

THE ECONOMIC GROWTH EFFECTS OF ALTERNATIVE EARLY HUMAN
CAPITAL INVESTMENT POLICIES IN THE TURKISH ECONOMY

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ABSTRACT

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The topic of early childhood development (ECD) and investment in ECD has come to the forefront recently, especially in the case of developing countries, and it is among the 2030 Sustainable Development Goals of the United Nations. Until recently, human capital has been associated with years of schooling. However, the latest studies show that brain development is fastest in the ECD period, which starts in the prenatal period and ends before formal schooling. Experience during this period and even maternal health before pregnancy have persistent effects on human capital of an individual. Investing in human capital during the ECD period is more effective than investing later in life. In this thesis, we develop a 9-period overlapping generations model examining the impact of parental human capital investment on economic growth, in a general equilibrium framework. Using a multiperiod human capital formation technology with parental human capital and physical input, we investigate the effects of alternative policies targeting the ECD period to reach the highest economic growth rate. We calibrate our model to 2019 Turkish data and find that mandatory and matching funds policy, which directly contribute to human capital, are more effective than income-increasing lump-sum subsidy policy. In the child tax credit policy, the decreasing amount of credit after a certain income level leads to lower economic

growth than in the lump sum subsidy policy, in which the subsidy is given equally to all income levels. Also, ECD subsidies raise the investment made for the child in the schooling period.

Keywords: early childhood development, human capital accumulation, overlapping generations modeling, general equilibrium, economic growth



ÖZ

TÜRKİYE EKONOMİSİNDE ALTERNATİF ERKEN BEŞERİ SERMAYE YATIRIM POLİTİKALARININ EKONOMİK BÜYÜME ÜZERİNDEKİ ETKİLERİ

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Erken çocukluk gelişimi (EÇG) ve EÇG yatırımı konusu, özellikle gelişmekte olan ülkeler söz konusu olduğunda son zamanlarda ön plana çıkmaktadır ve Birleşmiş Milletlerin 2030 Sürdürülebilir Kalkınma Hedefleri arasında yer almaktadır. Yakın zamana kadar beşeri sermaye okullaşma yılı ile ilişkilendirilmiştir. Ancak son çalışmalar beyin gelişiminin en hızlı olduğu dönemin doğum öncesi dönemden başlayarak ve örgün eğitimden önce sona eren EÇG döneminde gerçekleştiğini göstermektedir. Bu dönemdeki deneyimlerin ve hatta hamilelik öncesi anne sağlığının bireyin beşeri sermayesi üzerinde kalıcı etkileri vardır. EÇG döneminde bireyin beşeri sermayesine yatırım yapmak, yaşamın ilerleyen dönemlerinde yatırım yapmaktan daha etkilidir. Bu tezde, ebeveynlerin beşeri sermaye yatırımının ekonomik büyüme üzerindeki etkisini genel denge çerçevesinde inceleyen, 9 dönemli bir örtüşen nesiller modeli geliştirilmesi amaçlanmaktadır. Bu bağlamda ebeveyn beşeri sermayesi ve fiziksel girdi içeren çok dönemli bir beşeri sermaye oluşum teknolojisi kullanarak, en yüksek ekonomik büyüme oranına ulaşmak için EÇG dönemini hedefleyen alternatif politikaların etkilerini araştırmaktayız. 2019 Türkiye verilerine göre kalibre ettiğimiz modelimizde beşeri sermayeye doğrudan katkı sağlayan zorunlu eşleştirme fonları politikasının, gelir artırıcı götürü (lump-sum) sübvansiyon politikasından daha etkili

olduğunu bulmaktayız. Çocuk vergi kredisi politikasında belirli bir gelir seviyesinden sonra azalan kredi miktarı, sübvansiyonun tüm gelir seviyelerine eşit olarak verildiği götürü sübvansiyon politikasına göre daha düşük ekonomik büyümeye yol açmaktadır. Ayrıca, EÇG döneminde ebeveynlere verilen sübvansiyonların çocuğa örgün okul döneminde yapılan yatırımı arttırdığı da görülmektedir.

Anahtar Kelimeler: erken çocukluk gelişimi, beşerî sermaye birikimi, örtüşen nesiller modeli, genel denge, ekonomik büyüme



To my current and future family

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LIST OF ABBREVIATIONS

CES: Constant Elasticity of Substitution

CHB: Conditional Health Benefits

CTC: Child Tax Credit

ECD: Early Childhood Development

ECEC: Early Childhood Education and Care

GDP: Gross Domestic Product

HBS: Household Budget Survey

HTP: Health Transformation Program

MICS: Multiple Indicator Cluster Survey

MoFSS: Ministry of Family and Social Services

MoH: Ministry of Health

MoNE: Ministry of National Education

OECD: The Organization for Economic Cooperation and Development

SAM: Social Accounting Matrix

SES: Socioeconomic Status

TDHS: Türkiye Demographic and Health Survey

TL: Turkish Lira

TURKSTAT: Turkish Statistical Institute

UNICEF: United Nations Children's Fund

CHAPTER 1

INTRODUCTION

The four major determinants of economic growth are physical capital, human capital, natural resources, and technology. Among them, human capital is a crucial driver of long-term economic growth and sustainable development. One of the pioneers of the studies on human capital theory, Theodore Schultz, argued that many paradoxes about economic growth can be resolved by taking human capital investment into account (Schultz, 1961). Human capital broadly covers the technical and social skills acquired through a person's education level and experience, physical and mental well-being, work ethic and motivation, creativity, openness to innovation, communication skills, and many characteristics that affect the person's life success. Models that study the impact of human capital on economic growth suggest that individuals with better skills and health tend to be more productive (Lucas, 1988; Romer, 1990). This increased productivity is reflected in higher personal income and economic growth levels. Given the initial per capita gross domestic product, the growth rate is highly positively correlated with the initial human capital level (Barro, 1991).

A workforce with high human capital is more likely to promote innovation (Dakhli and De Clercq, 2004) and lower the cost and uncertainty associated with adapting to new technologies, which in turn increases the likelihood of early adaptation (Wozniak, 1987). Therefore, economic growth models have incorporated human capital accumulation for over half a century (see Nelson and Phelps, 1966; Mincer, 1984; Lucas, 1988). To increase a country's real economic growth rate in the long term, prioritizing investments in education and health to support human capital accumulation in that country is one of the important conclusions of the macroeconomic literature (see Barro, 1991; Mankiw et al., 1992; Barro and Lee, 1993; Benhabib and Spiegel, 1994).

Education and health outcomes are commonly used to analyze the effect of human capital on economic growth because they have quantifiable determinants. In the evaluation of the impact of health on economic growth, metrics such as adult survival rate, height, and mortality rate are utilized (Bhargava et al., 2001; Lorentzen et al., 2008; Weil, 2007). In education, the impact of schooling (Bils and Klenow, 2000; Hanushek and Kimko, 2000), school quality (Hanushek, 2013), and school expenses (Jackson et al., 2015; Dissou et al., 2016) are typically used to measure educational outcomes and their effects on economic growth. These studies show that most health and education indicators have a positive impact on economic growth; however, research in neuroscience, psychology, and economics over the past two decades suggests that human capital accumulation begins long before formal schooling. Research suggest that the accumulation of human capital is much faster, beginning from the prenatal period until the formal schooling period (see Heckman, 2000; Campbell et al., 2001; Thompson and Nelson, 2001; Rolnick and Grunewald, 2003; Heckman, 2011; García et al., 2017). This period is defined as the early childhood development (ECD) period and refers to the child's cognitive, physical, language, temperament, socio-emotional, and motor development process from conception to preschool age. Investing in early childhood programs is a far more secure tool for economic development than other high-risk economic development programs (Rolnick and Grunewald, 2007). Furthermore, there is no equity-efficiency trade-off in investing in the early years of childhood, but there is such a trade-off in the later years (Cunha et al., 2006).

The United Nations recognized the importance of ECD and included a related target in the 2030 Sustainable Development Goals (SDG). The target is that by 2030, every boy and girl will have access to quality early childhood development, care, and pre-primary education to ensure they are prepared for primary education. The inclusion of ECD in SDGs emphasizes the need to establish policies that promote high-quality ECD services at national and international levels. To this end, Türkiye has put forward goals, targets, and strategies for ECD in top policy documents.

Although studies have revealed the importance of ECD in terms of human capital accumulation and the high return on investment in this period, there is a lack

of research on the long-term economic effects of alternative policies that encourage investments in this period. To address this gap, we conducted a study that compares the current lump-sum policy implemented in Türkiye with alternative government policies aimed at promoting ECD investments by parents. As a result of our study, we present policy recommendations based on the balance between private and public ECD investment that will lead Türkiye to a higher growth path in the long term.

We build a 9-period overlapping generations model in which parents invest in their children's human capital. Our aim is to examine the impact of selected ECD policies on child investment and main economic indicators. We calibrated the steady state of the benchmark model to the 2019 Turkish economy by constructing a social accounting matrix (SAM) that represents the structure of the model. We use data from TURKSTAT National Accounts, Household Budget Survey, and Budget Finance Statistics for the same year in the construction of the SAM.

We investigate the effects of four policies that promote ECD investments. The first policy in this group is the lump-sum subsidy policy, which directly increases household income. In this policy, the decision to invest in the child is left to the parents mirroring the education and health subsidies provided to families in Türkiye. The second policy is the matching fund policy, in which the government directly supports the human capital production of the child provided that the parent contributes the same amount to the child's investment. Two scenarios are analyzed under this policy. In the first scenario, the government subsidy is equal to the subsidy in the lump sum policy while in the second scenario, the subsidy is half of that in the first scenario, with the total investment in the child by both the government and the household equal to that in the lump sum policy. Another policy is the universal child benefit policy, in which the level of financial assistance paid by the government is equal to that in the lump sum subsidy model and directly contributes to the child's human capital. In this policy, only the government is responsible for the investment in the ECD period for the child. The last policy is the child tax credit policy which is a policy that provides financial assistance to households, similar to the lump-sum subsidy policy. However, unlike lump-sum subsidy, when per capita wage income levels in the economy exceed a

certain threshold, the tax credit is reduced by half. We aim to determine the extent to which investments in ECD support economic growth when the government and households contribute at different levels, rates, and in different forms (such as increasing income or contributing to human capital).

We find that the least effective policy among these policies, in terms of increasing physical capital, human capital, output, and other economic indicators is the child tax credit policy, followed by the lump-sum subsidy policy. The next effective policy is the second scenario of the matching fund policy, where the total investment in the child is equal to the lump-sum subsidy, followed by the universal child benefit policy. The most effective policy is the first scenario of the matching fund policy, in which the state invests the same amount as in the lump sum policy, provided that the household contributes the same amount. When we examine the child investments made by households, we find that the increase in ECD investment in all policies cause an increase in the investment made during the formal schooling period. Higher investment in formal schooling periods leads to a higher accumulation of human capital and a higher economic growth path in all policies.

The rest of the thesis is organized as follows: In Section 2, we present the literature focusing on the importance of investment in ECD. In Section 3, we present the current state of ECD in Türkiye and the top policy documents focusing on ECD. In Section 4, we present a brief review of the literature on human capital investment models, the data and the model. In section 5, we present the calibration strategy and the social accounting matrix. In section 6, we introduce the implemented policies and discuss results of policy simulations. Section 7 concludes the study with policy recommendations along with limitations of the study and future work.

CHAPTER 2

IMPORTANCE OF EARLY CHILDHOOD DEVELOPMENT

Starting from the prenatal period, children experience significant developmental improvements in sensory formation, language acquisition, and cognitive functioning skills (Thompson and Nelson, 2001). Experiences during the early years have long-lasting effects on many health, education, and economic outcomes, such as infant mortality, schooling, academic achievement, earnings, behavioral and emotional syndromes, involvement in crime, occupation and receiving welfare. Almond and Currie (2009) provide a comprehensive review of studies on the effects of early environments on adult outcomes. Research also indicates that maternal malnutrition, smoking, and alcohol use, as well as high body mass index before pregnancy, can negatively affect fetal development (World Health Organization, 2013). In this section, we will present the following key factors that affect child outcomes: genes, socioeconomic status of family and the environment, early intervention and rationale of government intervention. After analyzing these effects, we explain why the government should intervene to support child development in the early years.

2.1. Genes

It is commonly believed that the differences in development among children are influenced by their genetic makeup; however, research shows that genetic alone is not the sole factor that affects an individual's development. Phillips and Shonkoff (2000) states that the long-standing debate about the distinct effects of nature and nurture on child development is oversimplified and scientifically obsolete. It is recognized that genetic and environmental factors work together in complex ways throughout development, and nature and nurture contribute to human potential, development, risk, and dysfunction. Phillips and Shonkoff also note that traits that are determined by

genetics, as well as those that are influenced by experience, can be improved through intervention, and it is essential to investigate how the environment affects gene expression and how genetics, combined with previous experiences, affect ongoing interactions with the environment during early childhood and beyond. According to Gibney and Nolan (2010), epigenetic information, which are modifications that can change gene activity without changing genetic information, is vulnerable to environmental factors during cell division, perinatal period, and puberty periods.

Changes in gene expression patterns in these periods can have long-term effects on the individual's phenotype (observable traits). Similarly Murgatroyd and Spengler (2011) reviews studies examining the effect of stress on brain development and notes that different regions of the developing brain go through critical periods during different perinatal periods, which are crucial for the development of specific brain functions. For this reason, the study states that the effects of stressors at different times may have more pronounced and long-lasting effects on the developing brain regions during that period. For example, late prenatal and early postnatal life is a critical period for the development of the brain region responsible for learning and memory formation, and it may be explained that environmental exposures during this period strongly affect these structures through epigenetic changes.

2.2. Socioeconomic Status of Family and the Environment

The ECD literature suggests that children from low socioeconomic backgrounds are at a higher risk of not developing the necessary skills for academic success compared to their higher socioeconomic counterparts (Burger, 2010).

There is a large body of literature attempting to assess the impact of family's socioeconomic status (SES), which is mostly measured by family income, parental education, and occupational status, and the home environment on a child's motor, cognitive, linguistic, emotional, and social development. These effects can be observed even before birth and continue into adulthood. Studies propose various factors to explain the link between SES and child well-being, with most of them relating to differences in access to material and social resources or reactions to stressful conditions by both the children and their parents. Children's well-being is

affected by SES at multiple levels, including both the family and the neighborhood. The effects of SES are moderated by characteristics of the child and their family, as well as external support systems (Bradley and Corwyn, 2002).

Recent research consistently reports that children experiencing persistent poverty are more likely to have lower IQ, academic achievement, and socioemotional functioning compared to children experiencing temporary poverty or those who have never experienced poverty (McLoyd, 1998). According to this study, there are several factors that contribute to lower outcomes for children. These include reduced access to resources that can help mitigate adverse effects, higher rates of perinatal complications, increased exposure to lead, less cognitive stimulation at home, lower teacher expectations, and poorer academic readiness skills. Children living in poverty also tend to have harsh and inconsistent parenting and are exposed to more acute and chronic stressors, which further contribute to their socioemotional issues (McLoyd, 1998).

The effects of SES on the neural architecture and functions of very young children, reflected shortly after birth, increase in early childhood, possibly as a result of postnatal experiences. Studies show that certain neural functions and structures, such as executive function and language, may be more sensitive to SES than others in the early years of life (Olson et al., 2021).

Duncan et al. (1994) finds that a family's income and poverty status, measured by income-to-needs ratio, strongly influence children's cognitive development and behavior even after controlling for other factors, such as family structure and the mother's education level. Research also finds that low-income neighborhoods have higher rates of externalizing behavior problems, while affluent neighborhoods have higher rates of age-5 IQ scores. Lima et al. (2004) states that environmental factors have a greater impact on child development than biological factors and recommends interventions that increase social capital and reduce poverty.

When studying the impact of the environment on a child, it is important to note that the family, especially the mother, who is often the primary caregiver, is the child's closest and most influential environment. As a result, the effects of a mother's

education, which is also a crucial determinant of socioeconomic status, have been extensively examined in relation to the child's outcomes. Currie and Moretti (2003) examines the impact of maternal education on birth outcomes and highlight four factors that can improve maternal education outcomes: prenatal care use, smoking, marriage, and fertility. They found that a higher level of maternal education improved infant health, as measured by birth weight and gestational age. They also find that higher levels of education reduced smoking and increased the likelihood that the mother would be married and use prenatal care, which had significant effects on the child's health. These effects are due to the effects of education on maternal behavior, such as reduced smoking. The effect of maternal education on the health of the adopted child, who has no genetic connections, is positive and similar to the effects on own birth, suggesting that education increases the quality of postpartum care, which is more important than genetic characteristics (Chen and Li, 2009). According to Augustine et al. (2009), education provides women with important social and human capital. This, in turn, helps them to better manage their children's school readiness and make informed choices about early childcare that is of high quality and appropriate in terms of type, quality, and quantity. This process reveals how human capital is passed down from one generation to the next. The relationship between education, childcare choices, and children's school readiness remains strong even after accounting for various confounding variables such as maternal cognitive and psychological skills and paternal characteristics. For example, Halle et al. (1997) shows the relationship between maternal education and child's outcomes using a sample of low-income minority families. The study finds that higher expectations of highly educated mothers for their children's academic achievement positively influence their children's subsequent achievement in math and reading.

