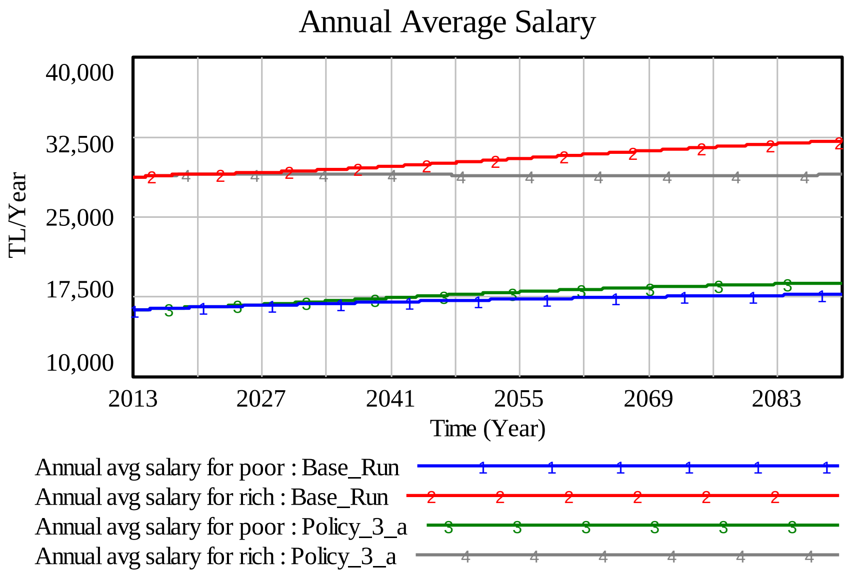


Figure 7.74. The annual average salaries of the poor and rich under the Policy_3_a.

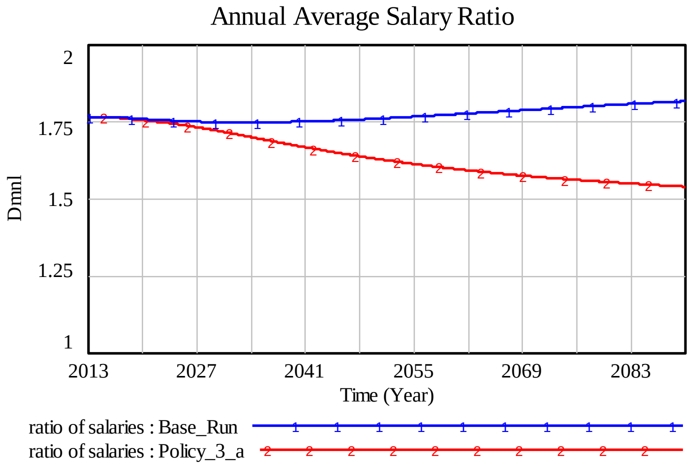


Figure 7.75. The ratio of annual average salaries under the Policy_3_a.

<u>7.2.3.2. Policy 3_b: 50% Quota Proposal for the Poor in Privatized Education and Funding for Education Fees for the Poor.</u> In the Policy_3_b, there is a 50% quota proposal for the poor, which means to reserve the 50% of the quota in high-quality education for the poor. In addition to the quota proposal, there is funding for privatized education fees for the poor in 2023, which is assumed to be 50% of the annual average privatized education fees. With the help of this policy, the poor students' ratio in high-quality education increases after 2023 (see Figure 7.76).

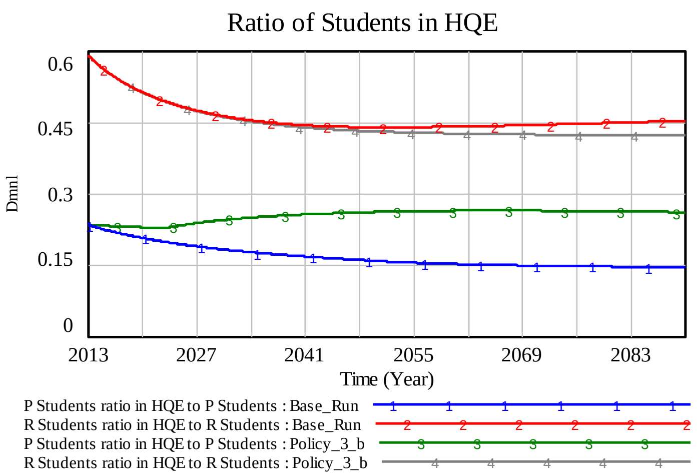


Figure 7.76. The ratio of students in HQE for the poor and rich under the Policy_3_b.

The results of this policy analysis are similar with the results of the Policy_3_a (see Figures 7.77, 7.78 and 7.79).

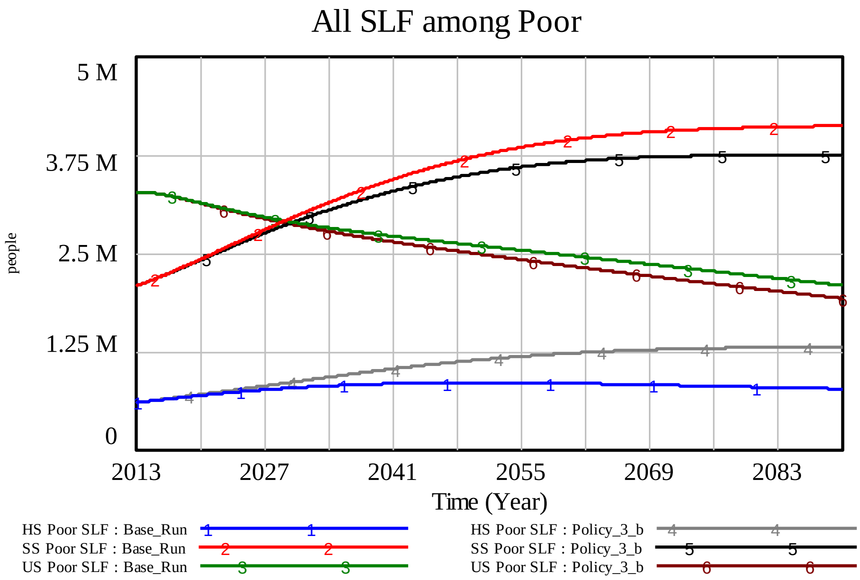


Figure 7.77. All SLF among the poor under the Policy_3_b.

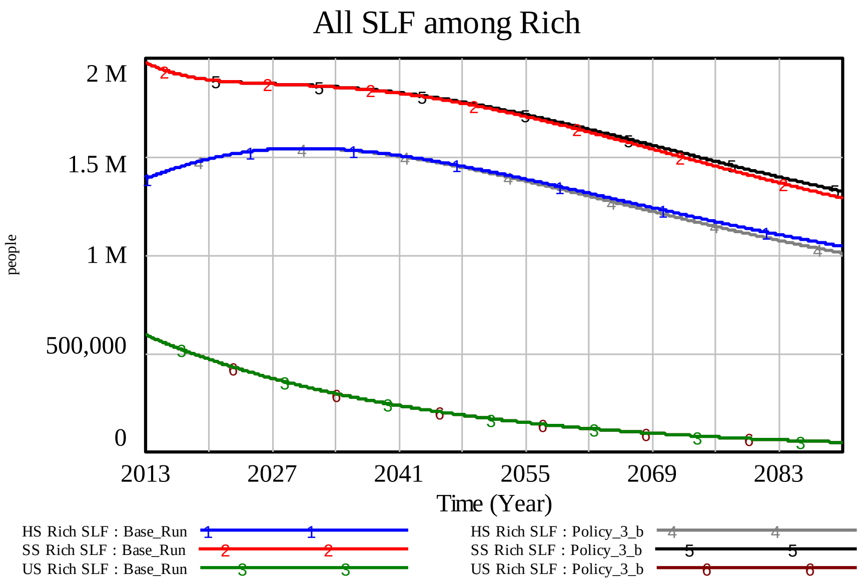


Figure 7.78. All SLF among the rich under the Policy_3_b.

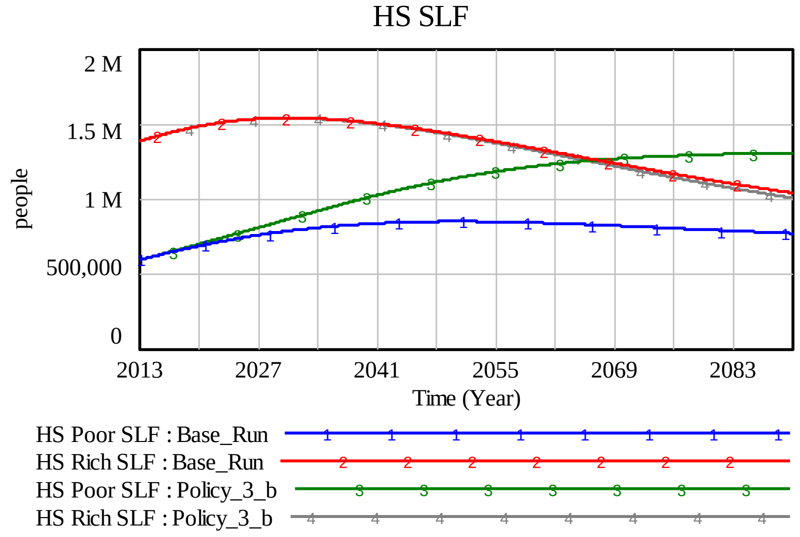


Figure 7.79. Highly skilled SLF among the poor and rich under the Policy_3_b.

The annual average salaries of the poor and rich are provided in Figure 7.80. Although the quota proposal under this policy is higher than it is under the Policy_3_a, there is still slight increase in the annual average salary of the poor, whereas the annual average salary of the rich stagnates at its initial value. The reasons behind the slight decrease in the annual average salary of the poor are explained in detail previously. The gap between their salaries starts to decrease after the 2023s (see Figure 7.81).

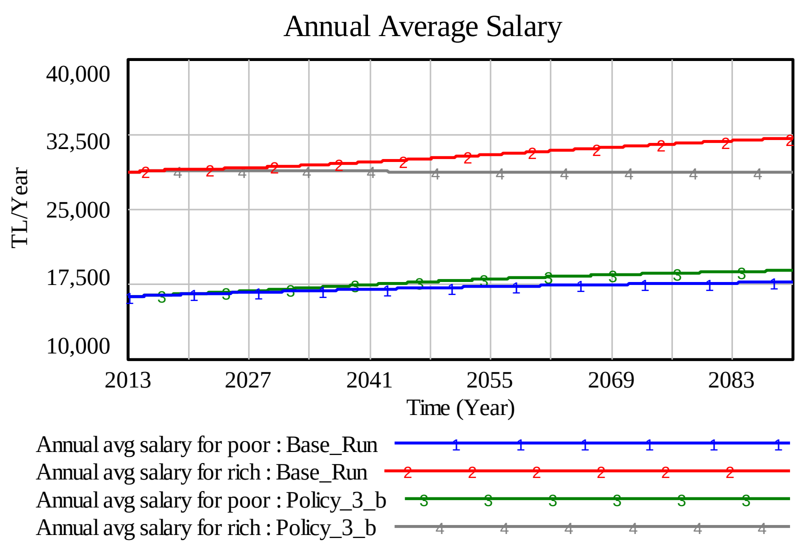


Figure 7.80. The annual average salaries of the poor and rich under the Policy_3_b.

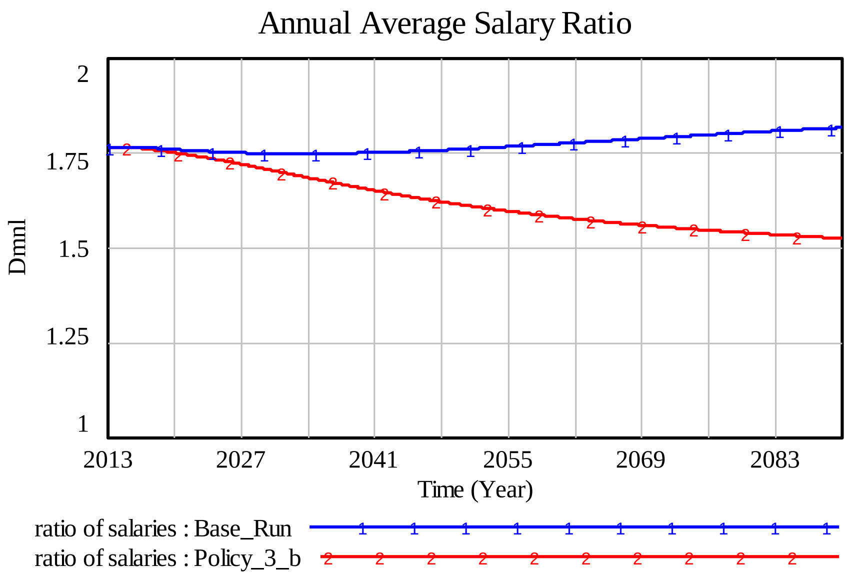


Figure 7.81. The ratio of annual average salaries under the Policy_3_b.