2.3. Early Intervention

Human capital accumulation is in fact a dynamic process, and the skills one acquires in the early years of life significantly affect their initial conditions and the technology of learning in the next stage. As a result, children from more privileged families and with higher abilities tend to benefit more from schooling. Consequently, the social and economic gap persists between children from different backgrounds (Carneiro and

Heckman, 2003; Cunha et al., 2006) and even widens throughout their education (Carneiro et al., 2005). In other words, when children from disadvantaged backgrounds in the preschool period cannot catch up with their peers developmentally, they fall behind throughout their education and adulthood. Research shows that high quality early childhood education and care (ECEC) can lead to better school readiness (Hustedt et al., 2008; Magnuson et al., 2004), improved academic performance (Barnett, 1995; Campbell et al., 2001), higher rates of high school graduation (McCoy et al., 2017), greater participation in higher education (M. L. Anderson, 2008; Garces et al., 2002), lower rates of criminal activity (García et al., 2017) and higher earnings in adulthood (Chetty, Friedman, Hilger, et al., 2011). In that sense, early intervention not only ensures that children start life on equal footing, but it also provides high economic returns to the individual and society.

Since its establishment in 1965, Head Start has been a program with the goal of enhancing the school readiness of low-income children in the United States. The program uses the "whole child" approach and provides various services, including preschool education, medical, dental, and mental health care, nutritional services, and services for parents to support their children's development (Puma et al., 2010). Garces et al. (2002) investigates the long-term effects of Head Start, using data from the Panel Study of Income Dynamics. The study finds that white children who attended the program are significantly more likely to complete high school, attend college, and earn higher earnings by their early twenties compared to their siblings who did not participate. On the other hand, African American children who participated in the program were less likely to be penalized or charged with a crime. The study also suggests that younger siblings of the children who participate in the program may experience positive spillover effects. The Perry Preschool Project was another randomized study conducted between 1962 and 1967 to track the effects of high-quality early childhood education on low-income, at-risk African-American children's IQ (Schweinhart, 2005). The study used the High/Scope education model, which is an active learning model. Teachers in the program had bachelor's degrees and certificates in education. In this model, teachers organized the classroom and daily schedule to support children's self-initiated learning activities, offer both small and large group activities, and assisted children. The project followed the progress of participating

children, and Schweinhart studied the data of participants at the age of 40 and finds that high-quality preschool programs such as Perry for children living in poverty could contribute to their intellectual and social development during childhood, improve academic performance and economic success, and reduce crime rates in adulthood. Heckman et al. (2013) conducts an analysis to identify channels through which the Perry Preschool Project improved outcomes for participants using longitudinal data on cognitive and personality traits from this program and finds that persistent changes in personality traits significantly contribute to the success of the Perry program.

Early intervention programs are mostly conducted in developed countries. However, a 2-year intervention program in Jamaica between 1986 and 1987 is one of the rare programs conducted in developing countries. The program provided psychosocial stimulation to children suffering from growth retardation and community health workers conducted weekly visits to teach parenting skills and encourage mothers and children to interact, building cognitive and socioemotional skills. The program's results indicate that it increased the earnings of the participants by 25% compared to the control group. The study concludes that ECD interventions may be a more effective strategy for enhancing long-term outcomes for underprivileged children in developing countries, as the estimated effects were significantly greater than those reported for US-based interventions (Gertler et al., 2014). Another study conducted in developing countries was recently conducted in China in 2014 and offers an integrated, cross-sectoral, and community-based package of nurturing care intervention focusing on five components (child health, nutrition, responsive care, protection, and early learning support) along with the national basic public health service package. Program results shows that it can significantly prevent developmental delay in children under three years of age in rural China (Zhou et al., 2019).

Anderson et al. (2003) conducts a comprehensive review of the literature and finds that programs like Head Start, which aims to bridge the gap in learning readiness between underprivileged children and their financially privileged counterparts, effectively prevent developmental delays. These programs help reduce grade retention and the need for special education. These findings highlight the importance of early

intervention to support development in children from lower socio-economic status families.

2.4. Rationale for Government Intervention

Research indicates that investing in ECD programs generates higher returns compared to investments made in later periods (Heckman, 2000; Cunha and Heckman, 2007). Failure to invest in children in their early years will lead to irreversible consequences for individuals, families and society in the long term (Denboba et al., 2014). The high returns provided by early intervention programs for individuals and society require government intervention. A government aiming to promote equality in society can intervene in three ways to reduce disparities between individuals. First, it can compensate for differences in individuals' outcomes in adulthood. Second, it can try to equalize the initial conditions, or, as a third way, it can do both. However, equalizing conditions in the early years through early childhood intervention programs may be a more effective approach to ensuring equality in society.

García et al. (2017) explores the rate of return to two early childhood development programs targeting disadvantaged children launched in the 1970s: the Carolina Approach to Responsive Education and the Carolina Abecedarian Project. Programs are evaluated by randomized control trials, and participants were included in the program from 8 weeks to 5 years of age in the study, followed up to their mid-30s. Results showed that programs have a 13.7% annual tax-adjusted internal rate of return and a 7.3 tax-adjusted benefit/cost ratio. Rolnick and Grunewald (2003) also indicates that the return on investing in ECD is exceptional, including improved public schools, a more educated workforce, and reduced crime rates, and argues that any future economic development agenda should prioritize ECD investment. As shown by the studies, investing in children at an early age has provided high economic returns for both individuals and society. While this is reason enough to prioritize investment during early childhood, it is also important to consider the role that early investment plays in creating equal opportunities for individuals from the very beginning of life. By providing all children with the same opportunities to succeed, society can reduce inequality and help ensure a fairer future for all.

Government intervention also eliminates moral hazard problems when society tries to compensate for poor outcomes due to insufficient investments. Furthermore, government interventions can help address market failures like liquidity constraints, information gaps, and externalities (Currie, 2001). Liquidity constraints may prevent parents from making the optimal investment in their children's human capital. To address this issue, the government can implement policies to increase household income. However, liquidity constraints alone would justify government intervention only to low-income households (Currie, 2001). Two types of credit constraints affect families. First, even if the family's lifetime income would enable them to make sufficient ECD investments, the family may not be able to make sufficient investments because they may have lower income levels when the child is young. The second is that the lifetime income is too low to borrow enough for the child investment (Schady et al., 2006). The second potential market failure in child development is information failure. Unlike liquidity constraints, this issue affects all children, regardless of their family's socioeconomic status. By informing families about child development, governments can enable them to make more optimal decisions about investing in their children. Finally, externalities are an important justification for government intervention in ECD investment. Because the family cannot consider the cost or benefit that the child will create for society when investing, but the state can internalize this benefit and provide the necessary investment.

CHAPTER 3

EARLY CHILDHOOD DEVELOPMENT IN TÜRKİYE

3.1. Introduction

Early childhood development refers to the period from conception until school age. This period generally covers the age range of 0-6 years, but can be extended to the age of 8 depending on the school starting age, which varies from country to country (Britto et al., 2017). In Türkiye, children under the age of 6 are considered to be in the early childhood period, as the official school starting age is 72 months.¹

According to data from TURKSTAT, the number of children under the age of 6 in Türkiye has increased from 6,976,815 in 2007 to 7,777,315 in 2018, but then showed a significant decrease and reached 6,967,178 in 2022. Since 2009, the share of children aged 0-6 in total population has started to decrease with the decrease in the birth rate. In 2022, as seen in Figure 3.1, it is at 8.2% and still constitutes a significant part of the total population. The young population rate is defined as the ratio of the population under the age of 15 to the total population.²

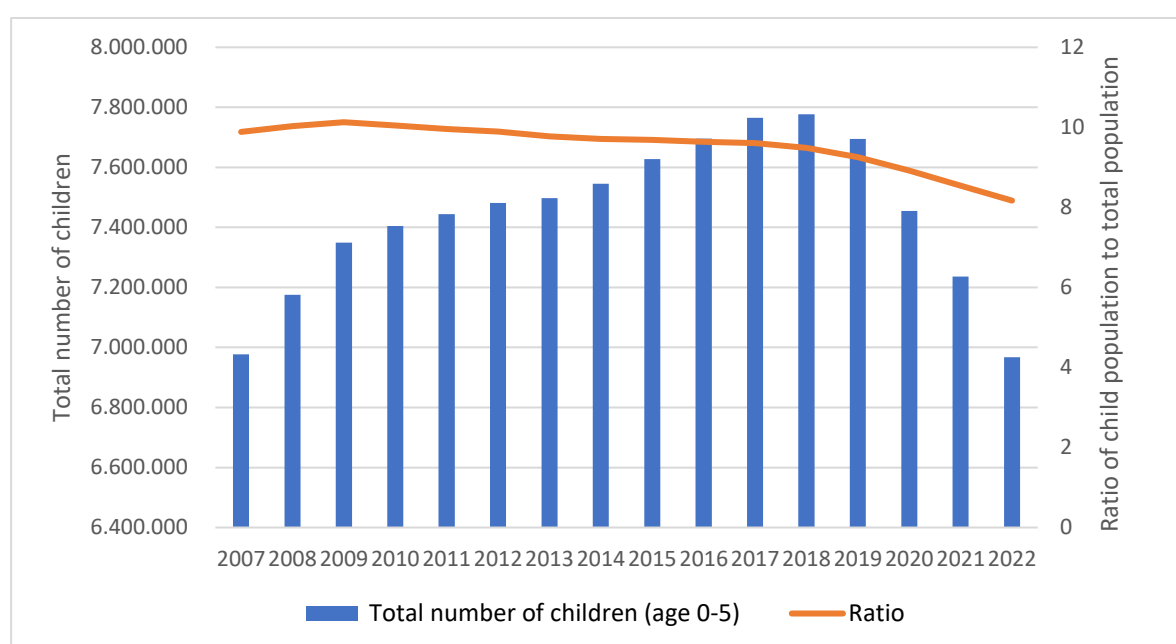
According to the data provided by The Organization for Economic Cooperation and Development (OECD), in Türkiye, this rate is 22.2%, which is similar to Brazil (20.5%) and Colombia (22.6%). However, in developed countries like the USA (17.8%), Germany (14%), and Canada (15.6%), or the average of countries in the European Union (15%) and OECD (17.3%), Türkiye has a significantly higher rate. The high rate of young population in Türkiye highlights the importance of investing in the country's youth.

¹ Children who are 72 months old on December 31 of that year, namely children who are 69 months old as of the end of September of the year of registration, are enrolled in the first grades of primary schools. In addition, if parents request, children aged 66, 67, and 68 months as of the end of September of the year of registration are also enrolled in the first grade of primary school.

² Data provided by the OECD according to this definition were used to make broader comparisons. TURKSTAT defines the youth population ratio as the ratio of the population under the age of 17 to the total population.

3.2. State of Children in ECD period

Compelling evidence suggests that investing in early childhood education can enhance human capabilities, especially for children from disadvantaged backgrounds, and also help prevent adverse economic and social outcomes. For example, the Programme for International Student Assessment (PISA), conducted by the OECD, assesses the performance of 15-year-old students and provides clear evidence of the benefits of early education. Students who attended pre-primary education for one year scored an average of 27 points higher compared to those who had not attended or attended for less than one year (OECD, 2020b).



Source: TURKSTAT

Figure 3.1: Number of Children

In this section, we analyze the ECD index results that were obtained for the first time at international standards in 2018. Additionally, we examine the situation of children in Türkiye regarding education and health during the ECD period.

3.2.1. Early Childhood Development Index

In 2018, ECD indicators based on the Multiple Indicator Clustering Survey (MICS) methodology, developed by the United Nations Children's Fund (UNICEF) and used to measure the development of children in the ECD period, were included in the

Türkiye Demographic and Health Survey (TDHS). This survey has been conducted every five years since 1968 and covers areas such as fertility, maternal and child health, and family planning. The availability of data at international standards in Türkiye would enable the investigation of the factors that determine ECD in the country and the development of policies that would improve ECD results. It would also enable comparison with countries using the same standards. The survey included 1071 children aged 36-59 months, along with information about their parents.

There are 10 items that determine if children are developmentally on track across four domains: literacy-numeracy, physical, social-emotional, and learning. In the 10-item questionnaire adopted from the Early Childhood Development module of UNICEF's Multiple Cluster Surveys (MICS) mothers are asked 10 questions about their children's development to determine whether their child is on track, or not. The questions cover four domains: literacy and numeracy skills, physical development, learning readiness, and socio-emotional development. The child is considered developmentally 'on track' if he/she is on track in at least three of the four development domains. In the literacy-numeracy domain, the child is assessed to be on track if they demonstrate two positive outcomes in three questions, including whether he/she identifies/names at least ten letters of the alphabet, reads at least four simple popular words, or names/recognize the symbol of all numbers from 1 to 10. In physical development, the child is assessed to be on track if they demonstrate one positive outcome in two questions, including whether he/she can pick up small objects with two fingers, like a stick or a rock from the ground, and whether he/she is sometimes too sick to play. In the learning readiness domain, the child is assessed to be on track if they demonstrate one positive outcome in two questions, including whether the child can follow simple directions on how to do something correctly, and when given something to do the child can do it independently. Finally, in the socio-emotional domain, the child is assessed to be on track if they demonstrate two positive outcomes in the question, including whether the child gets along well with other children, whether the child kicks, bites, or hits other children or adults, and whether the child gets distracted easily (Loizillon et al., 2017).

The early childhood development index (ECDI) calculates the percentage of children on track in at least three domains. Table 3.1 reports the results of ECDI and its

components. In Türkiye, 73.7% of children are developmentally on track. In the sub-indicators, a high percentage of children are developmentally on track in physical development and learning readiness and moderate level of children are on track in socio-emotional development. However, only a small proportion of children are developmentally on track in the field of literacy numeracy. When the subcomponents of the ECD index are examined, it is observed that the rate of children who are on track in the physical development and learning readiness domains is very high. However, the proportion of children who are on track in the social-emotional development domain is relatively lower, and a very low rate is observed in children who are on track in the field of literacy-numeracy.

Table 3.1: Early childhood development index (ECDI) in Türkiye

Developmental field	Percentage of children developmentally on track
ECD Index	73.7
Physical Development	97.9
Learning Readiness	95.7
Literacy/Numeracy	14.4
Socio-Emotional Development	73.3

Source: 2018 Türkiye Demographic and Health Survey Report

It's highly likely that the availability of universal healthcare has contributed to a high percentage of children being on track developmentally in physical development and learning readiness domains. However, the low percentage of children who are developmentally on track in literacy-numeracy and social-emotional domains is likely due to low participation in early childhood education and care programs. These programs are not compulsory and are not fully publicly subsidized, so parents may not be aware of the benefits, or they may find it too expensive to enroll their children in such programs (Karaoglan et al., 2023).

3.2.2. Education

In Türkiye, children between 57 and 68 months old may register for kindergarten and reception classes affiliated with Ministry of National Education (MoNE). If the

institution has adequate physical capabilities, children between 36 and 56 months old can enroll in kindergartens, and children between 45 and 56 months old can enroll in reception classes. In addition, nurseries affiliated with the Ministry of Family and Social Services (MoFSS) serve children aged 0-24 months, while daycare homes serve children aged 25-66 months.

Based on TURKSTAT data, Table 3.2 shows that enrollment rates in preschool education for 3-5-years old children have increased significantly from 26.9% in 2009-2010 school year to 51.4% in 2022-2023 school year. Enrollment rates for 4–5-year-olds have also increased from 38.6% in 2009-2010 school year to 63.6% in 2022-2023 school year due to the increase in kindergarten enrollment rate. As per the MoNE's 2015-2019 Strategic Plan, the target net enrollment rate for children aged 4-5 years was set at 70%. Unfortunately, this target was not achieved, and the actual rate as of 2019 was reported as only 50.8%.

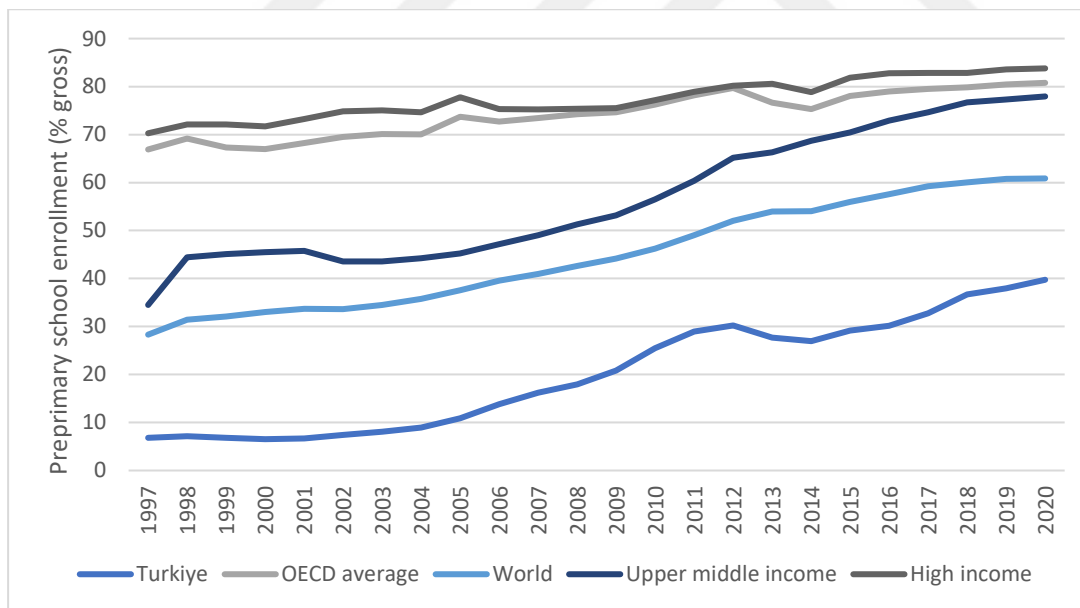
Table 3.2. Net enrollment rate in preschool education, Türkiye (%)

School year	The ages of 3-5	The ages 4-5
2009-2010	26.9	38.6
2010-2011	29.9	43.1
2011-2012	30.9	44.0
2012-2013	26.6	37.4
2013-2014	27.7	37.5
2014-2015	32.7	41.6
2015-2016	33.3	43.0
2016-2017	35.5	45.7
2017-2018	38.5	50.4
2018-2019	39.1	50.8
2019-2020	41.8	52.4
2020-2021	28.3	36.8
2021-2022	44.1	55.9
2022-2023	51,4	63,6

Source: TURKSTAT Education Statistics

According to the 2019-2023 Strategic Plan of the MoNE published in 2019, the gross enrollment rate target for ages 3-5 was 45.4% in 2019, while the target for 2023 was set at 55%. The schooling rate for this age group was 39.1 in 2019 and 51.4 in 2023, remaining below the targets. Considering the 11th Development Plan's 2019-MoNE in the Strategic Plan appears quite conservative.

Based on World Bank data, Türkiye has seen a slight increase in its preschool enrollment rate in recent years. However, it still lags behind both the global average and the average of the OECD as seen in Figure 3.2. When compared to other upper-middle-income countries, Türkiye must make progress in preschool enrollment. In high-income nations, pre-primary education is compulsory at certain ages. For example, in France, pre-primary education starts at age three, while in Luxembourg and Switzerland, it begins at age four. Consequently, these countries have maintained an average enrollment rate of higher than 80% in recent years. As shown in Figure 3.2, high-income countries have the highest pre-primary enrollment rates, followed by OECD countries and upper middle-income countries.



Source: World Bank, World Development Indicator Database

Figure 3.2: Schooling Rate in Pre-School Education (% , gross)

Türkiye's pre-primary enrollment rate remains below the world average. High enrollment rates in developed countries can be attributed to various factors, in addition

to compulsory pre-primary education. Firstly, developed countries are well aware of the high return on investment of the ECD period. Therefore, they prioritize early childhood education by implementing sound government policies such as financing and subsidizing preschool education. Many of these countries aim to achieve universal preschool education that can cover all children, regardless of their socioeconomic backgrounds (Havnes and Mogstad, 2015; OECD, 2020a). Secondly, there is a growing awareness in these countries about the long-term positive effects of early childhood education on child development, which increases the demand for these services (OECD, 2020a, 2021). Lastly, since the labor force participation of the mother, who is often the primary caregiver, is higher in developed countries, it becomes mandatory for children to benefit from these services (Thevenon, 2013). In order to achieve high participation rates in pre-primary schools, Türkiye needs to increase awareness about the importance of the ECD period and create policies for disseminating early childhood education services.

3.2.3. Health

Health is a critical factor in a child's development. Türkiye has significantly increased health expenditures with the Health Transformation Program (HTP) since 2003. The implementation of the HTP has led to significant improvements in the health of children in Türkiye. For instance, based on the data provided by the OECD, the child vaccination rate increased from 68% in 2003 to 96% in 2007 and has remained at this high rate since then (OECD, 2024a), and the infant mortality rate decreased from 29 in 2003 to 9.2 in 2022 per thousand per 1000 live births (OECD, 2024b). Türkiye has achieved a good vaccination rate among OECD countries. However, when it comes to infant mortality rates, Türkiye ranks fourth with the highest number of infant deaths after Costa Rica (9.6), Mexico (12.7), and Colombia (16.5) per thousand per 1000 live births.

The family practice system has been one of the most significant contributions to HTP (Ministry of Health, 2024b). This system has extended throughout the country since 2010 and has been expected to reduce the gap in healthcare services, particularly among children from different socioeconomic backgrounds. With the majority of

primary healthcare services provided for children being free, the system is expected to reduce inequality in the use of health services, such as laboratory tests and vaccines. Also, all individuals under the age of 18 are covered by general health insurance, regardless of their family's insurance status, in accordance with the Social Insurance and Universal Health Insurance Law published in the Official Gazette in 2006. Nevertheless, despite expectations, healthcare services do not benefit all children equally with HTP in Türkiye. Caner et al. (2018) conducted a study using data sets from the 2008-2012 Türkiye Health Survey. Their research confirms that the use of healthcare services by children aged between 0-5 is significantly affected by the socioeconomic status of their families. Specifically, the study found that children from families with higher education and income levels benefit more effectively from healthcare services. It has been suggested in various studies that the overall health of children is closely linked to the socioeconomic status of their family (for example Case et al., 2002; Currie and Hyson, 1999; Wolfe, 2015). Similar conclusions have also been reached in studies conducted in Türkiye. For example, Karaoğlu and Saraçoğlu (2018) analyzed data from the 2013 Türkiye Demographic and Health Survey (TDHS) and found that children living in urban areas tend to be healthier than those living in rural areas. They also observed that the mother's education level has a significant impact on the child's health. Similarly, using data from the 2008 TDHS, Güneş (2015) confirmed the causal relationship between the mother's education and the child's general health. In 2006, according to the Social Insurance and Universal Health Insurance Law, all children are covered by universal health insurance, regardless of their families' insurance status. A study conducted using data from Turkish Health Research Surveys found that there is still inequality in accessing healthcare services for children under the age of 6. The study found that children from families with higher income and education levels have benefited more from these services, indicating that there is still inequality in access to healthcare services (Caner et al., 2018).

3.3. ECD in National Strategy Plans

In Türkiye, policies for ECD are included in top policy documents such as development plans and presidential annual programs. In addition, Strategic Plans of

the MoNE the Ministry of Health (MoH), and the MoFSS also included ECD goals, targets, and strategies.

3.3.1. Top Policy Documents

Previous national development plans have acknowledged the insufficiency of ECD programs and the need for increased early childhood and parent education (DPT, 2006; Ministry of Development, 2013). However, targets towards ECD being included among the 2030 Sustainable Development Goals adopted by 193 countries at the United Nations Sustainable Development Summit in 2015, the more specific policies, goals, targets and strategies are defined in the field of ECD were included in the 11th Development Plan (2019-2023) prepared by the Presidency of Strategy and Budget (Strategy and Budget Department, 2019).

In the 11th Development Plan (2019-2023), the government aims to increase the number of institutions providing early childhood care and education services, diversify service delivery models, and increase inspections. Also, including early childhood education in compulsory education for 5-year-olds, creating flexible curricula and alternative education models are among the policies and measures.

In the 2024 Presidential Annual Program, it is planned to make more systematic progress in the field of ECD with the adoption of the Draft National Early Childhood Strategy Document prepared under the coordination of the Presidential Strategy and Budget (Presidency, 2023). However, there is still room for further progress regarding the early childhood period in Türkiye, as the targets for this period have not been achieved by 2023. Therefore, concrete policies and measures for this period have been determined in the 12th Development Plan (2024-2028) (Strategy and Budget Department, 2023). Some of these are as follows:

731. Starting from the prenatal period, the provision of services for children's health, nutrition, early learning, responsive care, safe environment, and social protection policies, increasing accessibility, and improving quality will be ensured.

731.1. Starting from the prenatal period, qualified, sustainable, accessible, and behavior change-oriented parent training will be increased.

731.3. A uniform regulation will be established for institutions providing early childhood care and services, with criteria set for the opening and operation of these institutions to allow for service diversity.

731.4. The number of institutions providing early childhood care and services will be increased, service delivery models will be standardized, and inspections will be made more effective.

731.5. The capacity of the personnel working in institutions that provide early child care and development services will be enhanced.

The policies and measures outlined in the Development Plan offer guidance on the goals and objectives set out in the strategic plans of the Ministries. Therefore, it is important to establish comprehensive, holistic, and concrete policies and measures in development plans in order to achieve the targets related to the ECD period in the future.

3.3.2. Strategic Plans of the Ministry of National Education

In the 2019-2023 period, the MoNE aims to increase the quality and prevalence of early childhood education to ensure preschool education students' cognitive, emotional, and physical development (Ministry of Education, 2019). While expanding its services, the Ministry has developed strategies to create an integrated system and improve the quality of education for underprivileged groups.

The difficulties in disseminating these services are defined as the need for more awareness about the impact of early childhood education on children and the cost of these services. In addition, the absence of a centralized system for operating and supervising various institutions that offer early childhood education poses a risk to the quality of services. Making legislative arrangements to include 5-year-olds within the scope of compulsory education, increasing the number and experience of teachers required in this regard, and developing service models to meet the access and nutrition needs of children in need are listed among the needs for disseminating these services. The Ministry has set a target to increase the enrollment rate of children aged 3-5 years old. The plan was to gradually increase the enrollment rate every year to reach 50% in

2022 and 55% in 2023, from the current rate of 44% in 2018 when the plan was prepared. However, the targeted level could not be achieved, and the schooling rate for 3-5-year-olds remained at 52.21% in 2023.

In its 2024-2028 strategic plan, under the target of "*access opportunities will be increased by supporting preschool education*" MoNE aims to increase the schooling rate for 3-5-year-olds to 60% by 2028 (Ministry of Education, 2023). It also aims to increase the number of students receiving at least one year of preschool education before starting formal education to 100% by 2028. In order to achieve these goals, the ministry has identified the following strategies: disseminating alternative access models, increasing physical space capacity in preschool education, enhancing parental information activities in preschool education, promoting school-family cooperation in preschool education, and raising awareness through information activities.

3.3.3. Strategic Plans of the Ministry of Health

The MoH has set the goal of reducing infant and child mortality rates by implementing an integrated health service model in the 2019-2023 Strategic Plan (Ministry of Health, 2022). This will involve strengthening the system that prevents risk factors and provides protective services for infant and child health. As part of the Plan, the first objective of the current health policies is to introduce an integrated health service model. The Ministry developed new strategies based on historical data to reduce the number of infant deaths. It has been found that the healthcare professionals working in the field of newborn, infant, and child health services are not meeting the desired standards. The Ministry aims to strengthen the prevention system and provide preventive services to reduce infant and child mortality rates by addressing risk factors in infant and child health. In addition, since the current screening programs for newborn, infant and child health services do not cover all diseases, the ministry aims to redesign and expand screening and monitoring processes to cover a wider range of diseases.

The Ministry suggests that raising awareness about risk factors associated with pregnancy and postpartum complications and improving the health systems are crucial to achieving a level of high-income countries in preventing maternal and infant deaths.

In order to improve the system, it is aimed to provide training to increase the capacity and competencies of healthcare personnel, establish referral processes, and disseminate screening-monitoring programs.

The MoH has set a goal to gradually decrease the infant death rate per 1,000 live births. It aims to reduce the infant death rate, which was 9.2 in 2018 when the plan was prepared, to 8.5 by 2021 and to maintain it at that level. However, the target was not achieved in 2022. The Ministry aims to reduce the infant mortality rate to 8.5 by 2028 in the 2024-2028 strategy document. The ministry concedes the difficulty in reducing the premature birth and low birth weight, which are the main causes of the infant mortality rate, as a risk factor in reaching the target. The infant and child mortality rate has been decreasing in Türkiye for three decades, according to OECD data. The Ministry acknowledges that reducing infant and child mortality rates to a lower level will be challenging due to the presence of complex causes in the 2019-2023 Strategic Plan, such as the competencies of healthcare personnel in newborn, infant, and child health services should be increased, the screening and monitoring processes should be redesigned, and their scope should be expanded, communication strategies and medical interventions should be developed to reduce premature births, referral processes should be designed and standardized, and transportation conditions should be improved. The Ministry also considers it necessary to organize awareness activities to popularize exclusive breastfeeding in the first six months and to improve the service delivery of health institutions in this field to achieve the targets on infant mortality rate. However, in the 2024-2028 Strategic Plan, the risk of "failure to reveal the exact causes of prematurity and related conditions or limited intervention area due to social structure" in reducing infant mortality is identified (Ministry of Health, 2024a).

3.3.4. Strategic Plans of the Ministry of Family and Social Services

In the 2022-2026 Strategic Plan, the MoFSS set a target to improve protective and preventive services, to ensure that children are raised in the family environment, protected from all kinds of risks, in order to ensure the healthy development of children and to ensure equality of opportunity with their peers, and to create the necessary mechanisms to achieve the targets. It aims to increase the service quality of specialized

care institutions for children under protection by expanding the activities carried out to raise children in need of care with their families (Ministry of Family and Social Services, 2022).

According to the Ministry, the current number of children who are able to attend private nurseries, daycare centers, and children's clubs free of charge is not enough, and aims to increase number of children from 2599 as of 2021 to 2900 by 2026.

The Ministry has also determined that children in the risk group should be supported socially and economically, and intervention methods should be developed for identified risk areas. In order to increase the quality of child care services, it is aimed to increase the number of trainings given to the personnel working in these institutions from 2 in 2021 to 20 in 2026. Failure to establish adequate cooperation with stakeholder institutions and organizations within the scope of the Child Protection Law has been shown among the risks in this field.

3.4. Investment in Early Childhood Development

Expenditures for children in the ECD period cannot be explicitly determined for Türkiye. In this sub-section, we will begin by presenting a study that estimates the proportion of ECD expenditures in public expenditures. Next, we will analyze the current situation of ECD investment by examining education expenditures in Türkiye and comparing different sectors and countries. Lastly, we will make a similar comparison based on health expenditures.

Saraçoğlu et al. (2020) categorized expenses related to children into four categories: child development, child education, child health, and child protection. This study then identified the institutions that are responsible for providing public service programs for children. These institutions' service programs and activities were analyzed based on their strategic plans, performance programs, activity reports, and budget documents in order to calculate public spending on children. The results of the study are presented in the Table 3.3.

Based on the results of the study, education expenditures have the highest share among the sub-categories of ECD at 67.6%, followed by health and social protection

expenditures at 26.7% and 5.8%, respectively. The share of education expenditures in gross domestic product (GDP) has slightly increased over time, while the share of health and social protection expenditures has remained nearly constant. When measured at constant prices, education expenditures have increased by 85.4%, health expenditures by 32.5%, and social protection expenditures by 103%.

3.4.1. Investment in Education

According to the National Education Statistics of the MoNE, 39,826 schools and institutions provided preschool education across Türkiye in the 2022-23 school year. 80% of these are public institutions, and 20% are private institutions. 83% of public institutions are affiliated with the MoNE, 54% of which are kindergartens, and 46% are reception classes. The majority of other public institutions that are not affiliated with the MoNE are nurseries opened by municipalities and associations, and community-based institutions affiliated with the Presidency of Religious Affairs. 71% of private institutions are kindergartens and reception classes affiliated with the MoNE, this rate has increased in recent years. On the other hand, it consists of private institutions that are not affiliated with the MoNE nurseries and daycare centers affiliated with the MoFSS, and nurseries opened in businesses in accordance with the Labor Law. Over the past year, there has been a notable rise in the number of schools and teachers. However, the most significant increase has occurred in kindergartens, which are present in both public and private institutions that are not associated to MoNE. In the 2022-2023 school year, slightly over 2 million children are enrolled in public and private preschools in Türkiye. Among them, 82% continue their education in public institutions while the remaining 18% attend private institutions.

Of the 1,681,705 children receiving education in public institutions, 51% attend kindergarten classes in schools that are affiliated with the MoNE. On the other hand, 77% of children attend kindergarten classes in private institutions that are affiliated with the MoNE.

In recent years, there has been an increase in the rate of private educational institutions affiliated with MoNE. In Türkiye, financial support is granted to preschool institutions based on the number of registered students, classrooms, and location. In addition to

Table 3.3. Expenditures on ECD in Türkiye under the General Administration

million TL

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Education	2.963	3.411	3.632	4.491	5.222	6.502	7.419	9.881	11.571
Health	1.637	1.764	1.987	2.201	2.464	2.820	3.292	3.841	4.567
Social Protection	230	280	345	379	445	616	748	849	985
Total	4.831	5.455	5.964	7.072	8.131	9.938	11.459	14.571	17.123
Percentage Distribution									
Education	61.3	62.5	60.9	63.5	64.2	65.4	64.7	67.8	67.6
Health	33.9	32.3	33.3	31.1	30.3	28.4	28.7	26.4	26.7
Social Protection	4.8	5.1	5.8	5.4	5.5	6.2	6.5	5.8	5.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Rates to GDP (%)									
Education	0.21	0.22	0.20	0.22	0.22	0.25	0.24	0.27	0.27
Health	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11
Social Protection	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total	0.35	0.35	0.33	0.35	0.35	0.38	0.37	0.39	0.40
At Fixed Prices (2009 = 100)									
Education	2.559	2.743	2.748	3.163	3.411	3.929	4.040	4.622	4.745
Health	1.414	1.418	1.503	1.551	1.609	1.704	1.793	1.796	1.873
Social Protection	199	225	261	267	291	372	408	397	404
Total	4.172	4.386	4.513	4.981	5.311	6.006	6.241	6.815	7.022

Source: Saraçoğlu et al. (2020)

public resources, financial support is also provided to preschool education institutions from special provincial administration budgets, project funds and donations, municipalities, private individuals, institutions and organizations (European Commission Eurydice Preschool Education Financing Türkiye National Policy Document). Of the 1,681,705 children receiving education in public institutions, 51% attend kindergarten classes in schools that are affiliated with the MoNE. On the other hand, 77% of children attend kindergarten classes in private institutions that are affiliated with the MoNE.