<u>7.2.3.3. Policy 3_c: Quota Proposal for the Poor in Privatized Education and Funding for Privatized Education Fees under the Horizontal Employment Hierarchy.</u> For this policy analysis, the quota proposal and funding for privatized education to the poor are applied under the horizontal hiring process. With the help of funding for the privatized education fees and quota proposal for the poor, the highly skilled salaried labor force population increases compared to the base run. On the other hand, there is a decrease in the rich's highly skilled salaried labor force, whereas the semi-skilled salaried labor force among the rich increases. Compared to the Policy_3_b, there are differences in the labor market of the rich because of the change in the hiring process. According to this policy results, there is an increase in the annual average salary of the poor compared to the base run and also to the Policy_3_b. All related figures are provided in Appendix D.

### 7.2.4. Policy 4: Quota Proposal for the Poor in Privatized Education, Funding for Privatized Education Fees and New Jobs for the Poor

According to the results of the first-three-education policy analysis, the poor cannot break the cycle of poverty just with the help of access to education opportunities. In addition, the unemployment ratio of the poor is persistent in most of the policy experiments. There is a need to apply more policies, which are aimed to alleviate poverty with also increasing in employment sector among the poor. There could be education policies that are also proposed along with the improvement in the employment market among the poor. Therefore, the fourth policy is suggested to this problem, which is the stagnation at low level of the poor's annual average salary. For this policy analysis, the quota proposal and funding for privatized education to the poor are applied with an increase in jobs for poor.

7.2.4.1. Policy 4_a: 50% Quota Proposal for the Poor in Privatized Education, Funding for Privatized Education Fees and 10% Increase in Jobs for the Poor. In this policy experiment, there is a 50% quota proposal for the poor, which means to reserve 25% of the quota in high-quality education for the poor. In addition to the quota proposal, there is funding for the privatized education fees for the poor in 2023, which is assumed to be 50% of the annual average of privatized education fees. Furthermore, there is a 10% increase in the employment sector among the poor, which is applied in 2023.

With the help of this policy, the highly skilled salaried labor force population increases compared to the base run (see Figure 7.82). On the other hand, there is no change in the rich's salaried labor force market, as expected (see Figure 7.83).

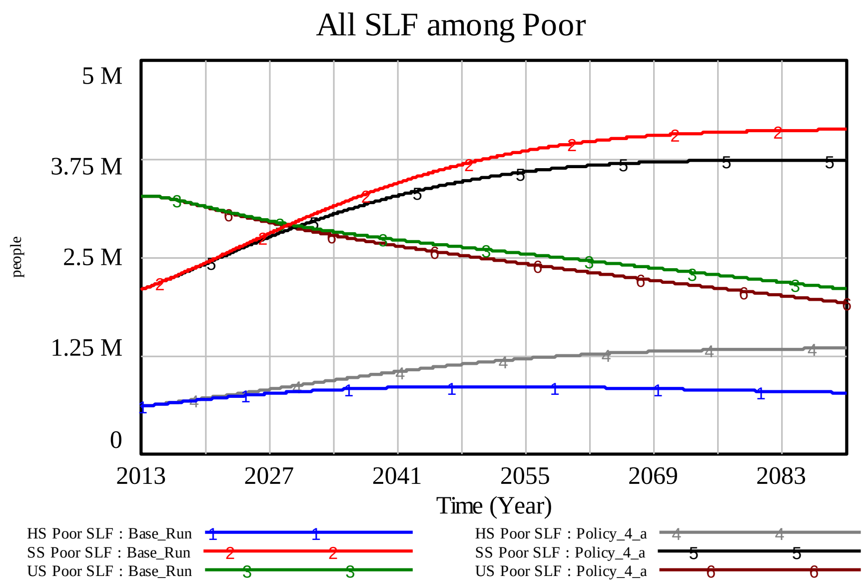


Figure 7.82. All SLF among the poor under the Policy_4_a.

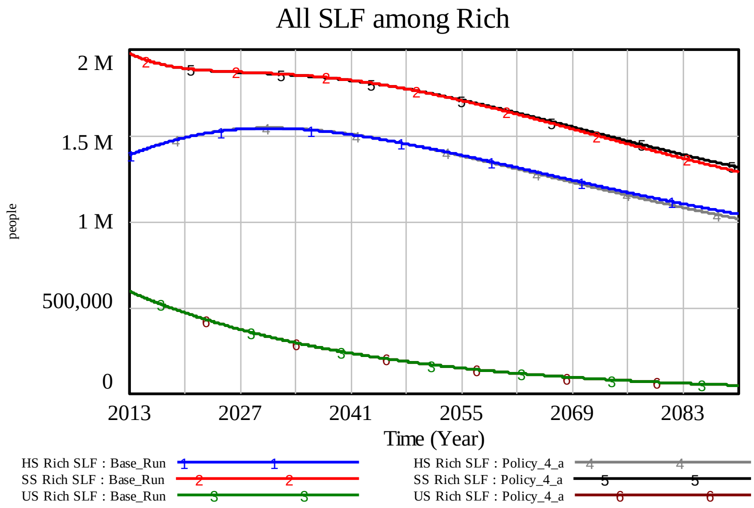


Figure 7.83. All SLF among the rich under the Policy_4_a.

According to the results of this policy, there is an increase in the annual average salary of the poor compared to the base run and also to the Policy_3_b (see Figure 7.84). The gap between the annual average salary of the poor and rich decreases after 2023 (see Figure 7.85). Although the gap between their salaries decreases increasingly, this does not imply that the poverty cycle is broke down for the poor. The decrease in this gap is also a result of the decrease in the rich's annual average salary.

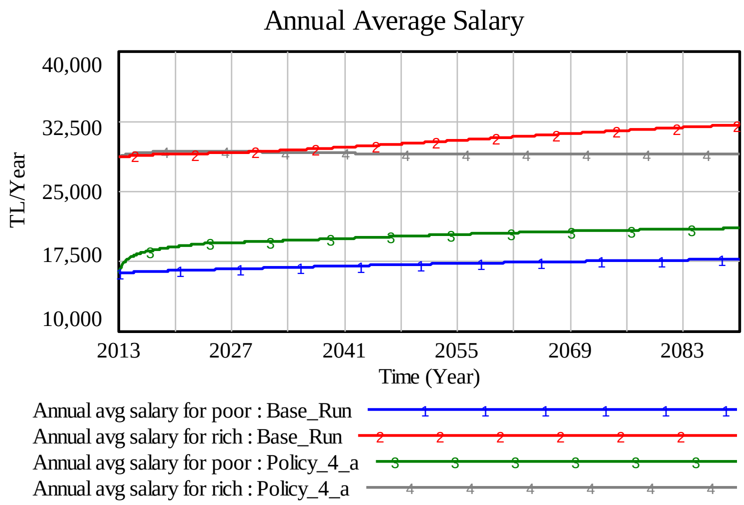


Figure 7.84. The annual average salaries of the poor and rich under the Policy_4_a.

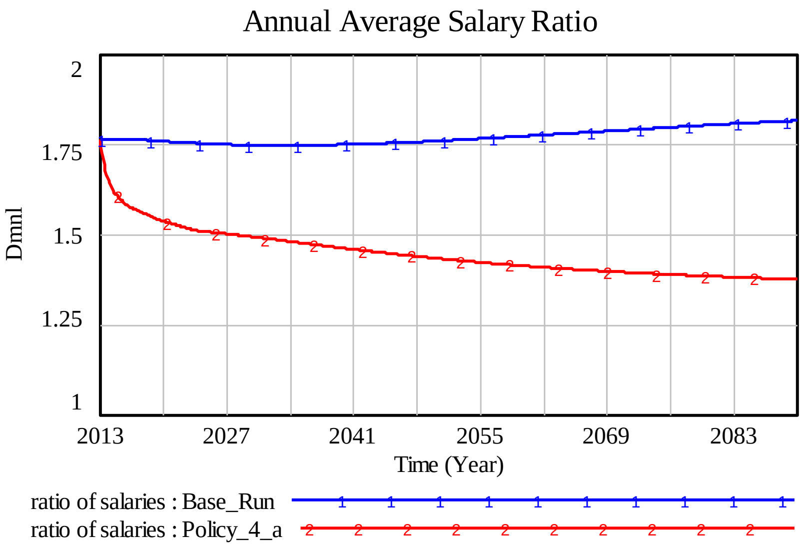


Figure 7.85. The ratio of annual average salaries under the Policy_4_a.

Here, the total and poor unemployment ratios decrease due to the increase in jobs for the poor. Although the unemployment ratio of poor is higher than the rich's unemployment ratio, it is significantly at low level compared to the base run (see Figure 7.86).

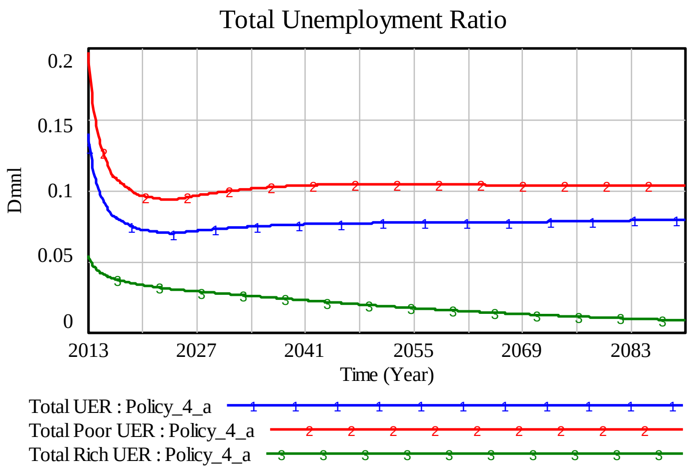


Figure 7.86. All unemployment ratios under the Policy_4_a.

<u>7.2.4.2. Policy 4_b: 50% Quota Proposal for the Poor in Privatized Education, Funding for Privatized Education Fees and 20% Increase in Jobs for the Poor.</u> In this policy experiment, there is a 50% quota proposal for the poor, which means to reserve 25% of the

quota in high-quality education for the poor. In addition to the quota proposal, there is funding for the privatized education fees for the poor in 2023, which is assumed to be 50% of the annual average of privatized education fees. Furthermore, there is a 20% increase in the employment sector among the poor, which is applied in 2023.

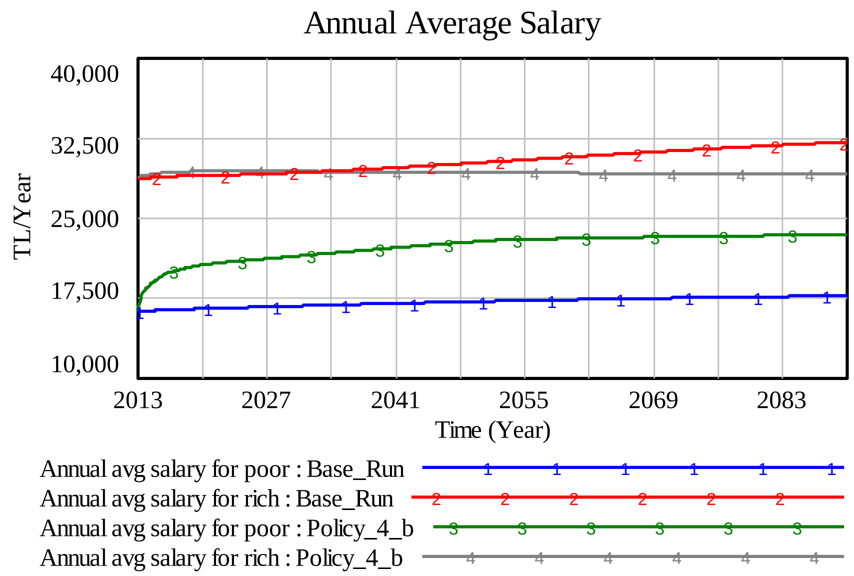


Figure 7.87. The annual average salaries of the poor and rich under the Policy_4_b.

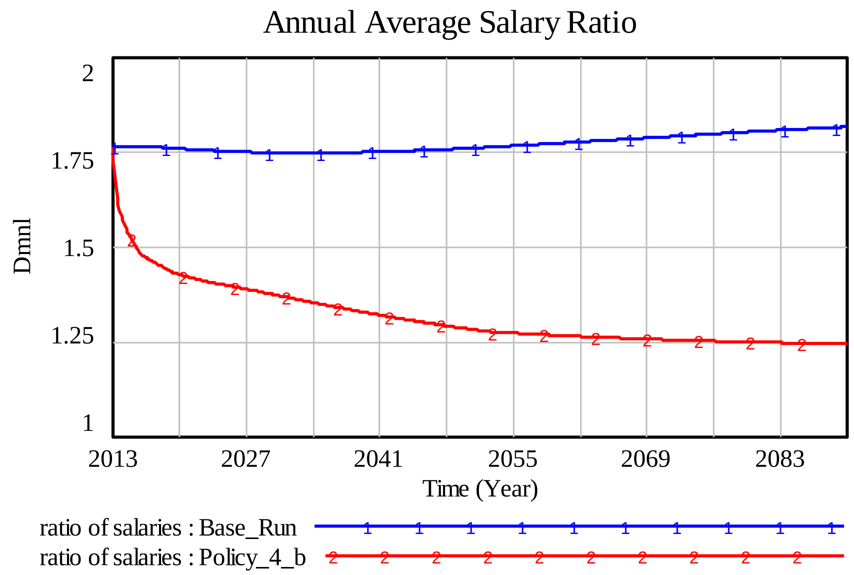


Figure 7.88. The ratio of annual average salaries under the Policy_4_b.

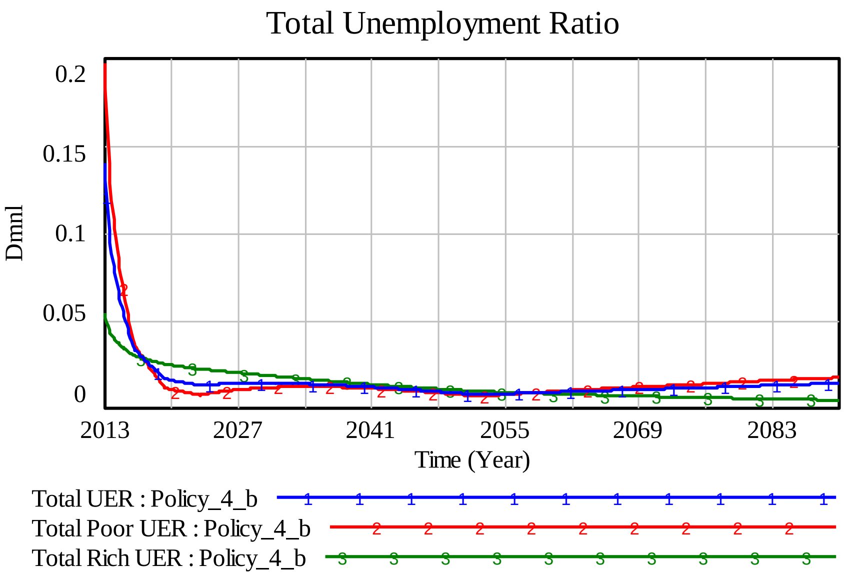


Figure 7.89. All unemployment ratios under the Policy_4_b.

# 8. CONCLUSION

The purpose of this study can be defined at two levels. First, it aims to build a generic system dynamics model for a particular form of poverty resulting from interactions between two fundamental structures in Turkey: inequality to access education at all levels due to privatization, and a growing polarization in the labor market between unskilled or semi-skilled and highly skilled jobs. Secondly, considering growing interest in and discussion of this issue in the literature; the model seeks to examine some policy options aimed at alleviating or combating the above working poverty.

Quality of employment is critical to tackle working poverty. The high capability to reach education services and equality in education opportunities are priorities for high skilled jobs. The causal relationship between employment and education services should be emphasized while arranging social policies, since quality of employment is a significant factor in working poverty. Lack of equal access to high quality education can potentially play a major role in causing a viscous cycle of poverty over successive generations of poor families. Therefore, the model is also deployed to answer the essential question behind the policy examination: can there be a break in the poverty cycle in a couple of generations?

The constructed model is first tested by a series of structural and behavioral credibility tests. At the end of these tests, it is shown that the credibility of the model is adequate. Subsequent results of the scenario and policy experiments with the model show that there is not a significant change in annual average salary of the poor; except in policies where there is a radical quota in private education and funding for private education fees for the poor. In some policies; even if there is an increase in quota in high-quality education for the poor, the annual average salary of the poor stagnates at low levels. Increasing only the net job growth rate is not the solution for the poverty cycle either. There may be decreases in the unemployment ratio of poor, but their annual average salary still stays much lower than it is for the rich. Also, the poor unemployment ratio is higher than the unemployment ratio of the rich in most scenarios. There could be different behaviors of the unemployment ratios with a different approach for choices of the employment sector, as is discussed in the first scenario. The first scenario works in a horizontal hiring process or horizontal employment hierarchy. In other words, all skill levels of the labor force first secure all jobs at their respective levels, which is opposite to how it is in the base run (where a high skill employee has higher priority if s/he applies for a job at a lower qualification level). The horizontal employment hierarchy changes the dynamics of the unemployment ratios of the poor and rich in the employment sector. The unemployment ratio of the rich becomes higher than the poor's unemployment ratio. However, the primary concern still exists; there is stagnation for the poor at a low level of annual average salary. The reality of the employment market may be between these two; between the base (vertical hiring hierarchy) scenario and the horizontal hiring scenario.

The results of the simulation model clearly show that the risk of working poverty is significant. There is a strong inertia of the stagnation at low income among the poor families. It is very hard to change their annual average salary significantly in a couple of generations. This is in part caused by an economic problem at the beginning that is the initial inequality in income distribution. It sends a clear message to policy makers; besides the increase in net job growth rate, equalizing education opportunities is one of the key necessities for combating working poverty. Notably, with the increase in education opportunities, there is decrease in annual average salary of the rich, in addition to an increase in the average salary of the poor. This is because of increasing competition among the highly skilled labor forces market. Interestingly, this side effect of poor-oriented policies on the rich salaries is stronger than its effect on poor salaries in most cases.

Policies that rely on reducing private education only do not have strong effect on the salary gap between the rich and the poor. On the other hand, policies that reserve quota (50%) for the poor in privatized education and funding (50%) for education fees for the poor do have noteworthy effect on reducing the salary gap. Finally, a radical policy that significantly increases the average salary of the poor (hence substantially reduces the salary gap) is: 'quota (50%) for the poor in privatized education, funding (50%) for education fees for the poor and new jobs (10%, 25%) reserved for the poor'.

The inequality in education opportunity must be addressed by social policy arrangements in Turkey. The equality of education opportunities means that offering high-quality knowledge and skills in schools irrespective of socioeconomic level, making sure those individuals from disadvantaged backgrounds have access to high quality schools. The model shows in its boundary, that there is very weak chance for intergenerational socioeconomic upward mobility without strong measures for equality of opportunity in education [10]

There is also a vital statement in the UNESCO's report called "Education for All (EFA)": "The good policies in the education sector cannot compensate for weak policies on poverty reduction or for the failure of political leaders to tackle extreme inequality" [41]. It should be remarked that poverty reduction is a long-term process, social policies should be in a long-term perspective, and flexible enough to respond to emerging needs [42]. According to the simulation results, using a single policy instrument to decrease poverty is not sufficient; integrated, multi-dimensional policies have a much better chance of success. There should be not only social assistance programs, but also opportunities providing education and training support which leads to increase in productivity, and therefore earnings [43]. These policies should be applied in a coordinated way.

As future research, job growth rate could be affected by changes in the labor market in the model with regard to the endogenous macroeconomic growth theory. Also, entrepreneurs, employers may be included in the labor market segment of the model, again influencing economic growth. Moreover, adding a taxation process and a government budget for education expenses would enrich the model. Thereby, there may be different taxation regulations/policies for education expenses for the poor and rich. Scenarios about inequality in income distribution, and policies on the redistribution of income may also be tested in an enhanced version of the model. Mobility between the poor and rich families could be included to the model. In other words, movements among the higher skill levels can be introduced to the model. Finally, the birth fractions of the poor and rich and also their enrollment fractions to public high-quality education could be affected by their annual average salaries in an enhanced model.

# APPENDIX A: MODEL EQUATIONS

access to SS jobs for unemployed HS poor= IF THEN ELSE( potential unemployed hs poor>0 , IF THEN ELSE(total potential unemployment among HS>0, potential unemployed hs poor min((SS jobs/total potential unemployment among HS), 1), 0), 0)
Units: jobs
access to SS jobs for unemployed HS rich=IF THEN ELSE( potential unemployed hs rich>0, IF THEN ELSE(total potential unemployment among HS>0, potential unemployed hs rich*min((SS jobs/total potential unemployment among HS),1), 0 ), 0)
Units: jobs
access to US jobs for unemployed SS poor=IF THEN ELSE( potential unemployed ss poor>0, IF THEN ELSE(total potential unemployment among SS>0, potential unemployed ss poor* min((US jobs/total potential unemployment among SS),1), 0), 0) Units: jobs
access to US jobs for unemployed SS rich=IF THEN ELSE( potential unemployed ss rich>0, IF THEN ELSE(total potential unemployment among SS>0, potential unemployed ss rich*min((US jobs/total potential unemployment among SS),1), 0 ),0)
Units: jobs
"actual # of ss jobs"=SS jobs-total access to SS jobs for unemployed HS
Units: jobs
"actual # of us jobs"=US jobs-total access to US jobs for unemployed SS
Units: jobs
Actual HS Employed Poor=Potential HS Employed Poor
Units: people
Actual HS Employed Rich=Potential HS Employed Rich
Units: people
Actual SS Employed Poor=Potential SS Employed Poor+access to SS jobs for unemployed HS poor
Units: people
Actual SS Employed Rich=Potential SS Employed Rich+access to SS jobs for unemployed HS rich
Units: people
Actual Unemployment among HS poor=potential unemployed hs poor-access to SS jobs for unemployed HS poor
Units: people
Actual Unemployment among HS rich=potential unemployed hs rich-access to SS jobs for unemployed HS rich
Units: people
Actual Unemployment among SS poor=potential unemployed ss poor-access to US jobs for unemployed SS poor
Units: people

Actual Unemployment among SS rich=potential unemployed ss rich-access to US jobs for unemployed SS rich
Units: people
Actual Unemployment among US poor=potential unemployed us poor
Units: people
Actual Unemployment among US rich=potential unemployed us rich
Units: people
Actual US Employed Poor=Potential US Employed Poor+access to US jobs for unemployed SS poor
Units: people
Actual US Employed Rich=Potential US Employed Rich+access to US jobs for unemployed SS rich
Units: people
aff ratio of priv edu for poor=Annual avg salary for poor/Annual avg education fees
Units: Dmnl
affratio of priv edu for rich=Annual avg salary for rich/Annual avg education fees
Units: Dmnl
"Age Group (0-14) among Poor"=Poor Chl
Units: people
"Age Group (0-14) among Rich"=Rich Chl
Units: people
"Age Group (15-24) among Poor"=P Students in HQE+P Students in LQE+Child Labor
Units: people
"Age Group (15-24) among Rich"=R Students in HQE+R Students in LQE
Units: people
"Age Group (25-54) among Poor"=HS Poor+SS Poor+US Poor
Units: people
"Age Group (25-54) among Rich"=HS Rich+SS Rich+US Rich
Units: people
"Age Group (55+) among Poor"=Retired HS Poor+Retired SS Poor+Retired US Poor
Units: people
"Age Group (55+) among Rich"=Retired US Rich+Retired SS Rich+Retired HS Rich
Units: people
Annual avg education fees=20000
Units: TL/Year
Annual avg salary for poor=((Actual HS Employed Poor*annual avg salary per HS emp)+(Actual SS Employed Poor*annual avg salary per SS emp)+(Actual US Employed Poor*annual avg salary per US emp))/(Total Poor SLF)
Units: TL/Year
Annual avg salary for rich=((Actual HS Employed Rich*annual avg salary per HS emp)+(Actual SS Employed Rich*annual avg

salary per SS emp)+(Actual US Employed Rich*annual avg salary per US emp))/(Total Rich SLF)
Units: TL/Year
annual avg salary per HS emp=4500*12
Units: TL/Year People
annual avg salary per SS emp=2000*12
Units: TL/Year People
annual avg salary per US emp=1000*12
Units: TL/Year People
Available Total Jobs= INTEG (net job growth rate, 1.28e+007*0+1.35e+007*0+1.4166e+007)
Units: jobs
Available Total Salaried Jobs=Available Total Jobs*salaried job ratio
Units: jobs
avg working time=30
Units: Year
base fr=1/15
Units: 1/Year
birth fr for poor chl= WITH LOOKUP (Time,([(2013,0)-(2090,0.04)],(2013,0.018959),(2014,0.018687),(2015,0.018428),(2016,0.018179),(2017,0.017943),(2018,0.017695),(2019,0.017447),(2020,0.017223),(2021,0.016998),(2022,0.016774),(2023,0.016549),(2024,0.016313),(2025,0.016136),(2026,0.015923),(2027,0.015711),(2028,0.015498),(2029,0.015285),(2030,0.015073),(2031,0.01486),(2032,0.014648),(2033,0.014435),(2034,0.014222),(2035,0.014021),(2036,0.013821),(2037,0.013632),(2038,0.013454),(2039,0.013277),(2040,0.013112),(2041,0.012947),(2042,0.012805),(2043,0.012651),(2044,0.012521),(2045,0.01238),(2046,0.012261),(2047,0.012131),(2048,0.012013),(2049,0.011895),(2050,0.011777),(2051,0.011671),(2052,0.011671),(2053,0.011659),(2054,0.011659),(2055,0.011647),(2056,0.011635),(2057,0.011624),(2058,0.011612),(2059,0.011588),(2060,0.011576),(2061,0.011553),(2062,0.011529),(2063,0.011517),(2064,0.011494),(2065,0.01147),(2066,0.011446),(2067,0.011423),(2068,0.011399),(2069,0.011375),(2070,0.011364),(2071,0.011352),(2072,0.01134),(2073,0.011328),(2074,0.011328),(2075,0.011328),(2090,0.01133) ))
Units: 1/Year
birth fr for rich chl= WITH LOOKUP (Time,([(2013,0)-(2090,0.08)],(2013,0.00948),(2014,0.009344),(2015,0.009214),(2016,0.00909),(2017,0.008972),(2018,0.008848),(2019,0.008724),(2020,0.008611),(2021,0.008499),(2022,0.008387),(2023,0.008275),(2024,0.008157),(2025,0.008068),(2026,0.007962),(2027,0.007855),(2028,0.007749),(2029,0.007643),(2030,0.007536),(2031,0.00743),(2032,0.007324),(2033,0.007217),(2034,0.007111),(2035,0.007011),(2036,0.00691),(2037,0.006816),(2038,0.006727),(2039,0.006639),(2040,0.006556),(2041,0.006473),(2042,0.006402),(2043,0.006326),(2044,0.006261),(2045,0.00619),(2046,0.006131),(2047,0.006066),(2048,0.006007),(2049,0.005948),(2050,0.005889),(2051,0.005835),(2052,0.005829),(2053,0.005824),(2054,0