In recent years, there has been an increase in the rate of private educational institutions affiliated with MoNE. In Türkiye, financial support is granted to preschool institutions based on the number of registered students, classrooms, and location. In addition to public resources, financial support is also provided to preschool education institutions from special provincial administration budgets, project funds and donations, municipalities, private individuals, institutions and organizations (European Commission Eurydice Preschool Education Financing Türkiye National Policy Document).

Table 3.4 shows that, in 2022, the private sector's share in the total expenditures made on preschool education by the public and the private sector decreased from 22.5% to 18.8%. However, the households' share in the private sector decreased from 78.1% in 2011 to 63.1% in 2022. Although there was a slight increase in the share of households in the previous four years, it decreased from 68.9 to 63.1 in 2022. There has been no significant change in the ratio between public expenditures made by central and local administrations.

Table 3.5 presents the share of preschool education expenditures in total education expenditures according to financial sources. The share of the MoNE budget in GDP has decreased in recent years and reached 2.4% in 2022. Although the share of expenditures for preschool education in total education expenditure has decreased in recent years, it increased to 5.1% in 2021 from 6.4% in 2022.

Similarly, although the share of the central public expenditure on preschool to the total state expenditures has decreased in recent years, it increased to 6.6% in 2022.

Table 3.4: Distribution of total, public and private expenditures in pre-primary education expenditures by source of finance (%)

	Total		Public		Private	
	Public	Private	Central	Local	Households	Private entities
2011	72	28.8	94.6	5.4	78.1	23.7
2012	68.8	31.9	94.3	5.7	78.5	23.2
2013	68.7	32.0	93.3	6.7	77.7	23.7
2014	68.3	32.5	97.4	2.6	78.2	23.2
2015	73.1	27.6	97.9	2.1	76.7	25.1
2016	72.4	28.1	98.6	1.4	74.9	27.0
2017	72.9	27.6	98.3	1.7	69.4	32.6
2018	80.3	21.1	98.6	1.4	64.2	37.8
2019	84.1	17.9	99.0	1.0	66.2	36.6
2020	86.1	14.9	99.2	0.8	67.4	35.1
2021	77.9	22.5	98.8	1.2	68.9	33.5
2022	82.5	18.8	98.2	1.8	63.1	40.0

Source: TURKSTAT, Education Expenditure Statistics, 2022

There has been a much more dramatic increase in the ratio of local public expenditure on preschool education, increasing from 7.9% in 2013 to 16.2% in 2022. Public expenditure on early ECEC in Türkiye is 0.3% of GDP, while the OECD average is 0.8%, and the European Union is 0.7%. Nordic countries like Iceland, Sweden, and Norway, which have notable investments in ECEC, have 1.7%, 1.6%, and 1.4% shares, respectively (OECD, 2023).

The data presented in the Figure 3.3 indicates that while the amount spent on each preschool student has increased in Turkish Lira (TL) in recent years, it has decreased when measured in US dollars. In 2022, the expenditure per student reached 19001 TL, approximately 75% higher than the previous year's level of 10892 TL. Even though this was the highest increase in recent years, the expenditure in dollars continued to decline. The expenditure per student, which was \$1224 per year in 2021, decreased to \$1145 in 2022. This decline can be attributed to the high inflation rate experienced in Türkiye in 2022. Although the expenditure per preschool student increased in nominal terms, there was a decrease in real terms.

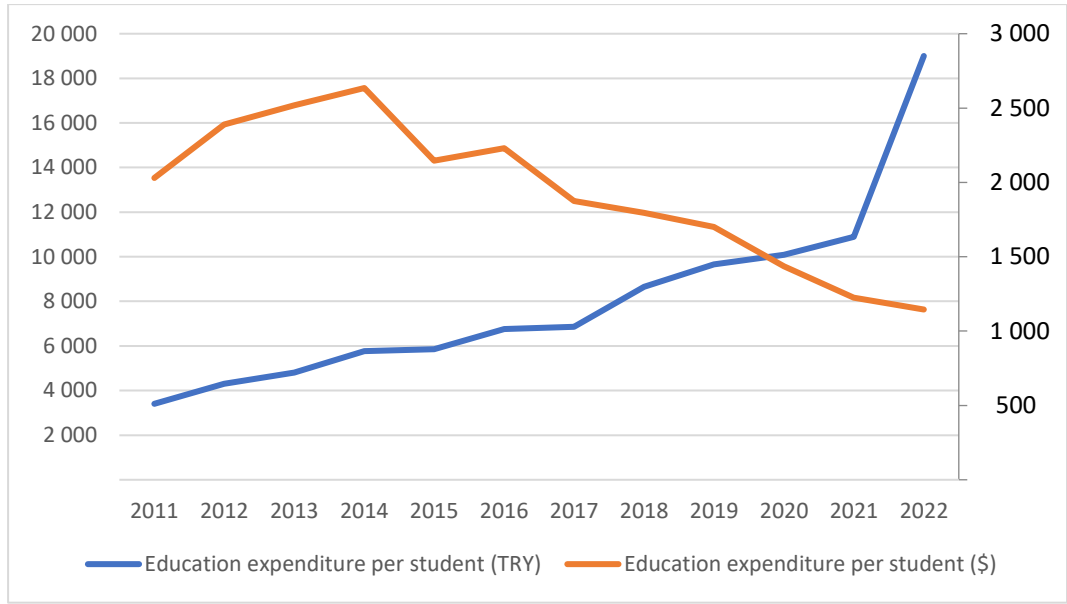
Table 3.5: Share of preschool education in total education expenditures by financial source (%)

Share of preschool expenditures in total education expenditures								
	MoNE Budget/GDP	Total	Public			Private Sector		
			Total	Central	Local	Total	Households	Private entities
2011	2.6	5.4	5.0	4.8	9.7	5.9	6.5	4.5
2012	2.8	5.4	4.8	4.7	8.9	6.0	6.6	4.6
2013	3.0	5.1	4.5	4.4	7.9	5.9	6.5	4.4
2014	3.2	5.5	4.9	4.9	8.3	6.3	6.9	4.8
2015	2.7	5.4	5.0	5.0	9.2	5.3	5.9	4.1
2016	2.9	5.6	5.2	5.1	8.9	5.6	6.1	4.5
2017	2.8	5.6	5.3	5.3	9.4	5.3	5.5	4.9
2018	2.7	6.1	6.5	6.4	8.8	4.4	4.2	4.8
2019	2.6	6.2	6.9	6.9	10.5	3.7	3.4	4.5
2020	2.6	5.2	5.9	5.9	9.3	2.8	2.6	3.3
2021	2.6	5.1	5.4	5.3	11.8	3.8	3.5	4.5
2022	2.4	6.4	6.7	6.6	16.2	4.8	4.9	4.8

Source: TURKSTAT, Education Expenditure Statistics, 2022

3.4.2. Investment in Health

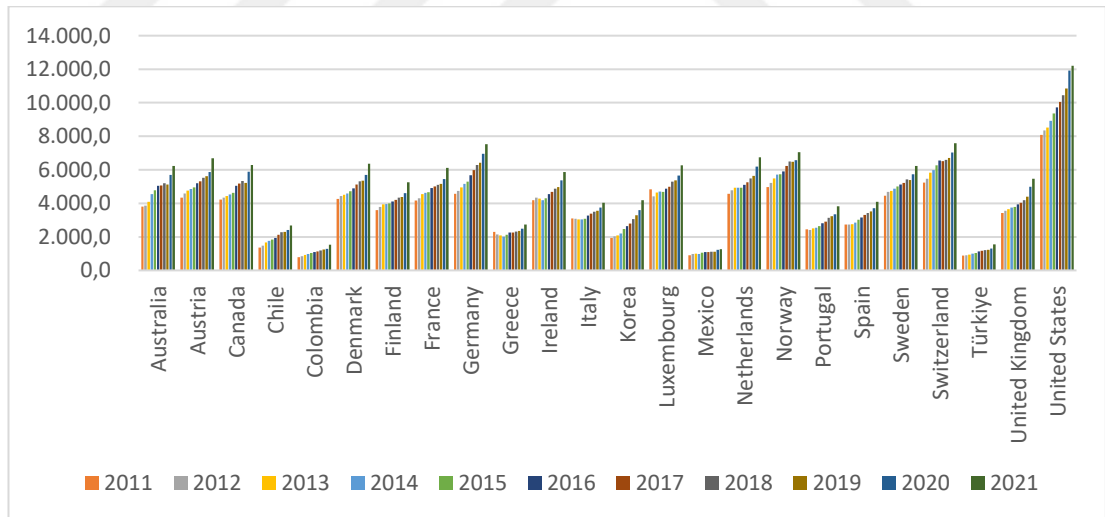
Studies have shown that investing in early childhood health is a crucial factor that affects a child's future. For instance, according to (Case et al., 2005), early childhood health has a significant impact on a child's health in later life, as well as their employment and socioeconomic status. Therefore, a country's policies that focus on improving child education and health will be one of its best investments in human capital. Moreover, such policies will help to improve child health and reduce inequality among children from different socioeconomic backgrounds (Murray and Frenk, 2000).



Source: TURKSTAT

In spite of the fact that Türkiye has made a significant improvement in health expenditures through the HTP put into practice in 2003, the amount of health expenditures per person is still quite low compared to that in the developed countries.

Figure 3.3: Educational Expenditure Per Student in Preschool Education

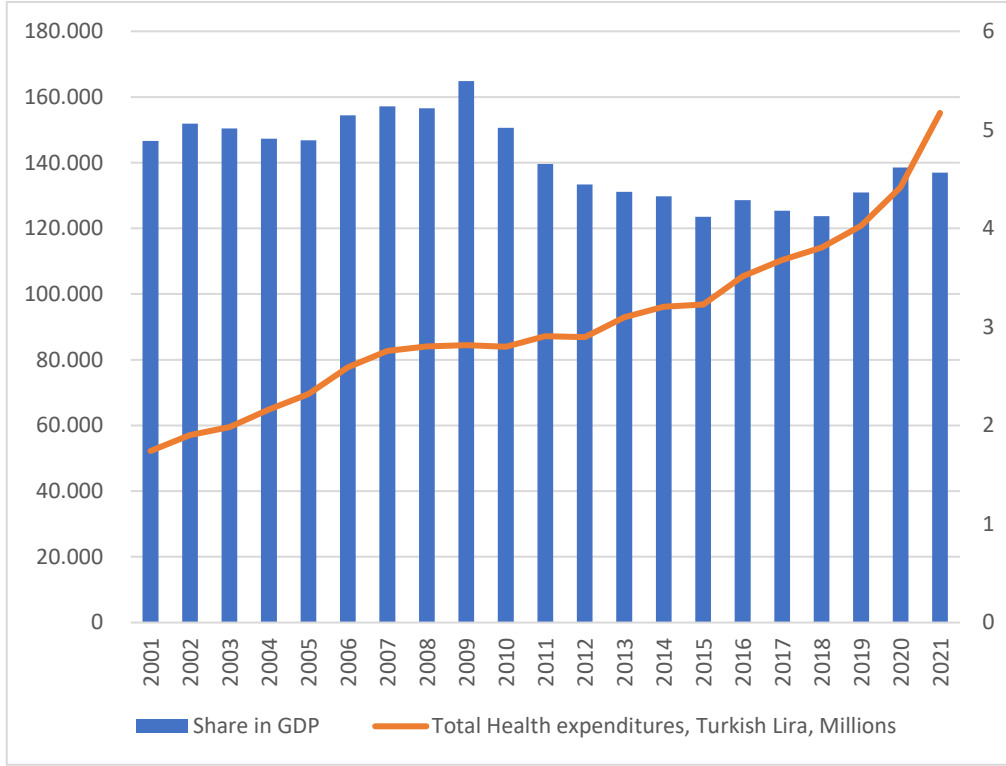


Source: OECD

Figure 3.4: Health Expenditures of Selected OECD Countries
(In USD According to Purchasing Power Parity)

In terms of health expenditures as a percentage of GDP in 2022, Türkiye ranks last among OECD countries at 4.2% followed by Mexico and Luxembourg with 5.5%. On the other hand, the USA and Germany are at the top with 16.6% and 12.7%

respectively (OECD, 2023). Figure 3.4 shows that although Türkiye has recorded a significant improvement in health expenditures with the HTP, which has been implemented since 2003, the amount of health expenditures per capita is still relatively low compared to developed countries.



Source: OECD

Figure 3.5: Total Health Expenditures in Türkiye and Their Rate to GDP (%)

As can be shown in Figure 3.5 total health expenditures in Türkiye at constant prices (2015 is the base year) and its share in GDP. Although there has been a significant increase in total health expenditures since 2001, the share of total health expenditures in GDP has remained at lower levels in recent years compared to the level in 2009.

The MoFSS provides Conditional Health Benefits (CHB) to families who do not have social security and are in need. These benefits are available if they take their children aged 0-6 for a health check-up and if expectant mothers go for a health check-up during pregnancy and give birth in a hospital. The CHB Program provides financial assistance to children aged 0-6. They receive a monthly allowance of 100 TL for a maximum of 72 months. Pregnant women are entitled to receive 200 TL per month for up to 9 months, while postpartum women receive 300 TL per month for a maximum of 2

months. A one-time cash aid of 500 TL is also given to women who give birth in a hospital.³



³ Legislation regarding examination and follow-up intervals for children and pregnant /postpartum women is determined by the MoH.

CHAPTER 4

THE THEORETICAL MODEL

4.1. Relevant Literature

Economic models study intergenerational investment through the lens of human capital accumulation. The transmission of human capital from parents to children is a key element in exploring various issues through intergenerational investment models. The structure of the model used in this study relates the transmission of human capital to various strands of literature, such as family economics, labor economics, and economic growth.

Intergenerational investment models date back to the work of Becker and Tomes (1979). They present a dynastic model in which parents derive utility from their own consumption as well as the number and income of their children. In their model, parental endowments, parental investment, children's luck in labor market and their endowed luck, the degree of inheritance, and the propensity to invest in children determine children's income. Investment in a child depends on the parameters that measure the propensity to invest in children and the degree of inheritability of endowments. For small values of these parameters, the effect of family income on the income of generations is negligible. In contrast, if the sum of the value of these two parameters is greater than one, the effect of family's income on the future generations' income is significant. Their analysis also indicates that progressive taxation and subsidies may increase inequality in income distribution in the long-run equilibrium. The primary reason for the rising inequality in the distribution of income is that parents may be discouraged from investing in their children due to reduced after-tax returns. In addition to analyzing the effects of progressive taxation, Benabou (2002) analyzes the effect of education financing on income distribution by employing an education investment model from early childhood to the secondary level and finds that education financing results in higher income growth than income tax and household transfers.

The paper also investigates the tradeoffs between growth and efficiency from implementing these redistributive policies. The results show that the efficiency costs and benefits of redistribution balance each other for a wide range of empirical estimates of fiscal and educational parameters.

Following their aforementioned study, Becker and Tomes (1986) extends the previous model by imposing a borrowing constraint, where parents are not allowed to borrow against their children's future earnings in order to invest in children's human capital, and investigates the intergenerational mobility of earnings. Capital market restrictions lead to a lower investment in children for low-income families. Results show that intergenerational mobility of earnings depends on the inheritability of endowments as well as the willingness of low-income families to invest in children without borrowing against their future earnings. Glomm and Ravikumar (1992) examines the effect of public and private schooling choices on the growth and the evolution of income inequality with a parental investment model. They build a two-period overlapping generations (OLG) model in which generations are linked through parental human capital. In their model, in the public school system, school investment is determined by majority voting, while in the private school system, each household chooses the quality of their children's education. The study concludes that public education reduces income inequality faster than private education. However, if initial income inequality is not very high, private education may provide higher per capita income. Solon (2004) employs a model similar to the one developed by Becker and Tomes (1979) to study the effect of the change in earnings return to human capital and public investment in human capital. This study suggests that intergenerational mobility decreases as the return on human capital increases. However, greater progressivity in public investment in human capital may result in an increase in intergenerational mobility.

Researchers have also examined family investment models with multiple children who have different initial abilities to determine whether parental investments compensate for or reinforce differences between siblings. If one child has a higher genetic ability than the other, allocating more resources to increase the earnings of a child with a lower genetic ability is a compensating strategy. Providing more resources to the more able children to increase their earnings is a reinforcing strategy. Behrman et al. (1982) introduces two models to investigate the behavior of parents in such a case. In their

wealth model, the parents' behavior depends on the characteristics of the earnings function: If higher genetic ability implies higher marginal returns to education, then parents adopt a reinforcing strategy. However, parents adopt a compensating strategy if it means a lower marginal return to education. On the other hand, in the separable earnings-bequest model of the study, parents may adopt a compensating or reinforcing strategy based on their aversion to inequality, in addition to the properties of the earnings function.