.005818),(2055,0.005812),(2056,0.005806),(2057,0.005812),(2058,0.005806),(2059,0.005794),(2060,0.005788),(2061,0.005776),(2062,0.005765),(2063,0.005759),(2064,0.005747),(2065,0.005735),(2066,0.005723),(2067,0.005711),(2068,0.0057),(2069,0.005688),(2070,0.005682),(2071,0.005676),(2072,0.00567),(2073,0.005664),(2074,0.005664),(2075,0.005664
),(2090,0.005664) ))
Units: 1/Year
Child Labor= INTEG (dropouts to CL+working rate as CL-working rate,395000)
Units: people
death fr for poor= WITH LOOKUP (Time,([(2013,0)-(2090,0.4)],(2013,0.027),(2014,0.0273),(2015,0.0276),(2016,0.028),(2017,0.0283),(2018,0.0287),(2019,0.029),(2020,0.0293),(2021,0.0297),(2022,0.0301),(2023,0.0315),(2050,0.0355),(2075,0.045),(2090,0.045) ))
Units: 1/Year
death fr for rich= WITH LOOKUP (Time, ([(2013,0)-(2090,0.04)],(2013,0.0135),(2014,0.0136),(2015,0.0138),(2016,0.014),(2017,0.0142),(2018,0.0143),(2019,0.0145),(2020,0.0147),(2021,0.0149),(2022,0.015),(2023,0.0152),(2050,0.01855),(2075,0.0225),(2090,0.0225) ))
Units: 1/Year
del=1
Units: Year
drop fr from PHQE=1e-005
Units: Dmnl
drop fr from PLQE=0.04
Units: Dmnl
drop fr from RHQE=1e-006
Units: 1/Year
drop fr from RLQE=1e-005
Units: Dmnl
dropouts from PHQE= (P Students in HQE*drop fr from PHQE)
Units: people/Year
dropouts from PLQE=drops*(1-growth fr)
Units: people/Year
dropouts from RHQE=(R Students in HQE*drop fr from RHQE)
Units: people/Year
dropouts from RLQE=(R Students in LQE*drop fr from RLQE)
Units: people/Year
dropouts to CL=drops*growth fr
Units: people/Year
drops=P Students in LQE*drop fr from PLQE
Units: people
eff of poor aff=LOOKUP EXTRAPOLATE(graph of aff, (aff ratio of priv edu for poor/normalized aff ratio))
Units: Dmnl
effof rich aff=LOOKUP EXTRAPOLATE(graph of aff, (affratio of priv edu for rich/normalized aff ratio))

```
Units: Dmnl
enroll fr among poor=Poor HQ public edu fr+Poor HQ privedu fr
Units: Dmnl
enroll fr among rich=Rich HQ public edu fr+Rich HQ priv edu
fr
Units: Dmnl
enroll rate to PHQE=Poor Chl*base fr*enroll fr among poor
Units: people/Year
enroll rate to PLQE=Poor Chl*base fr*(1-(enroll fr among
poor+fr of CL))
Units: people/Year
enroll rate to RHQE=Rich Chl*base fr*enroll fr among rich
Units: people/Year
enroll rate to RLQE=Rich Chl*base fr*(1-enroll fr among rich)
Units: people/Year
FINAL TIME  = 2090
Units: Year
fr of CL=0.005
Units: Dmnl
fr of highly skilled jobs=0.2
Units: Dmnl
"fr of semi-skilled jobs"=0.35
Units: Dmnl
fr of unskilled jobs=0.45
Units: Dmnl
grad fr= WITH LOOKUP (Time,([(2013,0.06)-
(2090,0.2)],(2013,0.071),(2023,0.077),(2050,0.083),(2075,0.09
09),(2090,0.1) ))
Units: 1/Year
grad rate from PHQE=P Students in HQE*grad fr
Units: people/Year
grad rate from PLQE=P Students in LQE*grad fr
Units: people/Year
grad rate from RHQE=
R Students in HQE*grad fr
Units: people/Year
grad rate from RLQE=
R Students in LQE*grad fr
Units: people/Year
graph of
aff([(0,0)(3,2)],(0,0),(0.394495,0.0350877),(0.633027,0.25438
6),(0.816514,0.54386),(0.908257,0.789474),(1,1),(1.11927,1.20
175),(1.26605,1.35965),(1.51376,1.55263),(1.75229,1.67544),(2
,1.75),(3,1.75))
Units: Dmnl
growth fr=1/3
Units: 1/Year
growth time=3
Units: Year
```

HS jobs=Available Total Salaried Jobs*fr of highly skilled jobs
Units: jobs
HS LF ratio=Total HS SLF/Total SLF
Units: Dmnl
HS Poor= INTEG (grad rate from PHQE-retirement rate of PHS emp,987500)
Units: people
HS Poor LF ratio=HS Poor SLF/Total Poor SLF
Units: Dmnl
HS Poor SLF=HS Poor*SLF ratio
Units: people
HS Rich= INTEG (grad rate from RHQE-retirement rate of RHS emp,2.30417e+006)
Units: people
HS Rich LF ratio=HS Rich SLF/Total Rich SLF
Units: Dmnl
HS Rich SLF=HS Rich*SLF ratio
Units: people
LFgrowthfr=("smoothrate-p1"+"smoothrate-p2"+"smoothrate-p3"+"smoothrate-r1"+"smoothrate-r2"+"smoothrate-r3")/Total Labor Force
Units: 1/Year
net growth rate of poor chl=Total Poor Population*birth fr for poor chl
Units: people/Year
net growth rate of rich chl=Total Rich Population*birth fr for rich chl
Units: people/Year
net job growth fr=LFgrowthfr
Units: 1/Year
net job growth rate=Available Total Jobs*net job growth fr
Units: jobs/Year
normalized aff ratio=1.3
Units: Dmnl
P Students in HQE= INTEG ( enroll rate to PHQE-grad rate from PHQE-dropouts from PHQE,800000)
Units: people
P Students in LQE= INTEG (enroll rate to PLQE-dropouts from PLQE-dropouts to CL-grad rate from PLQE,2.61253e+006)
Units: people
P Students ratio in HQE to P Students=P Students in HQE/Total Poor Students
Units: Dmnl
P Students ratio in LQE to P Students=P Students in LQE/Total Poor Students
Units: Dmnl
PLF ratio=Total Poor SLF/Total SLF
Units: Dmnl

Poor Chl= INTEG (net growth rate of poor chl-enroll rate to PHQE-enroll rate to PLQE-working rate as CL,6.22044e+006)
Units: people
Poor HQ priv edu base fr=0.12
Units: Dmnl
Poor HQ privedu fr=Privatization*eff of poor aff*Poor HQ priv edu base fr
Units: Dmnl
Poor HQ public edu base fr=0.2
Units: Dmnl
Poor HQ public edu fr=(1-Privatization)*Poor HQ public edu base fr
Units: Dmnl
Potential HS Employed Poor=HS Poor SLF*min((HS jobs/Total HS SLF),1)
Units: people
Potential HS Employed Rich=HS Rich SLF*min((HS jobs/Total HS SLF),1)
Units: people
Potential SS Employed Poor=SS Poor SLF*min(("actual # of ss jobs"/Total SS SLF),1)
Units: people
Potential SS Employed Rich=SS Rich SLF*min(("actual # of ss jobs"/Total SS SLF),1)
Units: people
potential unemployed hs poor=HS Poor SLF-Potential HS Employed Poor
Units: people
potential unemployed hs rich=HS Rich SLF-Potential HS Employed Rich
Units: people
potential unemployed ss poor=SS Poor SLF-Potential SS Employed Poor
Units: people
potential unemployed ss rich=SS Rich SLF-Potential SS Employed Rich
Units: people
potential unemployed us poor=US Poor SLF-Potential US Employed Poor
Units: people
potential unemployed us rich=US Rich SLF-Potential US Employed Rich
Units: people
Potential Unemployment among Poor=Total Poor SLF-Total Potential Employment among Poor
Units: people
Potential Unemployment among Rich=Total Rich SLF-Total Potential Employment among Rich
Units: people

Potential Unemployment Ratio for Poor=Potential Unemployment among Poor/Total SLF
Units: Dmnl
Potential Unemployment Ratio for Rich=Potential Unemployment among Rich/Total SLF
Units: Dmnl
Potential US Employed Poor=US Poor SLF*min(("actual # of us jobs"/Total US SLF),1)
Units: people
Potential US Employed Rich=US Rich SLF*min(("actual # of us jobs"/Total US SLF),1)
Units: people
Privatization= WITH LOOKUP (Time,([(2013,0)-(2090,1)],(2013,0.4),(2019.12,0.45614),(2028.07,0.508772),(2039.14,0.557018),(2050,0.6),(2072.63,0.6),(2090,0.6) ))
Units: Dmnl
PTAE ratio=Total Actual Employment among Poor/Total SLF
Units: Dmnl
PTAU ratio=Total Actual Unemployment among Poor/Total SLF
Units: Dmnl
R Students in HQE= INTEG (enroll rate to RHQE-dropouts from RHQE-grad rate from RHQE,1.5e+006)
Units: people
R Students in LQE= INTEG (enroll rate to RLQE-dropouts from RLQE-grad rate from RLQE,1.03835e+006)
Units: people
R Students ratio in HQE to R Students=R Students in HQE/Total Rich Students
Units: Dmnl
R Students ratio in LQE to R Students=R Students in LQE/Total Rich Students
Units: Dmnl
"rate-p1"=(dropouts from PHQE+dropouts from PLQE+working rate)-(retirement rate of PUS emp)
Units: people/Year
"rate-p2"=(grad rate from PLQE)-(retirement rate of PSS emp)
Units: people/Year
"rate-p3"=grad rate from PHQE-retirement rate of PHS emp
Units: people/Year
"rate-r1"=(dropouts from RHQE+dropouts from RLQE)-(retirement rate of RUS emp)
Units: people/Year
"rate-r2"=(grad rate from RLQE)-(retiremet rate of RSS emp)
Units: people/Year
"rate-r3"=(grad rate from RHQE)-(retirement rate of RHS emp)
Units: people/Year
ratep1=("rate-p1"-"smoothrate-p1")/del
Units: people/Year
ratio of salaries=Annual avg salary for rich/Annual avg salary for poor

Units: Dmnl
Retired HS Poor= INTEG (retirement rate of PHS emp-RHSP death rate,549330)
Units: people
Retired HS Rich= INTEG (retirement rate of RHS emp-RHSR death rate,1.10976e+006)
Units: people
Retired SS Poor= INTEG (retirement rate of PSS emp-RSSP death rate,1.72124e+006)
Units: people
Retired SS Rich= INTEG (retiremet rate of RSS emp-RSSR death rate,887807)
Units: people
Retired US Poor= INTEG (retirement rate of PUS emp-RUSP death rate,1.39164e+006)
Units: people
Retired US Rich= INTEG (retirement rate of RUS emp-RUSR death rate,443903)
Units: people
retirement rate of PHS emp=HS Poor/avg working time
Units: people/Year
retirement rate of PSS emp=SS Poor/avg working time
Units: people/Year
retirement rate of PUS emp=US Poor/avg working time
Units: people/Year
retirement rate of RHS emp=HS Rich/avg working time
Units: people/Year
retirement rate of RUS emp=US Rich/avg working time
Units: people/Year
retiremet rate of RSS emp=SS Rich/avg working time
Units: people/Year
RHSP death rate=Retired HS Poor*death fr for poor
Units: people/Year
RHSR death rate=Retired HS Rich*death fr for rich
Units: people/Year
Rich Chl= INTEG (net growth rate of rich chl-enroll rate to RHQE-enroll rate to RLQE3.20447e+006)
Units: people
Rich HQ priv edu base fr=0.4
Units: Dmnl
Rich HQ priv edu fr=Privatization*effof rich aff*Rich HQ priv edu base fr
Units: Dmnl
Rich HQ public edu base fr=0.35
Units: Dmnl
Rich HQ public edu fr=(1-Privatization)*Rich HQ public edu base fr
Units: Dmnl
RLF ratio=Total Rich SLF/Total SLF
Units: Dmnl

RSSP death rate=Retired SS Poor*death fr for poor
Units: people/Year
RSSR death rate=Retired SS Rich*death fr for rich
Units: people/Year
RTAE ratio=Total Actual Employment among Rich/Total SLF
Units: Dmnl
RTAU ratio=Total Actual Unemployment among Rich/Total SLF
Units: Dmnl
RUSP death rate=Retired US Poor*death fr for poor
Units: people/Year
RUSR death rate=Retired US Rich*death fr for rich
Units: people/Year
SS jobs=Available Total Salaried Jobs*"fr of semi-skilled jobs"
Units: jobs
SS LF ratio=Total SS SLF/Total SLF
Units: Dmnl
SS Poor= INTEG (grad rate from PLQE-retirement rate of PSS emp,3.45625e+006)
Units: people
SS Poor LF ratio=SS Poor SLF/Total Poor SLF
Units: Dmnl
SS Poor SLF=SS Poor*SLF ratio
Units: people
SS Rich= INTEG (grad rate from RLQE-retiremet rate of RSS emp,3.29167e+006)
Units: people
SS Rich LF ratio=SS Rich SLF/Total Rich SLF
Units: Dmnl
SS Rich SLF=SS Rich*SLF ratio
Units: people
TAE ratio=Total Actual Employment/Total SLF
Units: Dmnl
TAU ratio=Total Actual Unemployment/Total SLF
Units: Dmnl
total access to SS jobs for unemployed HS=access to SS jobs for unemployed HS poor+access to SS jobs for unemployed HS rich
Units: jobs
total access to US jobs for unemployed SS=access to US jobs for unemployed SS poor+access to US jobs for unemployed SS rich
Units: jobs
Total Actual Employment=Total Actual Employment among Poor+Total Actual Employment among Rich
Units: people
Total Actual Employment among Poor=Actual HS Employed Poor+Actual SS Employed Poor+Actual US Employed Poor
Units: people

Total Actual Employment among Rich=Actual HS Employed Rich+Actual SS Employed Rich+Actual US Employed Rich
Units: people
Total Actual Unemployment=Total Actual Unemployment among HS+Total Actual Unemployment among SS+Total Actual Unemployment among US
Units: people
Total Actual Unemployment among HS=total potential unemployment among HS-total access to SS jobs for unemployed HS
Units: people
Total Actual Unemployment among Poor=Actual Unemployment among HS poor+Actual Unemployment among SS poor+Actual Unemployment among US poor
Units: people
Total Actual Unemployment among Rich=Actual Unemployment among HS rich+Actual Unemployment among SS rich+Actual Unemployment among US rich
Units: people
Total Actual Unemployment among SS=total potential unemployment among SS-total access to US jobs for unemployed SS
Units: people
Total Actual Unemployment among US=total potential unemployment among US
Units: people
"Total Age Group (0-14)"="Age Group (0-14) among Poor"+"Age Group (0-14) among Rich"
Units: people
"Total Age Group (15-24)"="Age Group (15-24) among Poor"+"Age Group (15-24) among Rich"
Units: people
"Total Age Group (25-54)"="Age Group (25-54) among Poor"+"Age Group (25-54) among Rich"
Units: people
"Total Age Group (55+)"="Age Group (55+) among Poor"+"Age Group (55+) among Rich"
Units: people
Total HS SLF=HS Poor SLF+HS Rich SLF
Units: people
Total Labor Force=Total SLF/SLF ratio
Units: people
Total Poor Population="Age Group (0-14) among Poor"+"Age Group (15-24) among Poor"+"Age Group (25-54) among Poor" +"Age Group (55+) among Poor"
Units: people
Total Poor SLF=HS Poor SLF+SS Poor SLF+US Poor SLF
Units: people
Total Poor Students=P Students in HQE+P Students in LQE
Units: people

Total Poor UER=Total Actual Unemployment among Poor/Total Poor SLF
Units: Dmnl
Total Population=Total Poor Population+Total Rich Population
Units: people
Total Potential Employment=Total Potential Employment among Poor+Total Potential Employment among Rich
Units: people
Total Potential Employment among Poor=Potential US Employed Poor+Potential SS Employed Poor+Potential HS Employed Poor
Units: people
Total Potential Employment among Rich=Potential US Employed Rich+Potential SS Employed Rich+Potential HS Employed Rich
Units: people
Total Potential Unemployment=Total SLF-Total Potential Employment
Units: people
total potential unemployment among HS=potential unemployed hs poor+potential unemployed hs rich
Units: people
total potential unemployment among SS=potential unemployed ss poor+potential unemployed ss rich
Units: people
total potential unemployment among US=potential unemployed us poor+potential unemployed us rich
Units: people
Total Potential Unemployment Ratio=Total Potential Unemployment/Total SLF
Units: Dmnl
Total Rich Population="Age Group (0-14) among Rich"+"Age Group (15-24) among Rich"+"Age Group (25-54) among Rich"+"Age Group (55+) among Rich"
Units: people
Total Rich SLF=HS Rich SLF+SS Rich SLF+US Rich SLF
Units: people
Total Rich Students=R Students in HQE+R Students in LQE
Units: people
Total Rich UER=Total Actual Unemployment among Rich/Total Rich SLF
Units: Dmnl
Total SLF=Total HS SLF+Total SS SLF+Total US SLF
Units: people
Total SS SLF=SS Poor SLF+SS Rich SLF
Units: people
Total UER=
Total Actual Unemployment/Total SLF
Units: Dmnl
Total US SLF=US Poor SLF+US Rich SLF
Units: people
TPP ratio=Total Poor Population/Total Population

Units: Dmnl
TRP ratio=Total Rich Population/Total Population
Units: Dmnl
US jobs=Available Total Salaried Jobs*fr of unskilled jobs
Units: jobs
US LF ratio=Total US SLF/Total SLF
Units: Dmnl
US Poor= INTEG (dropouts from PHQE+dropouts from PLQE+working rate-retirement rate of PUS emp,5.43167e+006)
Units: people
US Poor LF ratio=US Poor SLF/Total Poor SLF
Units: Dmnl
US Poor SLF=US Poor*SLF ratio
Units: people
US Rich= INTEG (dropouts from RHQE+dropouts from RLQE-retirement rate of RUS emp,987500)
Units: people
US Rich LF ratio=US Rich SLF/Total Rich SLF
Units: Dmnl
US Rich SLF=US Rich*SLF ratio
Units: people
working rate=Child Labor/growth time
Units: people/Year
working rate as CL=Poor Chl*fr of CL*base fr
Units: people/Year

# APPENDIX B: SIMULATION MODEL

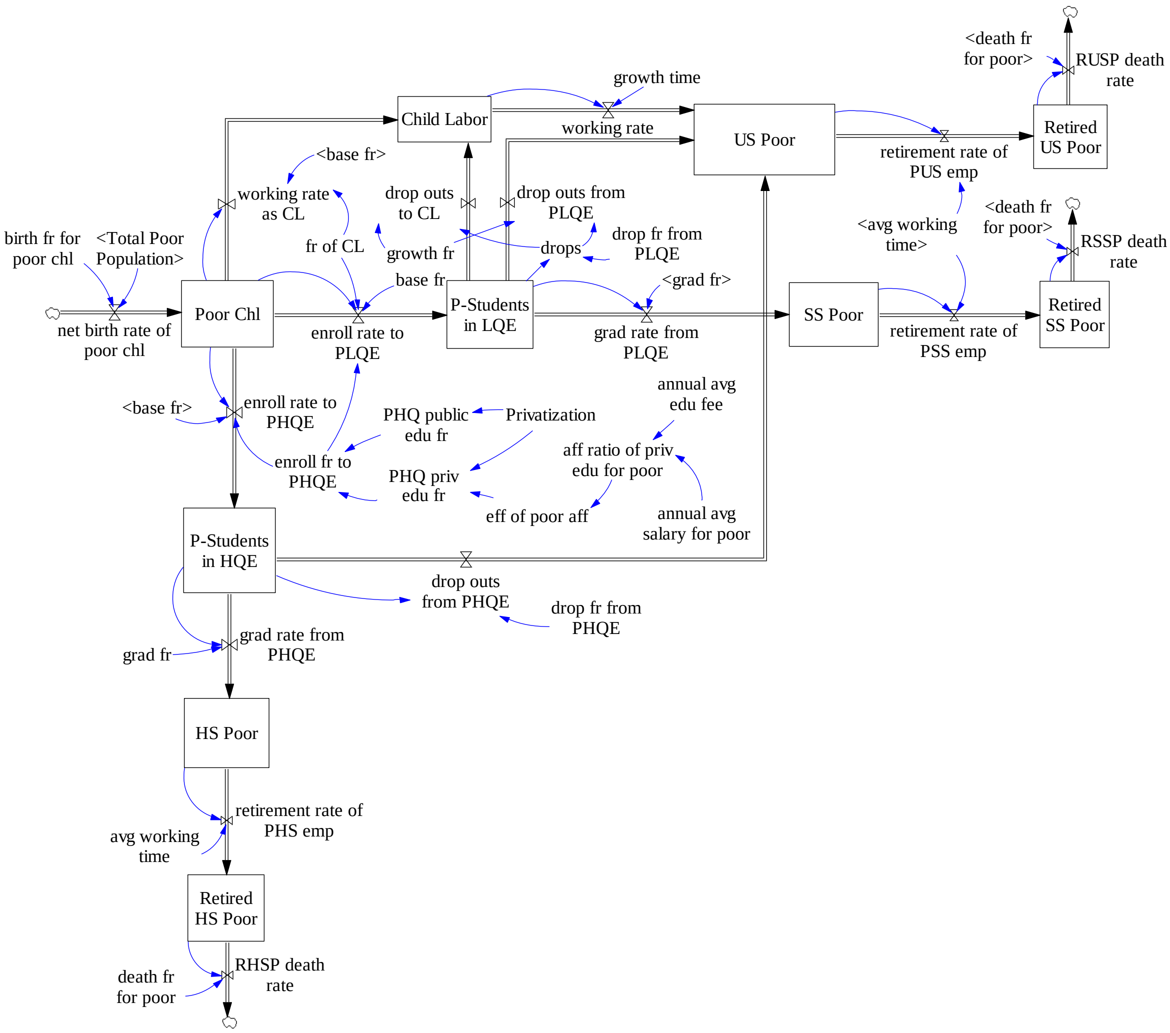


Figure B.1. Stock-flow diagram of the population-education sector among the poor.

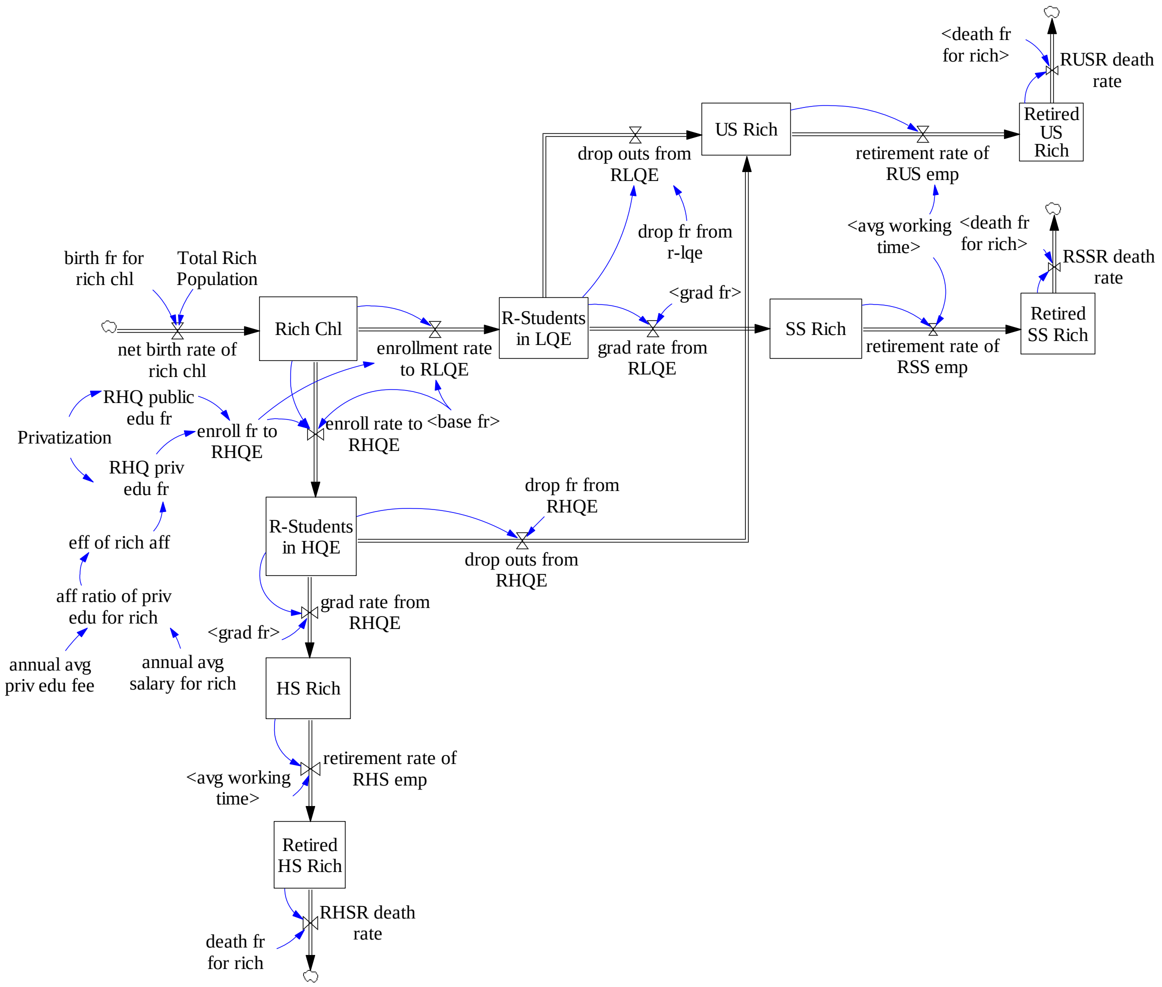


Figure B.2. Stock-flow diagram of the population-education sector among the rich.