All of these intergenerational human capital investment models consider childhood as a single period. Thus, it is assumed that there is no difference between early and late investments to the child. However, this assumption contradicts empirical studies showing that the returns on investments made in the early period are much higher than those made in later periods (Heckman and Mosso, 2014). Similarly, Carneiro and Heckman (2003) provides evidence that investing in children at earlier stages leads to higher returns because, as Knudsen et al. (2006) summarizes, there is evidence suggesting that some skills or traits are more easily acquired in earlier stages of childhood.

In order to take account of rationalizing the effectiveness of programs aimed at promoting human capital accumulation and to understand the dynamics of parental investment, it is necessary to establish a model with multiple childhood periods. To this end, we develop a model utilizing a multi-period childhood human capital formation technology similar to that in Cunha and Heckman (2007), which was the first to introduce multi-period human capital models to the literature. Multi-period investment models are based on the idea that there are particular periods in a child's development that are sensitive and critical. Sensitive periods refer to specific stages of a child's development when they are particularly receptive to experiences, leading to accelerated skill development. On the other hand, critical periods are crucial time frames during which specific experiences or inputs are necessary for timely development. If these periods are missed, there may be irreversible damages.

These models allocate varying efficiencies to investments during different stages of development of the child. Investments at varying degrees of efficiencies allocation ensure that families invest into the child' human capital in periods of high productivity

to maximize children's human capital. After its introduction to the literature, multi-period human capital production function became an important tool for analyzing various research questions in family economics.

Studies that use a multi-period human capital production technology to model family investments in children have focused on the effects of early versus late subsidies and different tax schedules. For example, Caucutt and Lochner (2020) develops a human capital investment framework that examines the intergenerational ability transmission process in determining human capital investments in children of different ages. Caucutt and Lochner find that providing subsidies at a younger age has a greater impact on overall welfare and human capital compared to providing them at older ages. Gayle et al. (2015) builds a dynastic model of parental time and monetary inputs in early childhood to analyze the sources of racial difference in the intergenerational transmission of human capital. Their results show that reducing disparities in the family structure and in earnings across different racial groups contributes to reducing racial achievement disparities. Lee and Seshadri (2019) develops a child investment model to explain intergenerational transmission of economic status. They show that education subsidies can significantly reduce intergenerational persistence of economic status, especially when provided early on. Del Boca et al. (2014) examines parents' time and financial investments in their children in a model where they also take a labor supply decision. According to their empirical findings, the amount of time parents spend with their children has a significant effect on children's cognitive development, particularly when the children are young. However, they find that the amount of monetary input is less productive than the time input regarding the quality of a child's outcomes. Their policy analysis indicates that giving cash transfers to households with children has a relatively small effect on child outcomes. This is true because households generally use a significant portion of the transfer for other expenses and leisurely activities. Their results hold for households with one child as well as for households with two children. The results are similar to the one-child case. In a study conducted in Türkiye, Yilmaz et al. (2011) demonstrates the extent to which social transfers to children reduce child poverty using 2008 TÜİK Household Budget Survey data and shows that the impact of implementing a policy aimed at eliminating child poverty will have negative consequences on public debt. The study concluded that

increasing the tax burden, which is low in Türkiye, and making regulations that will increase expenditure efficiency will reduce the risk of debt sustainability.

The aforementioned studies do not consider the long run impacts of ECD policies. The present study simulates five policies targeting the ECD period, lump-sum subsidy, matching fund (with two levels), universal child benefit, and child tax credit, by examining their impact on the households' decisions of human capital investment, consumption, and saving and ultimately the economy's aggregate human capital and output levels. This study aims to compare the impacts of various policies implemented in different countries with the lump-sum subsidy, which has limited applicability in Türkiye to determine the most effective policy for subsidizing ECD investment in terms of long run benefits. Comparing the effects of ECD policies on human capital and economic growth will help governments determine which policies to choose to subsidize ECD investments.

4.2. The Model Environment

In our model, we consider a closed economy with an infinite discrete-time horizon. Although the economy has an infinite life span, individuals live for a finite period of time. We build a 9-period OLG model where parents invest in their children's human capital. Each period lasts for eight years, and individuals live for nine periods before passing away. Every period, a new generation is born, and the size of each generation is fixed and normalized to one. As a result, the total measure of all generations is equal to nine.

In the model, a person's life cycle begins two years before birth as the health status of the mother before and during pregnancy also has an impact on the child's outcomes. Stephenson et al. (2018) examines evidence from countries with different income levels on the importance of pre-pregnancy health for child health. This study shows that there are strong links between pre-pregnancy health and maternal and child health outcomes and that the consequences can span generations. Being overweight or obese before pregnancy is linked with a higher risk of stillbirth, having a baby that is larger than what is expected for the gestational age, needing admission to a neonatal intensive care unit, and having a low birth weight. On the other hand, being underweight before

pregnancy is associated with an increased risk of having a baby born prematurely, being smaller than what is expected for the gestational age, as well as having a high risk of preterm birth and low birth weight (Liu et al., 2016).

Figure 4.1 illustrates the life span of an individual in the model. The first period of life encompasses the pre-pregnancy, pregnancy, and ECD stages, which span from two years before birth to six years of age. Since we calibrate the model based on the Turkish economy, we also designed the school years according to the education system in Türkiye.

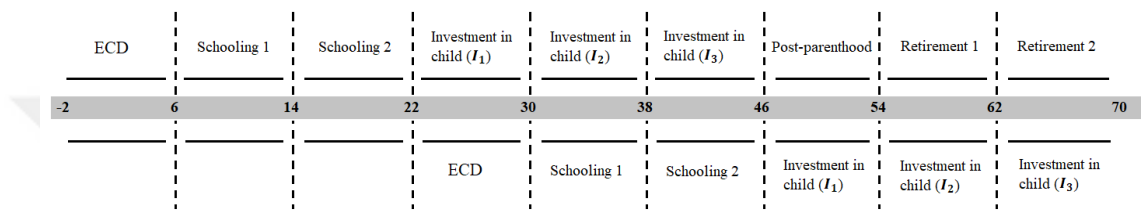


Figure 4.1: Sequence of Events in the Model

As per the 4+4+4 system, an individual completes primary and secondary school education in an eight-year period, which corresponds to the second period of the individual's life. In the third period, which also spans eight years, the individual completes high school and university education. During these three periods, the individual is a child of an adult parent and does not make any economic decisions but receives investments from his/her parent. Since the parent is assumed to be the decision-maker in the household, the child passively accepts investment, and his/her consumption is included in that of his/her parent⁴ or is ignored⁵. In the fourth period, the individual enters the workforce in his/her first period of adult life and supplies one unit of labor inelastically. The individual enters this period at the age of 22 and goes through the pre-pregnancy preparation period and the pregnancy period for two years before having a child at the age of 24. According to the data from the Ministry of Health in Türkiye, the age range with the highest number of births in 2019 was 25-29. Hence, we considered the eight-year interval and birth statistics when establishing the age at which the mother gave birth in the model. During this period, the individual

⁴ As suggested by De La Croix and Michel (2002).

⁵ As in the study by Heckman and Mosso (2014).

who starts to earn wage income $w_t h_t$ by joining the workforce invests in her child's ECD period. In the fifth period, the individual invests in his/her child's human capital throughout primary and secondary school. In the sixth period, the individual invests in his/her child's high school and university education. In the seventh period, the individual is in the post-parenthood period; the caregiving period ends, but he/she is still in the workforce. During this period, the child completes his/her education, joins the workforce, and has a child. In the eighth and ninth periods, while the individual leaves the workforce and goes into retirement, the his/her child invests in his/her own child's (the unborn grandchild) human capital for two periods. The individual dies at the end of the ninth period before his/her child's grandchild is born.

The number of each generation L_t is fixed means there is no population growth.

$$L_t = L_{t-1} \text{ for all } t=0,1,\dots$$

Preferences:

When the economy starts at $t=0$, nine generations are alive. The one born at $t = 0$ will live for nine periods. There are also eight “old” generations, each are endowed with fixed assets and human capital. The generation born at time -8 reaches age nine at time 0 . At the starting point, $t=0$, initial conditions drawn from the 2019 Turkish data. Figure 4.2 presents the demographic structure of the model.

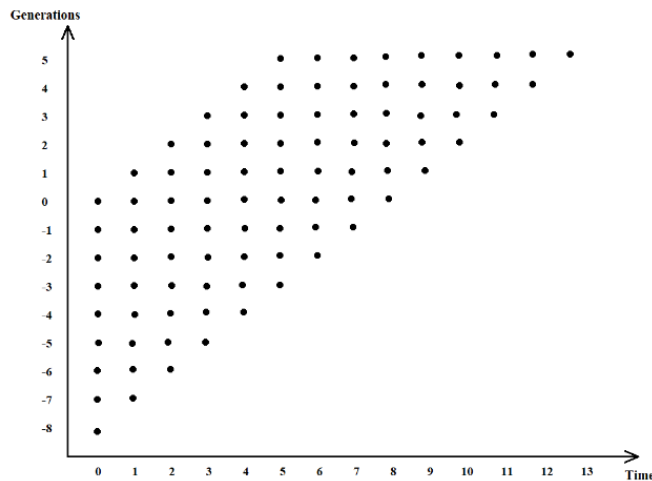


Figure 4.2: The Demographic Structure of the Model

For an individual born at time $t-3$ who becomes economically active and becomes a parent of a child at time t , maximizes the following lifetime utility at time t :

$$\begin{aligned}
 U_t(c_{4,t}, c_{5,t+1}, \dots, c_{9,t+5}, h'_{3,t+5}) & \quad (1) \\
 &= \log(c_{4,t}) + \beta \log(c_{5,t+1}) + \beta^2 \log(c_{6,t+2}) \\
 &+ \beta^3 \log(c_{7,t+3}) + \beta^4 \log(c_{8,t+4}) + \beta^5 \log(c_{9,t+5}) \\
 &+ \varphi \beta^6 \log(h'_{3,t+5})
 \end{aligned}$$

subject to the following budget constraints:

$$(1 + \tau_c)c_{4,t} + (1 + \tau_e)I_{4,t} + a_{5,t} = (1 - \tau_w) w_t h_t \quad (2)$$

$$\begin{aligned}
 (1 + \tau_c)c_{5,t+1} + (1 + \tau_e)I_{5,t+1} + a_{6,t+1} & \quad (3) \\
 &= (1 - \tau_w) w_{t+1} h_{t+1} + (1 + r_{t+1})a_{5,t}
 \end{aligned}$$

$$\begin{aligned}
 (1 + \tau_c)c_{6,t+2} + (1 + \tau_e)I_{6,t+2} + a_{7,t+2} & \quad (4) \\
 &= (1 - \tau_w) w_{t+2} h_{t+2} + (1 + r_{t+2})a_{6,t+1}
 \end{aligned}$$

$$(1 + \tau_c)c_{7,t+3} + a_{8,t+3} = (1 - \tau_w)w_{t+3}h_3 + (1 + r_{t+3})a_{7,t+2} \quad (5)$$

$$(1 + \tau_c)c_{8,t+4} + a_{9,t+4} = (1 + r_{t+4})a_{8,t+3} \quad (6)$$

$$(1 + \tau_c)c_{9,t+5} + a_{10,t+5} = (1 + r_{t+5})a_{9,t+4} \quad (7)$$

$$c_{g,t} \geq 0; I_{g,t} \geq 0; a_{g,t} \geq 0$$

Individuals derive utility from their consumption discounted with a time preference parameter β . Also, they drive utility from their children's human capital, as a result of their investments and the contribution of their own human capital, discounted by the time discount factor β and altruism parameter φ in the final stage of their lives.

We assume that the utility function is logarithmic, as a result of a change in the interest rate, wealth and substitution effect cancel each other.

The variable $c_{g,t}$ denotes the consumption expenditure in period g at time t and $a_{g,t}$ denotes the savings in period g at time t . Similarly, the investment made by parents in their child's human capital is represented with $I_{g,t}$.

Since individuals have children when they are economically active, the ECD investment is represented by $I_{4,t}$ in the first budget constraint. $I_{5,t+1}$ and $I_{6,t+2}$ represents child investment for schooling period 1 and 2 respectively. w_t denotes the wage per effective unit of labor and $h'_{3,t}$ denotes the human capital level of the child in period 3 (end of childhood) at time t . τ_c is the consumption tax rate, τ_e is the tax rate on investment expenditures made on children and τ_w is the income tax rate. We follow the conventions in the literature and impose no taxes on assets.

$$0 < \tau_c, \tau_e, \tau_w < 1$$

An individual who completes the first three periods of his/her life and becomes an adult begins to join the workforce and make economic decisions starting from this period.

In the fourth period of his life (equation 2), he/she spends his after-tax wage income on consumption and investment in his/her child's ECD period, and the remaining part is saved.

In the fifth period (equation 3), he/she spends his after-tax wage income, his/her savings from the previous period, and his/her interest income on consumption and on his/her investment in his child's first school term, and the remaining part constitutes his/her savings.

In the sixth period (equation 4), he/she spends her after-tax wage income, his/her savings from the previous period, and his/her interest income on consumption and investment in his/her child's second school term, and the remaining part constitutes his/her savings.

In period seven (equation 5), the parent no longer invests in his/her child who has left the household. He/she spends his after-tax wage income, his/her savings from the

previous period, and interest income on consumption, and the remaining part constitutes his/her savings.

He/she retired in the eighth and ninth periods (equations 6 and 7) and no longer receives wage income. In these two periods, he/she consumes his/her savings and dies. The individual has no physical bequest motive before death. During retirement, he consumes all of his/her savings. Therefore,

$$a_{10,t+5} = 0 \text{ for all } t=0,1,\dots \quad (8)$$

Here, $a_{10,t+5}$ denotes the savings of the individual at the 9th period of life at time $t+5$. However, bequest in the form of human capital is transmitted from generation to generation through the human capital accumulation technology. Human capital evolves according to human capital production function:

$$\begin{aligned} h'_{3,t+3} &= h'_{4,t+4} = h'_{5,t+5} = h'_{6,t+6} \\ &= \left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \\ &\quad + (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\ &\quad \left. \left. + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \right]^{\frac{\theta_1}{\theta_2}} \right]^{\frac{\eta}{\theta_1}} \end{aligned} \quad (9)$$

The level of human capital that individuals attain as a result of the investment they receive from their parents over three periods is represented by $h'_{3,t+3}$. It is assumed that the labor force supplied to the economy is determined by the same level of human capital during their economically active periods ($h'_{3,t+3} = h'_{4,t+4} = h'_{5,t+5} = h'_{6,t+6}$). In other words, after an individual has completed his/her education, his/her human capital will remain constant - there will be no appreciation or depreciation over time. The parent's human capital level, represented by h , appears in the child's human capital production function. Because, the positive effect of the parent's (generally mother's) human capital, typically measured by the level of education, on the child's outcomes has been shown by a number of studies. Cunha et al. (2010), Cunha and Heckman

(2008), Attanasio et al. (2020) and, Cuartas (2022) show that parental human capital directly affects child's human capital level. Productivity of child investment increases with the higher levels of parental human capital. The final contribution of the physical investment and parental human capital in that period is determined by a Cobb-Douglas function. ζ_1 , ζ_2 and ζ_3 show the human capital elasticities of parental human capital in ECD, first and second part of schooling respectively.

The share parameter γ_1 in the constant elasticity of substitution (CES) function is a skill multiplier. It shows the productivity of ECD investment in producing human capital level through self-productivity. Additionally, it shows to what extent ECD investment increases the productivity of the investment ($I_{5,t+1}$ and $I_{6,t+2}$) made in the formal school period (from primary to university education) through dynamic complementarity. Similarly, γ_2 reveals the impact of investment made in the first part of the formal schooling period on human capital and to what extent it increases the productivity of the investment in the following period. Another CES parameter θ_1 is the substitution parameter, $1/1 - \theta_1$ and it shows how easy it is to substitute between ECD investment and schooling period investment in producing human capital. Small levels of θ_1 indicates that low levels of ECD investments are not easily remediated by formal school investment. Also, a small level of θ_1 indicates that a high level of ECD investment should be sustained with a high level of school investment to get the highest return. Similarly, small levels of θ_2 indicates that low levels of investment for first schooling ($I_{5,t+1}$) periods are not easily remediated by second schooling periods ($I_{6,t+2}$) and a high level of first schooling period investment should be sustained with a high level of second schooling period investment for small level of θ_2 to get the highest return.

Firm and Production:

Individuals supply one unit of labor inelastically. Thus, labor supply in the economy equals four at every period t since there are four working-age adults in each period t . A representative firm uses a stock of physical capital (K_t) and a stock of effective labor (H_t)

to produce Y_t according to the following constant returns to scale Cobb-Douglas technology:

$$Y_t = K_t^\alpha [H_t]^{1-\alpha} \quad (10)$$

$$H_t = \sum_{g=4}^7 h_{g,t} l_{g,t} \quad (11)$$

where $h_{g,t}$ is the human capital level generation g at time t , $l_{g,t}$ is the labor supply of generation g at time t and $\alpha \in (0,1)$ is the output elasticity with respect to capital. As the measure of all generations is normalized to 1, the total human capital H_t in the economy at any given time t is the sum of the human capital of four individuals in the workforce. The aggregate human capital, which consists of the sum of the human capital of these four people, is obtained as follows:

$$H_t = \sum_{i=0}^3 \left[\gamma_1 (h_{t-3}^{\zeta_1} I_{4,t-i-3}^{1-\zeta_1})^{\theta_1} + (1 - \gamma_1) \left[\gamma_2 (h_{t-3}^{\zeta_2} I_{5,t-i-2}^{1-\zeta_2})^{\theta_2} + (1 - \gamma_2) (h_{t-3}^{\zeta_3} I_{6,t-i-1}^{1-\zeta_3})^{\theta_2} \right]^{\frac{\theta_1}{\theta_2}} \right]^{\frac{\eta}{\theta_1}} \quad (12)$$

Profit maximization of the firm implies the standard conditions where w is the wage rate per efficient labor unit, r is the interest rate and $\delta \in (0,1)$ is the depreciation rate.

Government:

In the base model we built above the government is assumed to finance the constant level of government spending and to levy taxes on labor wage and consumption.

$$\tau_c (c_{4,t} + c_{5,t} + c_{6,t} + c_{7,t} + c_{8,t} + c_{9,t}) + \tau_e (I_{4,t} + I_{5,t} + I_{6,t}) + \tau_w (H_t w_t) = G_t \quad (13)$$

G_t is government spending at time t ; τ_c , τ_e and τ_w are as defined before. Since the investment expenditure on the child is also a consumption expenditure, τ_e is taken as equal to τ_c . Economy' equilibrium is characterized by the time paths of consumption,

human capital investment physical capital, human capital, wage and interest rate at each point in time.

Equilibrium:

In this model the competitive equilibrium is defined as follows:

Definition 1: A competitive equilibrium for this economy is a list of sequences of consumption plans $\{c_{g,t}\}_{g=4}^9_{t=0}^\infty$, child investment plans $\{I_{g,t}\}_{g=4}^6_{t=0}^\infty$, asset stock sequence $\{a_{g,t}\}_{g=4}^9_{t=0}^\infty$, factor prices $\{w_t, r_t\}_{t=0}^\infty$, production plans $\{Y_t\}_{t=0}^\infty$ such that:

- i. Given the relative prices (w_t and r_t) and tax rates (τ_c and τ_w) household chooses the consumption sequence ($c_{4,t}, c_{5,t+1}, c_{6,t+2}, c_{7,t+3}, c_{8,t+5}, c_{9,t+6}$), asset stock sequence ($a_{5,t}, a_{6,t+1}, a_{7,t+2}, a_{8,t+3}, a_{9,t+4}$) and human capital investment ($I_{4,t}, I_{5,t+1}, I_{6,t+2}$) to maximize lifetime utility subject to the budget constraints;
- ii. Given the factor prices (w_t, r_t) the firm maximizes profits subject to a production technology;
- iii. The goods market clears:

$$Y_t = C_t + I_{h_t} + I_{k_t} + G_t$$

where

$$Y_t = K_t^\alpha [H_t]^{1-\alpha} \quad (14)$$

$$H_t = \sum_{g=4}^7 h_{g,t} l_{g,t} \quad (15)$$

$$C_t = \sum_{g=4}^9 c_{g,t} \quad (16)$$

$$K_t = \sum_{g=4}^9 a_{g,t} \quad (17)$$

$$I_{h_t} = \sum_{g=4}^6 I_{g,t} \quad (18)$$

$$I_{k_t} = K_{t+1} - (1 - \delta)K_t; \quad (19)$$

iv. The government budget (13) is balanced.

4.2.1 Characterization of Competitive Equilibrium

In equilibrium, firm maximizes profit according to:

$$\Pi_t = K_t^\alpha [H_t]^{1-\alpha} - w_t H_t - r_t K_t - \delta K_t \quad (20)$$

$$K_t \geq 0, H_t \geq 0$$

Implying the first-order conditions

$$\frac{\partial \Pi_t}{\partial K_t} = \alpha K_t^{\alpha-1} (H_t)^{1-\alpha} - r_t - \delta = 0 \quad (21)$$

$$\frac{\partial \Pi_t}{\partial H_t} = (1 - \alpha) K_t^\alpha (H_t)^{-\alpha} - w_t = 0 \quad (22)$$

Using (21) and (22) we obtain the following factor prices in equilibrium:

$$r_t = \alpha k_t^{\alpha-1} - \delta \quad (23)$$

$$w_t = (1 - \alpha) k_t^\alpha \quad (24)$$

where k_t is capital per unit of effective labor, w_t is wage per effective unit of labor, r_t is the interest rate, and δ is the physical capital depreciation rate.

On the household side, we first derive the intertemporal budget constraint by eliminating savings from individuals' budget constraints ((1)-(6)) to obtain the

conditions characterizing the steady-state equilibrium. The intertemporal budget constraint obtained as in equation (25).

We use the direct computation method to solve the problem. The Langrangian formulated with the lifetime utility (1), the human capital production function (9), and the intertemporal budget constraint (25) is maximized:

$$\begin{aligned}
(1 - \tau_w) w_t h_t &+ \frac{(1 - \tau_w) w_{t+1} h_{t+1}}{(1 + r_{t+1})} + \frac{(1 - \tau_w) w_{t+2} h_{t+2}}{(1 + r_{t+1})(1 + r_{t+2})} \\
&+ \frac{(1 - \tau_w) w_{t+3} h_{t+3}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})} - (1 + \tau_c) c_{4,t} \\
&- \frac{(1 + \tau_c) c_{5,t+1}}{(1 + r_{t+1})} - \frac{(1 + \tau_c) c_{6,t+2}}{(1 + r_{t+1})(1 + r_{t+2})} \\
&- \frac{(1 + \tau_c) c_{7,t+3}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})} \\
&- \frac{(1 + \tau_c) c_{8,t+4}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})} \\
&- \frac{(1 + \tau_c) c_{9,t+5}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})(1 + r_{t+5})} \\
&- (1 + \tau_c) I_{4,t} - \frac{(1 + \tau_c) I_{5,t+1}}{(1 + r_{t+1})} \\
&- \frac{(1 + \tau_c) I_{6,t+2}}{(1 + r_{t+1})(1 + r_{t+2})} = 0
\end{aligned} \tag{25}$$

$$\begin{aligned}
& \mathcal{L}(c_{4,t}, c_{5,t+1}, c_{6,t+2}, c_{7,t+3}, c_{8,t+4}, c_{9,t+5}, I_{4,t}, I_{5,t+1}, I_{6,t+2}) \\
&= \log(c_{4,t}) + \beta \log(c_{5,t+1}) + \beta^2 \log(c_{6,t+2}) + \beta^3 \log(c_{7,t+3}) \\
&+ \beta^4 \log(c_{8,t+4}) + \beta^5 \log(c_{9,t+5}) \\
&+ \beta^5 \varphi \log \left(\left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \right. \\
&+ (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
&+ (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}} \Bigg) \\
&+ \lambda \left[(1 - \tau_w) w_t + \frac{(1 - \tau_w) w_{t+1}}{(1 + r_{t+1})} + \frac{(1 - \tau_w) w_{t+2}}{(1 + r_{t+1})(1 + r_{t+2})} \right. \\
&+ \frac{(1 - \tau_w) w_{t+3}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})} - (1 + \tau_c) c_{4,t} - \frac{(1 + \tau_c) c_{5,t+1}}{(1 + r_{t+1})} \\
&- \frac{(1 + \tau_c) c_{6,t+2}}{(1 + r_{t+1})(1 + r_{t+2})} - \frac{(1 + \tau_c) c_{7,t+3}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})} \\
&- \frac{(1 + \tau_c) c_{8,t+4}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})} \\
&- \frac{(1 + \tau_c) c_{9,t+5}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})(1 + r_{t+5})} \\
&\left. - (1 + \tau_c) I_{4,t} - \frac{(1 + \tau_c) I_{5,t+1}}{(1 + r_{t+1})} - \frac{(1 + \tau_c) I_{6,t+2}}{(1 + r_{t+1})(1 + r_{t+2})} \right]
\end{aligned} \tag{26}$$

where $\lambda > 0$ is the Lagrange multiplier.

Problem (26) implies the following first order conditions:

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial c_{4,t}} &= \frac{1}{c_{4,t}} - \lambda(1 + \tau_c) = 0 \\
\Rightarrow \frac{1}{c_{4,t}(1 + \tau_c)} &= \lambda
\end{aligned} \tag{27}$$

$$\frac{\partial \mathcal{L}}{\partial c_{5,t+1}} = \frac{\beta}{c_{5,t+1}} - \frac{\lambda(1 + \tau_c)}{(1 + r_{t+1})} = 0 \quad (28)$$

$$\Rightarrow \frac{\beta(1 + r_{t+1})}{c_{5,t+1}(1 + \tau_c)} = \lambda$$

$$\frac{\partial \mathcal{L}}{\partial c_{6,t+2}} = \frac{\beta^2}{c_{6,t+2}} - \frac{\lambda(1 + \tau_c)}{(1 + r_{t+1})(1 + r_{t+2})} = 0 \quad (29)$$

$$\Rightarrow \frac{\beta^2(1 + r_{t+1})(1 + r_{t+2})}{c_{6,t+2}(1 + \tau_c)} = \lambda$$

$$\frac{\partial \mathcal{L}}{\partial c_{7,t+3}} = \frac{\beta^3}{c_{7,t+3}} - \frac{\lambda(1 + \tau_c)}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})} = 0 \quad (30)$$

$$\Rightarrow \frac{\beta^3(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})}{c_{7,t+3}(1 + \tau_c)} = \lambda$$

$$\frac{\partial \mathcal{L}}{\partial c_{8,t+4}} = \frac{\beta^4}{c_{8,t+4}} - \frac{\lambda(1 + \tau_c)}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})} = 0 \quad (31)$$

$$\Rightarrow \frac{\beta^4(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})}{c_{8,t+4}(1 + \tau_c)} = \lambda$$

$$\frac{\partial \mathcal{L}}{\partial c_{9,t+5}} = \frac{\beta^5}{c_{9,t+5}} - \frac{\lambda(1 + \tau_c)}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})(1 + r_{t+5})} \quad (32)$$

$$= 0$$

$$\Rightarrow \frac{\beta^5(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})(1 + r_{t+5})}{c_{9,t+5}(1 + \tau_c)} = \lambda$$

$$\begin{aligned}
& \frac{\partial \mathcal{L}}{\partial I_{4,t+1}} \tag{33} \\
&= \beta^5 \left[\left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \right. \\
&+ (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
&+ (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}-1} \eta \gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1-1} h_t^{\zeta_1} (1 \\
&- \zeta_1) I_{4,t}^{-\zeta_1} \left. \right] \\
&/ \left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \\
&+ (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}} - \lambda \\
&= 0
\end{aligned}$$

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial I_{5,t+2}} = \beta^5 & \left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \\
& + (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
& + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}-1} \left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \\
& + (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
& + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left(1 \right. \\
& \left. \left. - \gamma_1 \eta \gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2-1} h_t^{\zeta_2} (1 - \zeta_2) I_{5,t+1}^{-\zeta_2} \right] \right] \\
& / \left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \\
& + (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
& + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}} - \frac{\lambda}{(1 + r_{t+1})} = 0
\end{aligned} \tag{34}$$

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial I_{6,t+3}} = & \beta^5 \left[\left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \right. \\
& + (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
& + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}-1} \left[\gamma_1 (h_{t-3}^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \\
& + (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
& + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} (1 \\
& - \gamma_1) \eta (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2-1} h_t^{\zeta_3} (1 - \zeta_3) I_{6,t+2}^{-\zeta_3} \left. \right] \\
& / \left[\gamma_1 (h_t^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \\
& + (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
& + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}} - \frac{\lambda}{(1 + r_{t+1})(1 + r_{t+2})} \\
& = 0
\end{aligned} \tag{35}$$

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial \lambda} = & (1 - \tau_w) w_t + \frac{(1 - \tau_w) w_{t+1}}{(1 + r_{t+1})} + \frac{(1 - \tau_w) w_{t+2}}{(1 + r_{t+1})(1 + r_{t+2})} \\
& + \frac{(1 - \tau_w) w_{t+3}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})} - (1 + \tau_c) c_{4,t} \\
& - \frac{(1 + \tau_c) c_{5,t+1}}{(1 + r_{t+1})} - \frac{(1 + \tau_c) c_{6,t+2}}{(1 + r_{t+1})(1 + r_{t+2})} \\
& - \frac{(1 + \tau_c) c_{7,t+3}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})} \\
& - \frac{(1 + \tau_c) c_{8,t+4}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})} \\
& - \frac{(1 + \tau_c) c_{9,t+5}}{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})(1 + r_{t+5})} \\
& - (1 + \tau_c) I_{4,t} - \frac{(1 + \tau_c) I_{5,t+1}}{(1 + r_{t+1})} - \frac{(1 + \tau_c) I_{6,t+2}}{(1 + r_{t+1})(1 + r_{t+2})} = 0
\end{aligned} \tag{36}$$

The first order conditions ((27)- (35)) imply the following equilibrium conditions for the individual:

$$c_{5,t+1} = \beta(1 + r_{t+1})c_{4,t} \quad (37)$$

$$c_{6,t+2} = \beta(1 + r_{t+2})c_{5,t+1} \quad (38)$$

$$c_{7,t+3} = \beta(1 + r_{t+3})c_{6,t+2} \quad (39)$$

$$c_{8,t+4} = \beta(1 + r_{t+4})c_{7,t+3} \quad (40)$$

$$c_{9,t+5} = \beta(1 + r_{t+5})c_{8,t+4} \quad (41)$$

$$\begin{aligned} & \left[\left[\gamma_1 (h_{t-3}^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \right. \\ & + (1 - \gamma_1) \left[\gamma_2 (h_{t-3}^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\ & + (1 - \gamma_2) (h_{t-3}^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}-1} \frac{\eta}{\theta_1} \gamma_1 \theta_1 (h_{t-3}^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1-1} h_{t-3}^{\zeta_1} (1 \\ & - \zeta_1) I_{4,t}^{-\zeta_1} \left. \right] \\ & / \left[\gamma_1 (h_{t-3}^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1} \right. \\ & + (1 - \gamma_1) \left[\gamma_2 (h_{t-3}^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\ & + (1 - \gamma_2) (h_{t-3}^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \left. \right]^{\frac{\theta_1}{\theta_2}} \left. \right]^{\frac{\eta}{\theta_1}} \\ & = \frac{(1 + r_{t+1})(1 + r_{t+2})(1 + r_{t+3})(1 + r_{t+4})(1 + r_{t+5})}{c_{9,t+5}(1 + \tau_c)} \end{aligned} \quad (42)$$

$$(1 + r_{t+1}) = \frac{\gamma_1 (h_{t-3}^{\zeta_1} I_{4,t}^{1-\zeta_1})^{\theta_1-1} h_{t-3}^{\zeta_1} (1 - \zeta_1) I_{4,t}^{-\zeta_1}}{(1 - \gamma_1) \gamma_2 (h_{t-3}^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2-1} h_{t-3}^{\zeta_2} (1 - \zeta_2) I_{5,t+1}^{-\zeta_2}} \quad (43)$$

$$(1 + r_{t+2}) = \frac{\gamma_2 ((h_{t-3}^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2-1} h_{t-3}^{\zeta_2} (1 - \zeta_2) I_{5,t+1}^{-\zeta_2})}{(1 - \gamma_2) (h_{t-3}^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2-1} h_{t-3}^{\zeta_3} (1 - \zeta_3) I_{6,t+2}^{-\zeta_3}} \quad (44)$$

The solution to the firm's and the individual's problems and the government budget constraint implies equilibrium allocation.

4.2.2 Steady State Equilibrium

In this economy, in the long run all endogenous variables (i.e., consumption, child investments, savings, interest rate, wage rate, human capital, physical capital) are constant (i.e., zero growth in this case). Such an equilibrium is called the steady state equilibrium.

Definition 2: A steady state is an equilibrium such that it satisfies conditions above and given tax rate and behavioral parameters $(\tau_w, \gamma_1, \gamma_2, \theta_1, \theta_2, \zeta_1, \zeta_2, \zeta_3, \eta, \varphi)$ all endogenous variables $((c_{g,t})^{g=4,\dots,9}, (I_{g,t})^{g=4,\dots,6}, (a_{g,t})^{g=5,\dots,9}, w_t, r_t, h_t, H_t, K_t, Y_t)$ are constant for all periods of time.

By solving system of equations consisting household budget constraints (2)-(7), individual level of human capital production function (9), physical capital production function (10), aggregate level of human capital production functions (11), aggregate consumption function (16), physical capital function (17), human capital investment (18), physical capital investment (19), interest rate (23), wage per effective unit of labor (24), and Euler equations from household side (37)-(44) we can obtain 23 endogenous variables $((c_{g,t})^{g=4,\dots,9}, (I_{g,t})^{g=4,\dots,6}, (a_{g,t})^{g=5,\dots,9}, w_t, r_t, h_t, H_t, K_t, Y_t, I_t, C_t, G_t)$. However, the analytical solution method is not applicable due to the complex structure of multi-period OLG models. Therefore, we use the Gauss-Seidel method, which is a numerical solution method adopted by Auerbach and Kotlikoff (1987). The details of this solution are presented in Chapter 5.