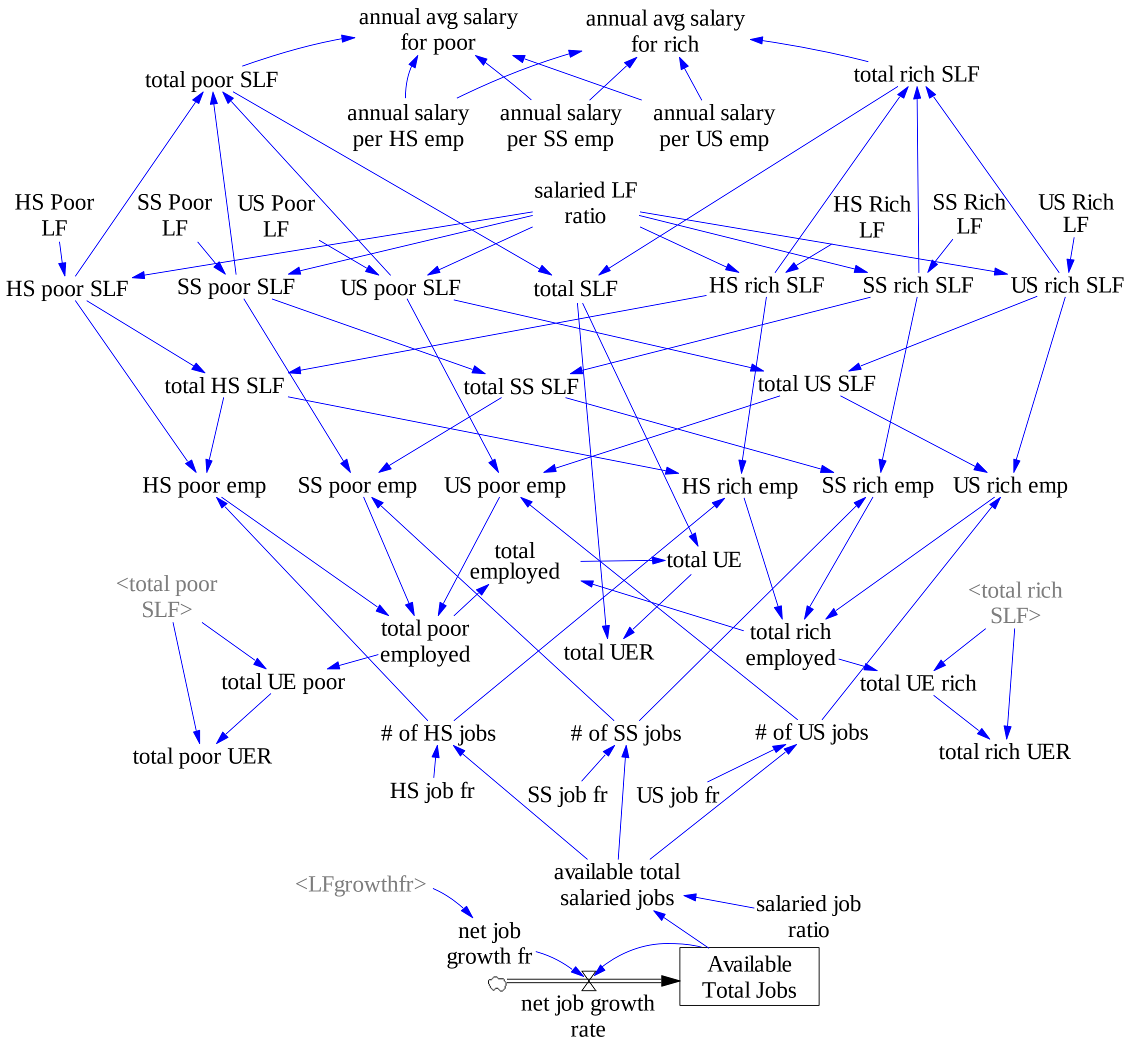


Figure B.3. Stock-flow diagram of the employment sector.

# APPENDIX C: RESULTS OF EXTREME CONTION TESTS

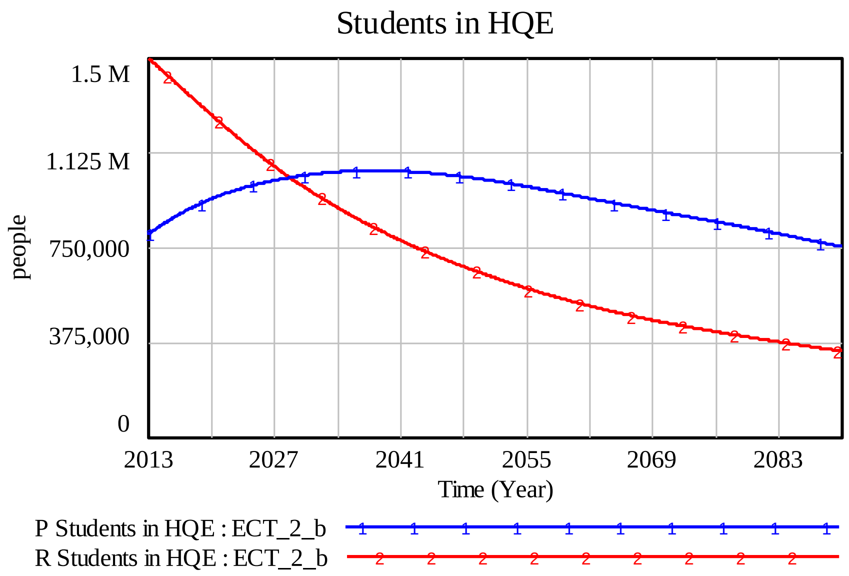


Figure C.1. The poor and rich students in HQE under the ECT_2_b.

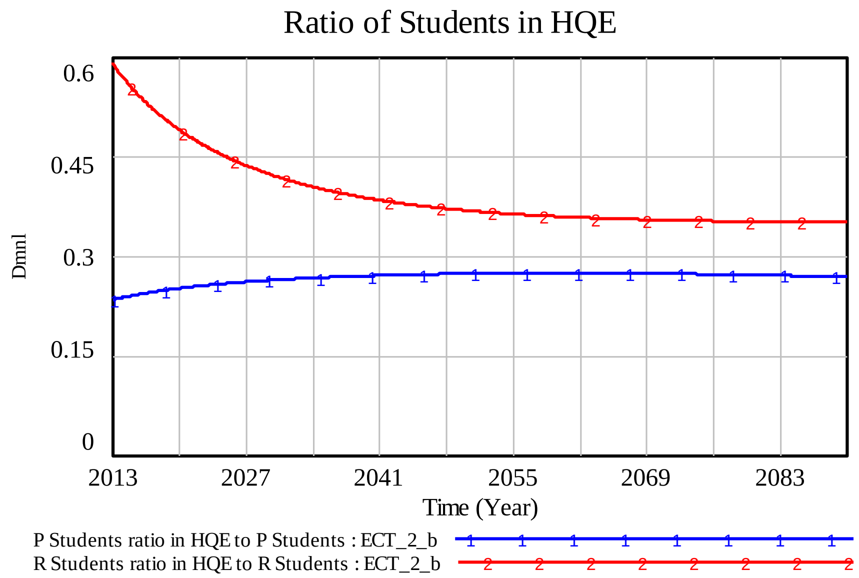


Figure C.2. The ratio of students in HQE for the poor and rich under the ECT_2_b.

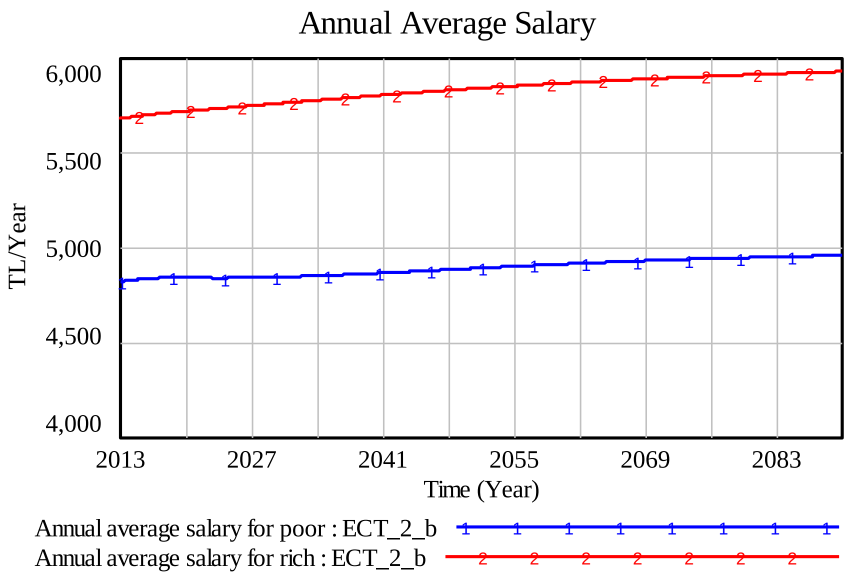


Figure C.3. The annual average salaries of the poor and rich under the ECT_2_b.

# APPENDIX D: RESULTS OF THE SCENARIO & POLICY ANALYSIS

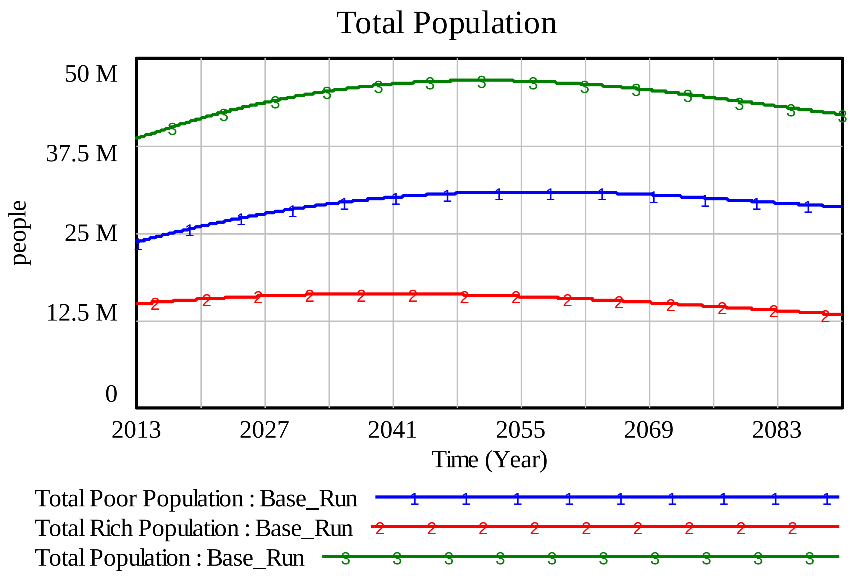


Figure D.1. Total population among the poor and rich in the base run.

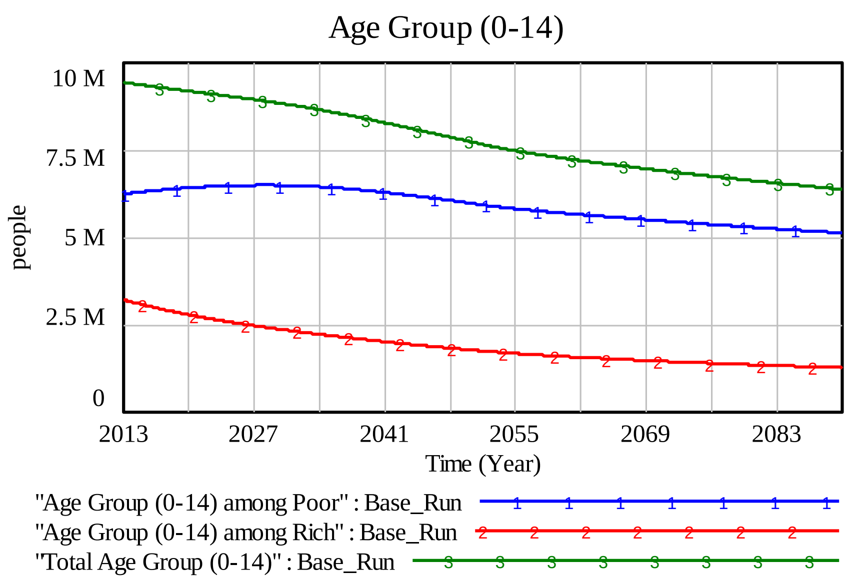


Figure D.2. Population among poor and rich 0-14-year-old children in the base run.