4.2.3. Transition Path Equilibrium

In order to compute the transition path, we first obtain the steady-state results of the benchmark model using equations (2)-(7), (9)-(11), (16)-(19), (23),(24), (37)-(44). Then, we compute the steady-state results that the economy will reach after implementing the ECD policies. Given the initial conditions, we simultaneously compute the transition path of the economy. We use the method adopted by Auerbach and Kotlikoff (1987) to compute the transition period between these two steady states. Chapter 5 presents the policies and details used to compute the transition path.



CHAPTER 5

THE BENCHMARK ECONOMY AND POLICY SIMULATIONS

In this chapter, first we describe the numerical solution strategy for the benchmark model that is characterized in Chapter 4. Secondly, we describe the transition and steady-state equilibrium computations of the economy resulting from the government's policies to subsidize the ECD investment. Next, we present the data used to calibrate the model's parameter. Then, we describe the conceptual structure of the social accounts matrix and its version created with the data from the TURKSTAT National Accounts and Household Budget Survey (HBS), the Budget Financing Statistics of the Ministry of Treasury and Finance for 2019 Turkish economy. And finally, we elaborate on the selected ECD investment policies and implemented policy simulations regarding the alternative policies.

5.1. The Solution Strategy

The process of computing the equilibrium path of the economy involves three stages. Firstly, we solve for the steady state equilibrium of the benchmark economy with no policy. Secondly, we solve the steady state to which the economy converges after a policy is implemented. Finally, we solve for the transition path of the economy between these two steady state equilibria.

Solving for the benchmark model the initial steady-state equilibrium means solving simultaneously the system of equations that characterize the equilibrium described in Chapter 4. This system of equations is solved using a technique called the Gauss-Seidel method, which is a numerical solution method adopted by Auerbach and Kotlikoff (1987). In the solution process, initially, some of the endogenous variables in the model are guessed. Based on these values, other endogenous variables of the model are computed, including the ones that were initially guessed. If the obtained values for the guessed variables in the beginning match the values obtained at the end of the computation, this indicates that the system of equation system has been solved.

However, if the computed values are not consistent with the initial estimates, the process is repeated using the values obtained at the end of the previous computation. This iterative process continues until a consistent result is achieved.⁶

5.1.1. Computation of the benchmark model's steady-state equilibrium

The algorithm for the model established in this study works as follows: The algorithm starts with guessing initial physical and human capital levels (K, H) . Factor prices (w, r) are calculated according to this initial guess. Household's problem is solved according to these factor prices and human capital level. The solution is formulated to meet the model's assumption that no physical assets are passed down to individuals and that agents are unable to borrow. Household problem is solved by "*secant method*" which is a root finding method (Mathews and Fink, 2004). This method is applied as follows: We first guess two initial points for asset holding to compute the optimal path for consumption and savings. Using the first initial point (as the asset holding for the period before the last period), other entries of asset and consumption paths with the help of budget constraints and the Euler equations of the consumer are computed. Using the second initial point, another asset and consumption paths are computed. Then, the next initial point using the previous two points are computed with the help of the secant method. The secant method used to create the third guess is formulated as follows:

$$x_{s+2} = x_{s+1} - \frac{x_{s+1} - x_s}{f(x_{s+1}) - f(x_s)} f(x_{s+1})$$

The function $f(x_{s+t})$ gives the value of the first-period asset holding corresponding to the initial value x_{s+t} . Then, we compute the new asset and consumption path using the new initial value of asset holding. The computation is repeated applying the secant method to find new initial points until finding the first-period asset holding as zero (or very close to zero according to a tolerance value). When we find an asset matrix whose first entry is zero, then the computation of the household problem ends, and we continue with the computation of new physical and human capital. Since the sum of

⁶ All simulations in this study were performed using MATLAB software.

the savings of adult individuals in the economy will constitute the total physical capital in that period, this value becomes the new physical capital estimate. The solution to the household problem includes investment in human capital, which determines the level of human capital in the new generation. If the computed physical and human capital value converges to the guessed value (according to a certain tolerance value), the algorithm is terminated. Otherwise, the process starts with a new guess. In order to improve the accuracy of the numerical analysis, we select a very low tolerance value (10^{-13}) to compute consumption and savings paths, as well as physical and human capital paths.⁷

5.1.2. Computation of the steady-state equilibrium with alternative policies

The method used to compute the steady-state equilibrium after a policy is implemented is essentially the same as the methods used to compute the steady state before the policy. What is different between the two methods is determination of consumption tax rate, which is exogenously determined in the benchmark model. The government finances the subsidy for ECD investments by increasing the consumption tax rate levied on households. While government spending remains constant at the level in the benchmark model, the balanced budget is maintained with a consumption tax rate to offset the increase in subsidies. Therefore, at the end of each iteration, the consumption tax rate is calculated to satisfy a balanced government budget.

5.1.3. Computation of the economy's transition path

The transition begins with the implementation of the policy which comes as an exogenous change in the economy. In the model, the implementation of the policy begins with an individual who is born at time $t = -3$ and who becomes an adult at time $t = 0$. The ECD policy implemented by the government has an impact on human capital of children born at time $t = 0$ and thereafter. There are five adult individuals, called "old generations", who are alive during the time period when the policy is implemented. However, since those generations do not have young children, they are not eligible to receive ECD subsidy. The policy only affects older generations through

⁷ At the end of the computations, the output (gross domestic product) value was calculated separately using the production, expenditure, and income approach to analyze the accuracy of the values.

increased consumption tax rates since the government will balance subsidies for households with young children with an increase in consumption tax rates in the budget. The outcomes of the decisions made by these old generations will be computed separately.

Transitional equilibrium computations of the economy are similar to steady-state equilibrium computations. However, when computing the transition path, all periods are solved simultaneously, as the actors in the economy will take into account the factor prices and consumption tax rate that will change in a dynamic structure when making their choices. Before computing the transitional equilibria, one must decide on the number of periods before the economy reaches its steady state equilibrium. It is important to set a time long enough for the economy to reach steady state equilibrium because if this time is insufficient, the computations will be incorrect as the economy will prematurely converge to a steady state equilibrium. We start the computations by guessing the initial value for physical capital, human capital, and consumption tax rates for the number of periods determined as the transition period. We guess the initial values for these endogenous variables by linearly interpolating between the first and last steady state. As in steady state computations, using this first guess, We first compute factor prices, and then household consumption, investment and savings levels from budget constraints and Euler equations, and consumption tax rate from the government's balanced budget. With the help of these two levels, new guess for physical capital, human capital and consumption tax is obtained, and computations are implemented again using the new guesses.

However, this procedure is used only to compute the outcomes of the decisions of the individual who becomes an adult with young children after a policy is implemented. We also implement computations for old generations who start to take decisions assuming that the economy would continue in its previous steady state before the policy is exogenously introduced and change their decisions accordingly after the policy. The problems of the old generations are solved under the factor prices and consumption tax rates in the economy after the policy, given the savings and investment decisions before the policy. The problems of old generations are solved with the “*false position method*”, which is an alternative root-finding method (Mathews and Fink, 2004). This method is implemented as follows: Firstly, two initial

points, x_s and x_{s+1} , are guessed to bracket the root of asset holding by having opposite signs between $f(x_s)$ and $f(x_{s+1})$. Then, using these initial points, a third guess (false position) is calculated by the formula

$$x_{s+2} = x_{s+1} \frac{f(x_{s+1})(x_{s+1} - x_s)}{f(x_{s+1}) - f(x_s)}$$

Then, we identify which subintervals contain the root by checking the signs of $f(x_s)$, $f(x_{s+1})$, and $f(x_{s+2})$. If $f(x_{s+2})$ has the same sign as $f(x_s)$, the root is between x_{s+2} and x_{s+1} , then x_{s+2} is chosen instead of x_s . If $f(x_{s+2})$ has the same sign with $f(x_{s+1})$, the root is between x_s and x_{s+2} , then x_{s+2} is chosen instead of x_{s+1} , and the process is repeated for the predetermined maximum number of iterations. When the results converge, the last calculated false position is taken as the approximation of the root.

5.2. Calibration

In calibrating a general equilibrium model, the parameters and variables of the model are adjusted to fit a given set of real economic data and the theoretical assumptions in establishing the model. In order to calibrate the model's parameters for the initial steady-state equilibrium of the economy to the 2019 Turkish economy, a social accounts matrix (SAM) using data from various sources is established.

5.2.1. Data

The data used to create the SAM is obtained from various sources. The 2019 TURKSTAT National Accounts provide the data on payments made to employees and capital, as well as individual consumption expenditures. The share of investment expenditures on children in total expenditures is determined using data from the 2019 TURKSTAT HBS Indirect and direct tax rates and the share of total tax revenue in national income are calculated using data obtained from the Budget Financing Statistics of the Ministry of Treasury and Finance for the same year.

5.2.2. Social Accounting Matrix

A Social Accounting Matrix (SAM) is a comprehensive and detailed representation of transactions in an economy over a specific period, usually a year, including production, consumption, investment, and government activities. It provides a structural framework that captures the flow of goods, services, and factors of production in an economy in terms of revenues and expenditures. SAM is an important tool for calibrating the model for the initial condition of the economy, both with macroeconomic and behavioral parameters, to a real economy before a policy is implemented. In the SAM established in this study, GDP is derived from the sum of payments made to the workforce and net operating surplus (mixed income). The share of capital income in GDP (α) is obtained from the ratio of net operating surplus to GDP (Y):

$$\alpha = \frac{r.K}{Y}$$

Since no detailed data on households' investments in early childhood development for Türkiye exist, these data are calibrated through the "preschool education expenditure" with code 10101 in the HBS. The share of preschool expenditure in the total consumption expenditures of households (I_4/Y) is used to find the ratio of investment in children within the consumption value obtained from macroeconomic data. The altruism parameter (φ) is calibrated to match with to this ratio. Household's time preference (ρ), is calibrated to be consistent with key macro indicators. Interest rate and wage per active labor force are computed endogenously in the model. Interest rate is calculated as the marginal product of capital and wage per active labor force the marginal product of the active labor force. Tax on wage income in the model constitutes the direct tax income, while tax on consumption and investment expenditures in children constitutes the indirect tax. These tax rates are calibrated according to the ratio of indirect and direct tax revenues ($t_c(C + I_4 + I_5 + I_6) / t_w(Hw)$) and the ratio of total tax revenue to GDP (T/Y) using the data from 2019 Budget Financing Statistics of the Ministry of Treasury and Finance. The ratio of total consumption to GDP (C/Y) calibrated using the data from 2019 TURKSTAT National Accounts. Government expenditures are calculated to be consistent with row

and column balances in the SAM. The behavioral $(\zeta_1, \zeta_2, \zeta_3)$ and technical parameters $(\gamma_1, \gamma_2, \theta_1, \theta_2, \eta)$ in the human capital production function could not be calibrated due to lack of data, and the parameter values are taken from studies conducted in this field in the literature (Cunha and Heckman, 2007; Lee and Seshadri, 2019). Sensitivity analysis, presented in Chapter 6, is conducted with different parameter values to check to what extent the policy simulation result changes

The social accounts matrix (SAM) is theoretically presented in Table 5.1, and numerical structure created based on Turkish data for 2019 presented in Table 5.2. Parameter values used in the model are presented in Table 5.3



Table 5.1: Theoretical structure of the Social Accounts Matrix

	Activities	Consumer	Child Investment (ECD period)	Child Investment (School period)	Labor	Capital	Government
Activities		Final consumption expenditures (Household)	Investment in the child in the ECD period	Investment in school age children			Final consumption expenditures (Government)
Consumer					Wage income	Savings	
Child Investment (ECD period)		Investment in the child in the ECD period					
Child Investment (School period)		Investment in school age children					
Labor	Payments to the workforce						
Capital	Operating surplus/mixed income; net						
Government		Taxes on wage income, consumption and investment in children					

Table 5.2: Social Accounts Matrix (Thousand TL)

	Activities	Consumer	Child Investment (ECD period)	Child Investment (School period)	Labor	Capital	Government	Total
Activities		2.446.587.159,14	3.840.934,44	5.841.140,61			726.597.059,42	3.182.866.293,61
Consumer					1.342.907.498,40	1.839.958.795,21		3.182.866.293,61
Child Investment (ECD period)		3.840.934,44						3.840.934,44
Child Investment (School period)		5.841.140,61						5.841.140,61
Labor	1.342.907.498,40							1.342.907.498,40
Capital	1.839.958.795,21							1.839.958.795,21
Government		726.597.059,42						726.597.059,42
Total	3.182.866.293,61	3.182.866.293,61	3.840.934,44	5.841.140,61	1.342.907.498,40	1.839.958.795,21	726.597.059,42	

Sources: 2019 TURKSTAT National Accounts (payments to labor force, payments to capital and household's final consumption expenditures), 2019 Household Budget Survey (Share of early childhood development expenditures in total consumption), Ministry of Treasury and Finance 2019 Budget Finance Statistics (rate of direct and indirect taxes)), Lee and Seshadri (2019) (Behavioral parameters) and authors' calculations Note: The tax revenues and expenditures of the government are calculated with SHM offsetting applications.

Table 5.3: Calibrated parameters

Parameter	Definition	Value
α	Production elasticity of capital	0.5781
ρ	Time preference rate	0.0417
φ	Altruism parameter	2.45
t_c	Consumption tax rate	0.1835
t_w	Wage tax rate	0.2069
C/Y	Total consumption/GDP	0.7681
T/Y	Total tax income/GDP	0.2288
$t_c(C+I_4+I_5+I_6) / t_w(Hw)$	Indirect taxes/direct taxes	1.6211
I_4/C	ECD investments/Total consumption	0.0015
γ_1	Skill multiplier of ECD period	0.8
γ_2	Skill multiplier of schooling period	0.7
θ_1	Elasticity parameter of ECD period	0.1
θ_2	Elasticity parameter of schooling period	0.2
η	CES parameter	0.7
ζ_1	Parental contribution on child (ECD period)	0.9
ζ_2	Parental contribution on child (school period 1)	0.71
ζ_3	Parental contribution on child (school period 2)	0.68

Source: Own calculations, Lee and Seshadri (2019) ve Cunha and Heckman (2007)

CHAPTER 6

IMPLEMENTED POLICIES AND SIMULATION RESULTS

In this section, we will begin by outlining the policies implemented to subsidize ECD investment. We will then present the steady-state outcomes of both the benchmark model and policy simulations and compare the policy outcomes to determine which is more effective in terms of increasing economic indicators. Finally, we analyze the results of the transition path calculations, which is the trajectory of variables between the steady-state equilibrium of the benchmark economy and the steady-state equilibrium that the economy reaches after implementing a policy.

6.1. Implemented Policies

For policy simulations, we select four policies the government implements to subsidize ECD investments. These policies are lump-sum subsidy, matching funds (with two levels), universal child benefit, and child tax credit policies.

Currently, only lump-sum subsidy is being applied in the Turkish context. After comparing the impact of different policies with the one currently implemented in Türkiye, we can determine the most effective policy for promoting ECD and achieving the highest level of all economic indicators.

6.1.1. Lump-sum Subsidy Policy

This policy is designed to support households with young children in the ECD period by providing them with cash transfers. The primary goal is to increase household income and boost child investment.

The government provides this subsidy unconditionally, meaning that households are free to decide how much of the transfer they want to spend on improving their child's human capital and how much they want to allocate for other expenses. The

subsidy provided by the government appears in the budget constraint of households with children during the ECD period as in (45).

$$(1 + \tau_c)c_{4,t} + (1 + \tau_e)I_{4,t} + a_{5,t} = (1 - \tau_w)w_t h_t + ECD_subsidy \quad (45)$$

Since the government maintains a balanced budget, one way to finance the subsidy is to increase consumption tax rate. As a result of the lump-sum subsidy policy, the government's budget constraint is as in (46).

$$\begin{aligned} \tau_c(c_{4,t} + c_{5,t} + c_{6,t} + c_{7,t} + c_{8,t} + c_{9,t}) + \tau_e(I_{4,t} + I_{5,t} + I_{6,t}) + \tau_w(H_t w_t) \\ = G_t + ECD_subsidy \end{aligned} \quad (46)$$

Studies have demonstrated the effects of the household income-increasing lump-sum subsidies. For example, Dahl and Lochner (2012) conducts a study to determine the effect of the Earned Income Tax Credit, which increases household income, on children's math and reading achievement. The research reveals that a \$1,000 increase in income raised test scores in math and reading by 6 percent of a standard deviation. Additionally, the study finds that this effect was more pronounced in children from disadvantaged families. Milligan and Stabile (2011) investigates the impact of the expansion of Canadian child benefits on various outcomes such as test scores, mental health, physical health, and deprivation measures. The study revealed that an increase in child benefits led to an improvement in test scores and a reduction in aggression, maternal depression, and the incidence of hunger. The study concluded that higher child benefits can significantly improve the mental health and well-being of both children and mothers. Aizer et al. (2016) conducts a study to determine how cash transfers to low-income families affected their children's life expectancy, nutritional status, educational attainment, and income in adulthood using the data from the Maternal Pension program, administrative records, censuses, and World War II enlistment and death records. The program was the first government-sponsored welfare program in the United States and was active from 1911 to 1935. The study finds that the sons of mothers whose applications were accepted under the program lived a year longer than those whose mothers were rejected. In addition, boys of

accepted mothers were less likely to be underweight, received one-third more education, and had higher incomes in adulthood than the children of rejected mothers.