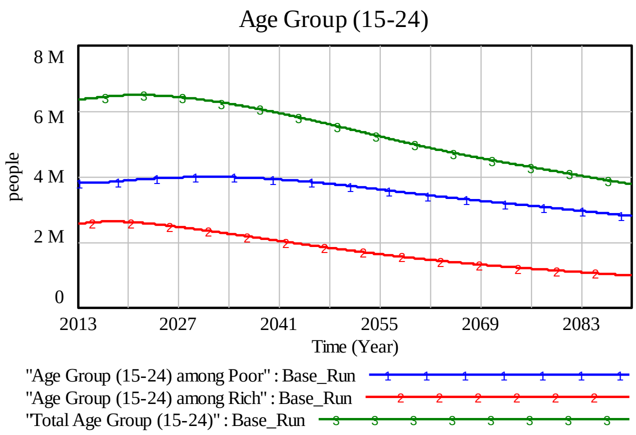


Figure D.3. Population among poor and rich 15-24-year-olds in the base run.

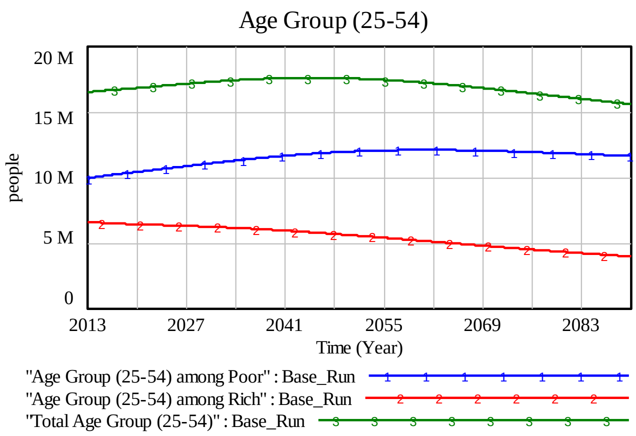


Figure D.4. Population among poor and rich 25-54-year-olds in the base run.

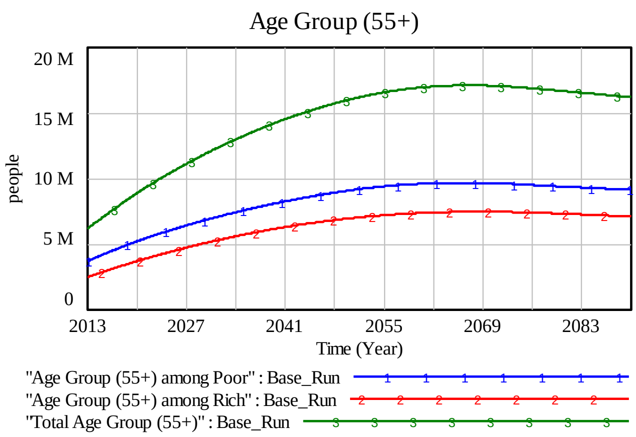


Figure D.5. Population among poor and rich over 55-year-olds in the base run.

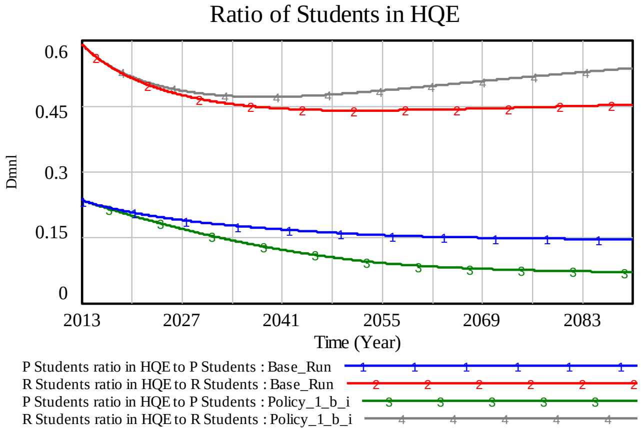


Figure D.6. The ratio of students in HQE for the poor and rich under the Policy_1_b_i.

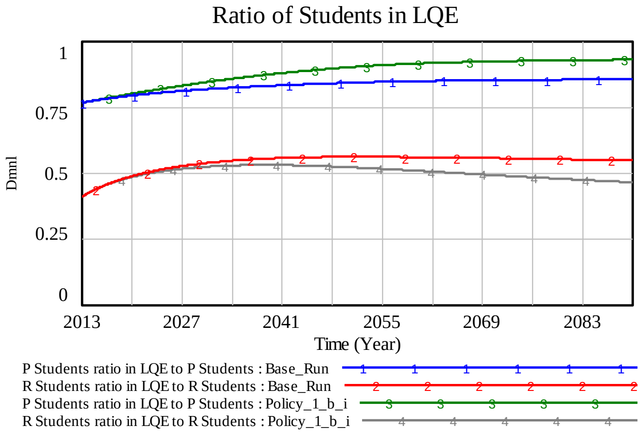


Figure D.7. The ratio of students in LQE under the Policy_1_b_i.

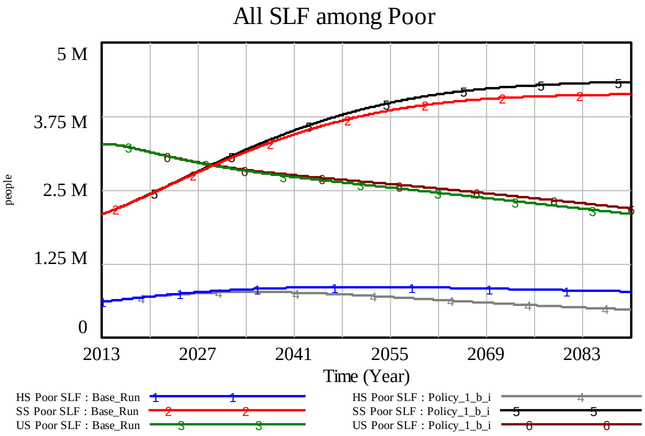


Figure D.8. All SLF among the poor under the Policy_1_b_i.

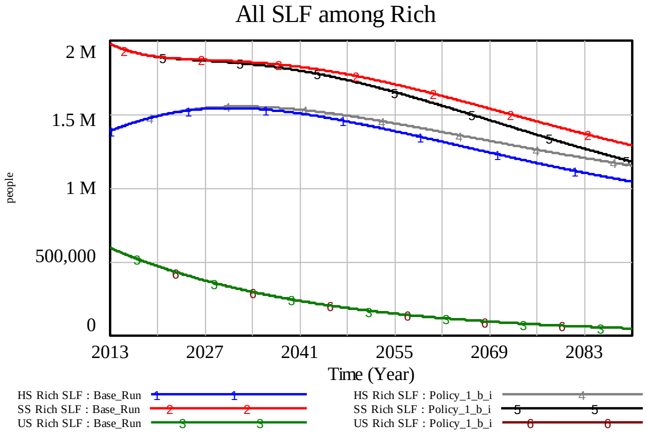


Figure D.9. All SLF among the rich under the Policy_1_b_i.

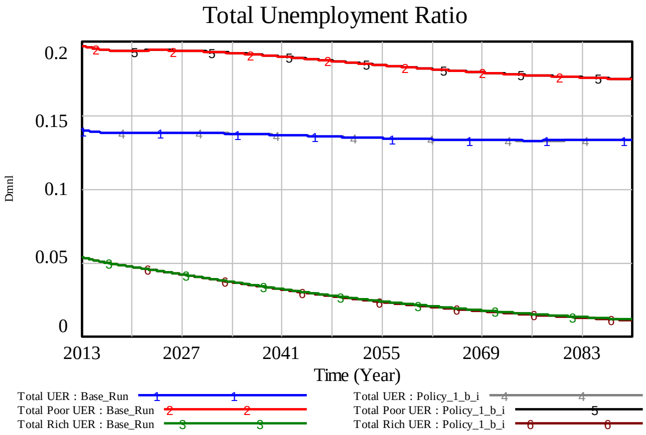


Figure D.10. All unemployment ratios under the Policy_1_b_i.

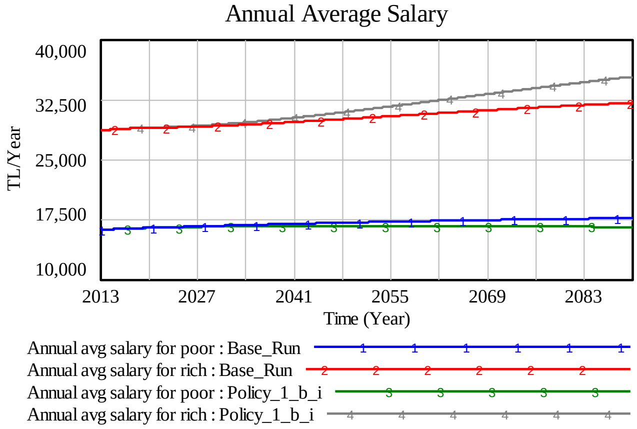


Figure D.11. The annual average salaries of the poor and rich under the Policy_1_b_a.

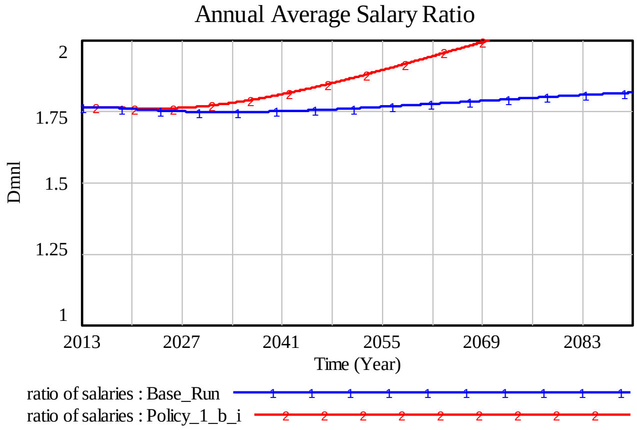


Figure D.12. The ratio of annual average salaries under the Policy_1_b_a.

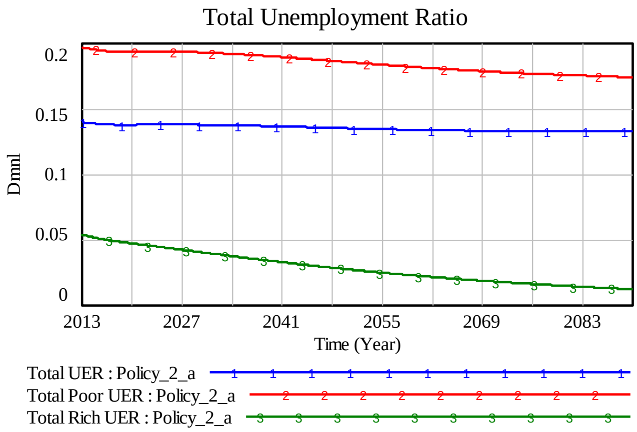


Figure D.13. All unemployment ratios under the Policy_2_a.

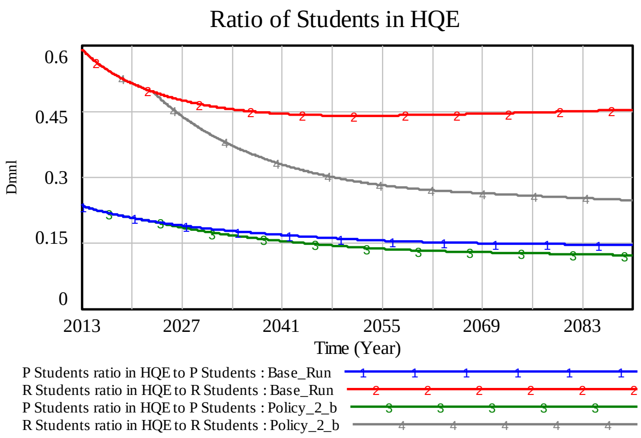


Figure D.14. The ratio of students in HQE for the poor and rich under the Policy_2_b.

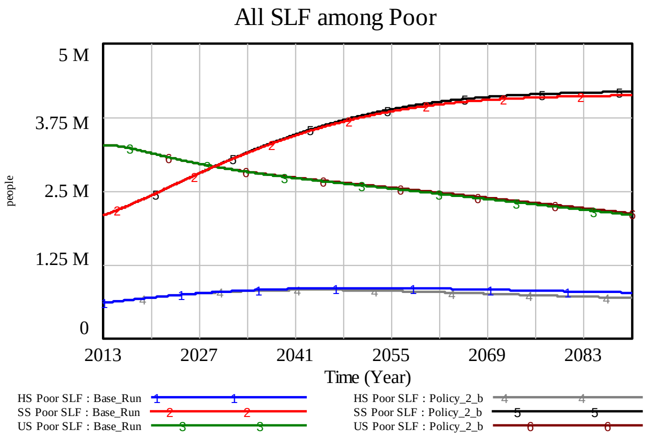


Figure D.15. All SLF among the poor under the Policy_2_b.

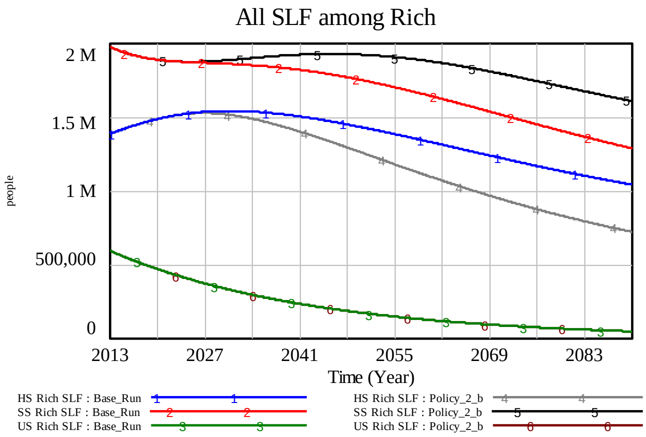


Figure D.16. All SLF among the rich under the Policy_2_b.

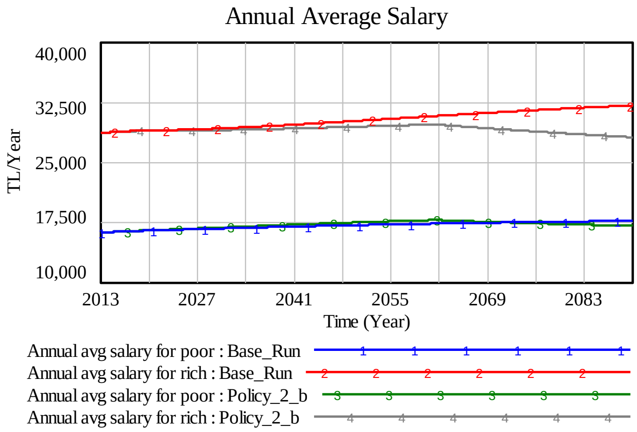


Figure D.17. The annual average salaries of the poor and rich under the Policy_2_b.

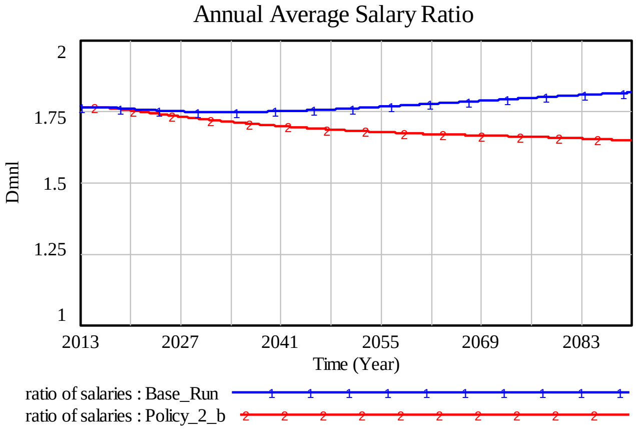


Figure D.18. The ratio of annual average salaries under the Policy_2_b.

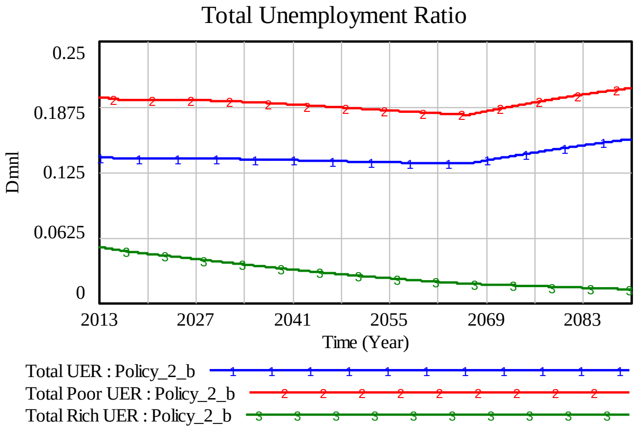


Figure D.19. The unemployment ratios under the Policy_2_b.

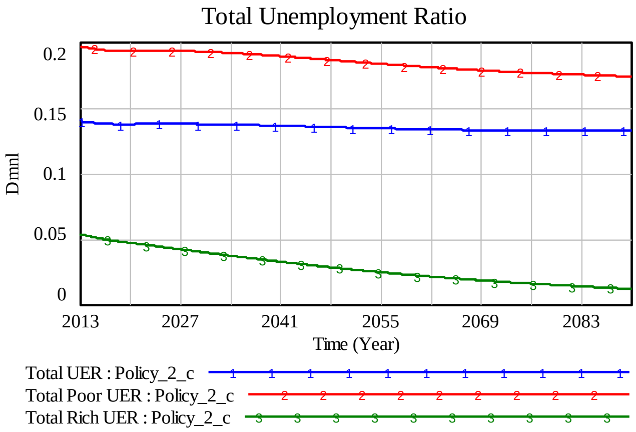


Figure D.20. All unemployment ratios under the Policy_2_c.

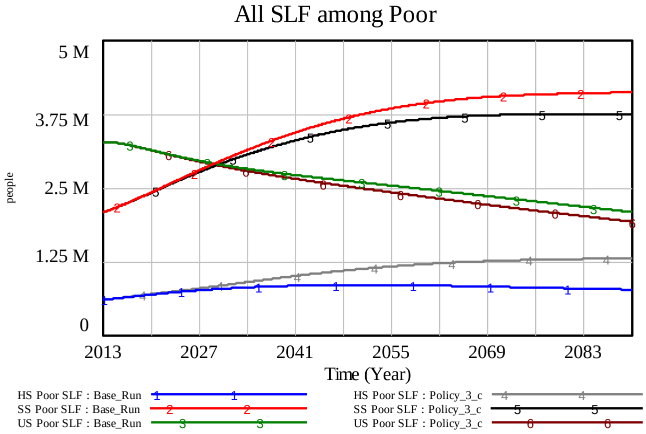


Figure D.21. All SLF among the poor under the Policy_3_c.

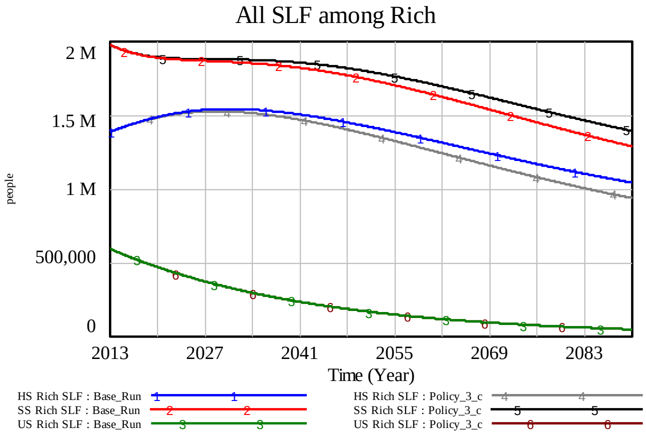


Figure D.22. All SLF among the poor under the Policy_3_c.

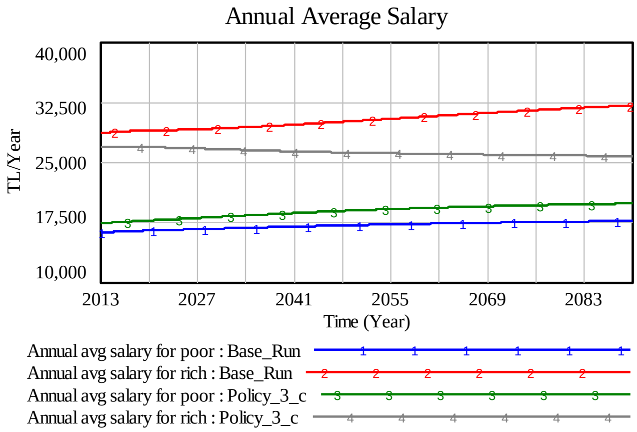


Figure D.23. The annual average salaried for the poor and rich under the Policy_3_c.

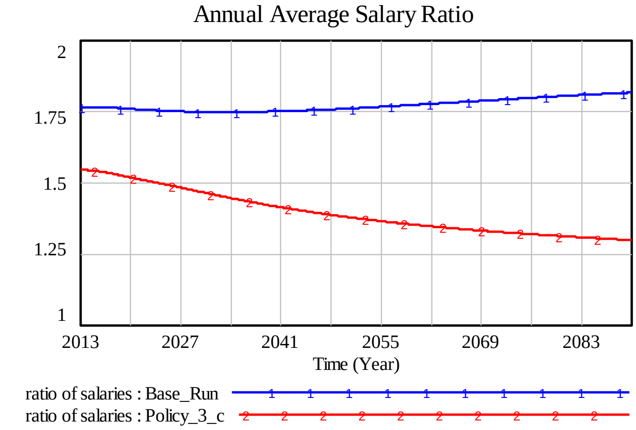


Figure D.24. The ratio of annual average salaries under the Policy_3_c.

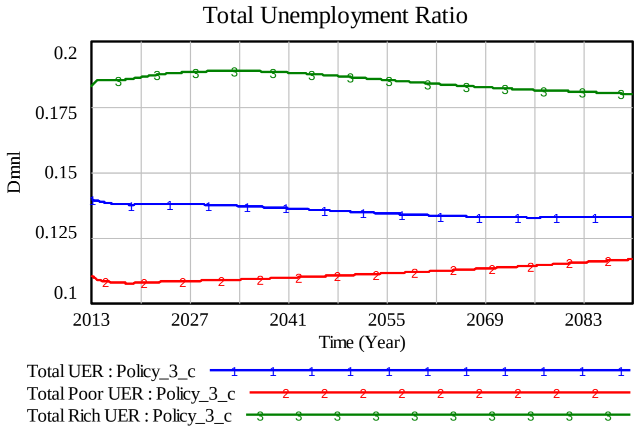


Figure D.25. All unemployment ratios under the Policy_3_c.

# APPENDIX E: ASSUMPTIONS OF THE MODEL

Two levels of income groups are modeled in this study, which are the groups of high (top 60-80%) and low (bottom 10-40%) levels of income. The high level of income group is called salaried rich and the low level of income group is called salaried poor. Thus we only focus on salaried workforce (no entrepreneurs or self-employed). Approximately the net birth fraction of the poor is two times the rich's net birth fraction. The death rate is ignored in all age groups by adjusting the net growth rates, except the retired age group where there is explicit death rate. The retirement age is assumed to be 55.

Privatized education is used in part as a metaphor to define the collection of all education that requires significant expenditures to enroll in. The high-quality education consists of the education in high quality high school and high quality university. It is assumed that the universities in high-quality education would offer high-skilled jobs and high quality high school education would make it possible to enter high-quality university. Conversely, the low-to-average quality education represents "not high quality" education. The education period lasts ten years on average. There are public and private schools in high-quality education. It is assumed that, the poor's enrollment fraction to public high-quality schools is normally higher than their enrollment to the private high-quality schools. That is because of the private high-quality education enrollment rate is a function of privatized education fees. However, enrolling to high-quality education is not trivial for the poor in general. Their enrollment fraction to public high quality schools is also lower than enrollment fraction of rich to the same public schools .

It is assumed that, if students receive high-quality education, they are able to join the highly skilled labor force, and if students receive low-to-average quality education, they join the semi-skilled labor force. On the other hand, if they drop out of school during the education, they directly join the unskilled labor force. So, there are three skill levels of salaried labor force and salaried jobs, which are called highly skilled, semi-skilled and unskilled.

The time unit of the model is one year. The time horizon of the simulations is set to 77 years, from 2013 to 2090, to be long enough to represent a couple of generations. In the base run of the model, the privatization ratio, which is partially a metaphoric variable as defined above , is assumed to be increasing from 40% to 60% until 2050.

There is an endogenous growth of available total jobs in the model. The job growth is proportional to the population, in other words, it changes by the labor force growth. The endogenous growth will keep today's relative job availability throughout the time horizon. As mentioned, it is assumed that all labor force and jobs are salaried. Therefore, there is a salaried employee and job ratio in this model, which is taken as 60%. It is assumed that 20% of the jobs are highly skilled, 35% are semi-skilled, and 45% are unskilled jobs; and, they are at their constant values in model runs. The monthly gross salary per unskilled, semi-skilled and highly skilled employees are assumed to be 1000 TL, 2000 TL and 4500 TL, respectively.

# APPENDIX F: GLOSSARY OF VARIABLES

The variables exist for the poor and rich separately in the model.

Table F.1. The list of variables of the model.

| Variable | Definition |
|---|---|
| Children | Children represent the number of children, who are 0-14-year-olds, born into low or high level of income family. |
| HQE | High-quality education that offers highly qualified education from the high school to university graduation. |
| LQE | Low-to-average quality education represents “not high quality” education. |
| Students in HQE | The number of students, who are 15-24-year-old, in HQE. |
| Students in LQE | The number of students, who are 15-24-year-old, in LQE. |
| Enrollment rate to HQE | The rate of student enrollment to HQE. |
| Enrollment rate to LQE | The rate of student enrollment to LQE. |
| HS SLF | People among highly skilled salaried labor force, who are 25-54-year-old, coming from poor or rich family, after receiving HQE. |
| SS SLF | People among semi-skilled salaried labor force, who are 25-54-year-old, coming from the poor or rich family, after receiving LQE. |
| US SLF | People among unskilled salaried labor force, who are 18-54-year-old, coming from the poor or rich family. |
| Retired SLF | Retired people, who are over 55-year-old, are defined for all skill levels. |
| Unemployment ratio | Unemployed labor force divided by labor force. (Also calculated separately for the poor and the rich). |
| Annual average salary | The annual average salary of the poor and the rich among the poor and the rich’s salaried labor force |
| The ratio of annual average salaries | The ratio of the annual average salary of the rich over the annual average salary of the poor |

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