Lump-sum subsidy policy is implemented within the scope of articles 202-206 of the Civil Servants Law No. 657, which provides financial assistance to civil servants who are married with children in Türkiye (family allowance). This assistance is 1500 of reference amount for the civil servant's spouse who does not work or does not receive a pension from any social security institution and 250 of reference amount for each of his/her children by the monthly coefficient (increased by one-fold for children in the 0-6 age group, including the 72nd month). Only the difference is paid if the family allowance paid to one of the spouses for their children is lower under the employment contract or collective agreement. "The Council of Ministers is authorized to increase this level by up to 3 times." According to this law, in July 2023, the amount was 127.45 TL for households with children over the age of six in Türkiye and 254.89 TL for households with children under the age of six. As of 2024, these amounts are 190.22 TL and 380.44 TL, respectively.

In the model, under the lump-sum subsidy policy, the amount of subsidy provided by the government is set conservatively to correspond to about half of the average level of 0.8% of OECD countries' government expenditure on pre-school education to national income (0.039) (OECD, 2019).

6.1.2 Matching Funds Policy

Matching funds refer to funds that are provided in proportion to funds obtained from alternative sources. Some government programs offer matching funds to encourage savings for particular goals, such as education or homeownership. For example, in Child Development Account program, governments open an account at the birth of a child and provide matching funds to encourage family savings for investing in a child's future. This policy implemented in many countries. Loke and Sherraden (2009) provides an overview of the Child Development Account policies in Singapore, Canada, the United Kingdom, Korea, and the United States of America (USA) and discusses the proposed policy in terms of its inclusiveness, progressivity, coherence, integration, and development.

Kim et al. (2017) shows that Child Development Accounts can encourage parents to invest in their children's education at an early stage and set high expectations for their academic success. Ambler et al. (2015) also shows that matching funds increase education investment and reduce labor force participation among school-age youth. Moreover, it has been observed that it causes a crowd-in effect. In other words, government investment leads to an increase in household investment, although it is not conditional. Grinstein-Weiss et al. (2014) investigates the outcomes of experimental programs with different types of savings accounts. These programs match the contributions of low-income individuals, enabling them to build up their savings. One experiment finds positive impacts on the social-emotional development of disadvantaged children at the age of four.

In this model, the government and the household simultaneously provide the investment for the child. Although this policy can be implemented in different ratios by households and governments, we examine the effects of 1:1 financing in this analysis, as it is the most common form of this practice.

The subsidy given in this policy directly contributes to the child's human capital production function. Since this fund will be spent only on the child, we suggest an in-kind payment so the given subsidy does not appear in the household budget constraint. The subsidy is paid on the condition that the family contributes the same amount to the investment in their child. As a result of the subsidy given by the government, the human capital production function is as in (3).

$$\begin{aligned}
 h'_{3,t+3} &= h'_{4,t+4} = h'_{5,t+5} = h'_{6,t+6} \\
 &= \left[\gamma_1 \left(h_t^{\zeta_1} (I_{4,t}^{1-\zeta_1} + ECD_subsidy) \right)^{\theta_1} \right. \\
 &\quad + (1 - \gamma_1) \left[\gamma_2 (h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2})^{\theta_2} \right. \\
 &\quad \left. \left. + (1 - \gamma_2) (h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3})^{\theta_2} \right]^{\frac{\theta_1}{\theta_2}} \right]^{\frac{\eta}{\theta_1}}
 \end{aligned} \tag{47}$$

Since the government maintains a balanced budget, the subsidy increases the consumption tax rate to compensate for the ECD subsidy. As a result of the matching funds subsidy policy, the government's budget constraint is as in (46).

The government directly provides the expenditure to the child instead of transferring it to the household. This policy simulations under two different scenarios examines the effects of two different subsidy amounts. The first scenario involves using the same amount of subsidy in the lump-sum model to observe the effects of an equal subsidy amount provided by the government. In the second scenario, the subsidy level is set at half of the level in the lump-sum subsidy policy. This amount, combined with the amount of investment made by the household, is equal to the subsidy given in the lump-sum model.

6.1.3. Universal Child Benefit Policy

A universal child benefit is a payment from the government to families to support the costs of raising children. It is available to all families with children within a specific age range, regardless of their income level or socioeconomic status. Universal child benefit programs reach a larger portion of the child population compared to other transfer programs that use means testing or other targeting criteria. The high participation rates in universal child benefits are mainly due to the simplicity of eligibility rules, such as including all resident children up to a certain age, and the ease of administrative implementation, such as registering children for child benefits automatically at birth (Bastagli et al., 2020).

Universal child benefits can be in cash or in kind. However, since the assistance provided in this policy simulation directly enters the child's human capital production function, this practice fits better with in-kind subsidy, so the implementation of the policy could be in the form of universal childcare assistance. With this assistance, children access free early childhood education and care services, regardless of their parents' income level. Studies have shown the positive effects of these services on child development (García et al., 2017; J. J. Heckman, 2011). Gormley et al. (2005) investigates the effect of Oklahoma's universal pre-kindergarten program. The study finds that children from various ethnic backgrounds, including Hispanic, Black, White, and Native American, and those from different income brackets, all benefited from the program in terms of improving their school readiness. In this policy, ECD investment for the child is covered only by the government. Households do not invest in the child during this period. The subsidy given in this policy directly enters the child's human

capital production function. Therefore, subsidies are the only factor in the ECD investment part of the human capital production function, as can be seen in (48).

$$\begin{aligned}
 h'_{3,t+3} &= h'_{4,t+4} = h'_{5,t+5} = h'_{6,t+6} \\
 &= \left[\gamma_1 \left(h_t^{\zeta_1} (ECD_subsidy) \right)^{\theta_1} \right. \\
 &\quad + (1 - \gamma_1) \left[\gamma_2 \left(h_t^{\zeta_2} I_{5,t+1}^{1-\zeta_2} \right)^{\theta_2} \right. \\
 &\quad \left. \left. + (1 - \gamma_2) \left(h_t^{\zeta_3} I_{6,t+2}^{1-\zeta_3} \right)^{\theta_2} \right]^{\frac{\theta_1}{\theta_2}} \right]^{\frac{\eta}{\theta_1}}
 \end{aligned} \tag{48}$$

In application, families may receive different benefits, such as cash transfers or in-kind benefits for early childhood care and education, healthcare, food, or housing. The design and implementation of universal child benefit programs may vary across countries. There may be differences in these programs' administrative structures, eligibility criteria, benefit levels, and financing mechanisms.

The model in this study does not include different income groups, but household income levels increase as the economy grows during the transition period. Therefore, instead of covering all children in different income groups at any given time of the economy, we propose a universal child benefit that covers all children at all times during the transition period of the economy. In this policy, the government provides households with an equal amount of ECD subsidy as in the lump-sum policy. Thus, the universal child benefit policy is compared with the lump-sum subsidy policy and the first scenario of the matching funds policy since the subsidy provided by the government is the same. Additionally, the universal child benefit policy will be compared with the second scenario of the matching funds policy, as both policies have the same total child investment level.

6.1.4. Child Tax Credit Policy

In general, a tax credit allows taxpayers to subtract the credit from their debt when paying total tax to the government. There are two types of tax credits: refundable tax credits and non-refundable tax credits. A refundable tax credit is a credit where the

government repays the difference to the taxpayer if the amount of the credit to be deducted exceeds the amount of tax payable. Thus, a low-income taxpayer is able to pay negative taxes by being entitled to receive a tax credit that exceeds his/her tax liability. In a non-refundable tax credit, taxpayers only receive a tax credit for the amount of tax they pay, even if they are entitled to more than that amount (IRS, 2023).

This policy draws inspiration from the USA model, where two types of tax credits are available based on eligibility. The first is the earned income tax credit, which is a type of tax credit that low-income taxpayers can benefit from, whether they have children or not. The second is the child tax credit, which is a tax credit that benefits taxpayers with dependent children under the age of 17 (IRS, 2023). However, since the aim of the policies implemented in this study is to support the human capital investments of families with children in the ECD period, they were designed to be implemented only in households when they have young children. The Child Tax Credit (CTC) was introduced in the United States in 1997 as a part of the Taxpayer Relief Act. Initially, it was a non-refundable tax credit of \$500 per child, but over time, the amount was increased and made accessible to more taxpayers. In 2003, it was raised to \$1,000 per child, and it gradually became refundable. From 2018 to 2025, the child tax credit amount for each eligible child has been increased to \$2000, out of which \$1400 can be refundable (Crandall-Hollick, 2018). However, due to the COVID-19 pandemic, the amount of credit is significantly increased in 2021. Under the American Rescue Plan Act, the credit has been raised to \$3600 for children under the age of 6 and \$3000 for children between the ages of 6 and 17. Additionally, significant changes have been made to the child tax credit plan during this period. For low-income households, the child tax credit plan has been provided as non-refundable and has a two-stage “phase-in” threshold. After reaching a fixed-level plateau, it enters the phase-down period at a certain income level and phases out for the next higher income level. However, during the COVID-19 period, the phase-in part of the plan was removed and became fully refundable (Crandall-Hollick, 2021). Research shows that tax credits can lower child poverty rates, improve academic performance, and increase lifetime earnings. Chetty et al. (2011) estimates that a tax credit of \$1000 boosts a child's test score by 6% of a standard deviation and increases their lifetime earnings by 0.54 percentage points. Wimer et al. (2021) shows that the expanded child tax credit in 2021 led to a

significant decrease of 43% in child poverty rates, bringing them to the lowest level ever recorded. This decrease is due to low-income households not receiving full tax credits because of the non-refundable tax credit system, but with the new regulation, they are able to receive full tax credits. In 2020, approximately 33% of children did not qualify for the full CTC due to family income restrictions. However, the temporary expansion of CTC eligibility under the American Rescue Plan made almost all of these children eligible for the full credit (Collyer et al., 2023). The phase in part of the non-refundable CTC policy is not implemented in this policy simulation because, as aforementioned studies show, it is an unfair practice for low-income groups. In practice, the subsidy level gradually enters the phase-out phase after a certain threshold level of per capita wage, but in this policy simulation, for the convenience of computations, the amount of subsidy initially given at the same level as the lump sum policy is reduced to half of this amount after the threshold level. The threshold value is determined as the level at which wage income in the benchmark model increased by 3.5 percent.

6.2. Policy Experiments

We compare the steady-state results of the benchmark model, the lump-sum subsidy policy, the matching funds policy, the universal child benefit policy and the CTC policy to assess the impact of government subsidies on micro- and macro-level outcomes. Benchmark model values are normalized to 100 for ease of interpretation in macro-level outcomes.⁸

6.2.1. The Results of the Steady-State Computations

Table 6.1 presents a comparison of steady-state results of the benchmark model, lump-sum subsidy policy, matching funds policy (with two scenarios), universal child benefit policy, and CTC policy.

The lump-sum subsidy policy, which increased the total income of the family with children during the ECD period, increased output by 3.4% compared to the benchmark model. In the first scenario of the matching funds policy, where the same amount of

⁸ The results created with the model values are also presented in Table A.1 in the Appendix.

subsidy directly contributes to the child's human capital production function with an equal amount of investment by the household resulting in a 33.6% boost in output. Under the second scenario of the matching funds policy, where the government and households invested at a level of 0.19% of the benchmark model's GDP, there is a 20.8% increase in output. In the universal child benefit policy, where the total investment in the child is at the same level as in this policy, output increased by 22.3% while increase in output in child tax credit policy is limited to 1.7%. Similarly, while the lump-sum policy leads to a 4.88% increase in physical capital, a 1.4% increase in aggregate human capital, and a 4.4% increase in total consumption, the first scenario of the matching funds policy leads to a significantly higher increase of 32.5% in physical capital, 35.1% in aggregate human capital, and 42.8% in total consumption. In the second scenario of the matching funds policy, the subsidy increases physical capital by 20.5%, aggregate human capital by 21.1% and total consumption by 26.6%. The universal child benefit policy increases physical capital by 22.9%, aggregate human capital by 21.4%, and total consumption by 28.5%. Compared to these policies, CTC policy has a limited impact on physical capital, aggregate human capital and consumption, with only 2.5%, 0.7% and 2.2%, respectively.

Since the amount of direct investment made to the child in the second scenario of the matching funds policy and the universal child benefit policy are equal, the results are close to each other. However, the universal child benefit policy's outcomes levels are slightly higher. For example, while the aggregate human capital level increased by 20.7% in the second scenario of the matching funds policy, it increased by 20.9% in the universal child benefit policy. The reason for this is that in the universal child benefit policy, since the investment in children is made only by the government, the household invests more during the school period as there is a decrease in its total expenses of the household. This caused a positive impact on all outcomes.

When we examine the increase in ECD investments due to lump-sum subsidy and CTC policies compared to the benchmark model, the results show a 6.4% increase in the lump-sum policy and a 3.2% increase in the CTC policy.

There is also an increase in the investments made by the households during the schooling period for the child for all policies as a result of the ECD subsidy given by

the government. Investment in the 8-year period, which constitutes the first schooling period after ECD period, increased by 5.8% and investment in the second schooling period increased by 4.9% in the lump-sum model, in the first scenario of the matching funds model, investment in the first schooling period increased by 30.2% and investment in the second schooling period increased by 30.7%, in the second scenario of the matching funds model, investment in the first schooling period increased by 19.4% and investment in the second schooling period increased by 19.5% while in the universal child benefit policy investment in the first schooling period increased by 22.3% and investment in the second schooling period increased by 21.9% as a result of providing ECD subsidy. Compared to other policies, the effect of the CTC policy on school investment is limited as in other outcomes. CTC policy increases investment in first schooling period increased by 2.9% and investment in the second schooling period increased by 2.5%.

Table 6.1: Results of benchmark economy and policy simulations

	Benchmark model	Lumpsum subsidy model	Matching funds model	Universal Child Benefit	Matching funds model	Child tax credit
Wage	0.20	0.20	0.20	0.20	0.20	0.20
Interest rate (annual)	0.09	0.09	0.09	0.09	0.09	0.09
Consumption tax rate	0.18	0.18	0.13	0.13	0.11	0.18
Wage tax rate	0.21	0.21	0.21	0.21	0.21	0.21
Subsidy level*	0	0.39	0.19	0.39	0.39	0.39/0.19
ECD investment*	0.12	0.12	0.19	0.00	0.39	0.12
School 1 investment*	0.11	0.11	0.13	0.13	0.14	0.11
School 2 investment*	0.10	0.10	0.11	0.12	0.12	0.10
Output	100.00	103.40	120.75	122.26	133.62	101.74
Physical capital	100.00	104.88	120.54	122.88	132.51	102.47
Aggregate human capital	100.00	101.42	121.10	121.37	135.07	100.73
Consumption	100.00	104.38	126.61	128.52	142.81	102.21
Government expenditure	100.00	100.00	100.00	100.00	100.00	100.00

Source: Author's computations

* As a percentage of the benchmark model's GDP

When comparing the second scenario of the matching funds policy and the universal child benefit policy, where the total level of investment during the ECD period is

equal, we obtain the following results. In the second scenario of the matching funds policy, while the household's investment in the child's first schooling period increased by 19.4%, investment in the second schooling period increased by 19.5%. In the universal child benefit policy, investment in the first schooling period increased by 22.3%, while investment in the second schooling period increased by 21%. Since the government makes all the investments made in the child during the ECD period in the universal child benefit policy, there is a decrease in household expenditures, which causes an increase in investments in the following schooling periods.

To reach the steady state levels, it takes approximately 30 periods (240 years) for the economy in the lumps sum policy, approximately 40 periods (320 years) in the universal child benefit policy, and in the second scenario of the matching policy, and approximately 50 periods (400 years) in the second scenario of the matching policy.

6.2.2. The Results of Transition Path Computations

The Figure 6.1 shows that the most effective policy in terms of increasing output in the steady-state is the first scenario of the matching funds policy in which the amount contributed by the government is spent directly on the human capital of the child, provided that the households invest the same amount. The following two policies, in terms of their impact on output, are the second scenario matching funds policy and the universal child benefit policy. Both policies consider an equal investment in a child's human capital production function. However, the universal child benefit policy is more effective in terms of increasing output in the steady-state than the matching funds model because the investment in the child is only made by the government, which reduces the household's total expenditure. As a result, households invest more in children's human capital in the following two school terms, leading to a higher impact on all outcomes.

Based on Figure 6.2, the first scenario of the matching funds policy is the most effective policy regarding increasing physical capital. However, it also causes the highest decline in physical capital in the short term, as it leads to a decrease in household savings due to the increased tax rate for financing. According to the long-term effects, after the first scenario of the matching funds policy, the most effective

policy is the universal child benefit policy and the second scenario of the matching funds policy, respectively. The least effective policy is the lump-sum subsidy policy. In the model, the human capital transfer occurs from parent to child, and there are three periods between the parent and the child's first period of adulthood when human capital accumulation is completed. Therefore, human capital accumulates gradually, which creates a staircase-like appearance in the graphs.

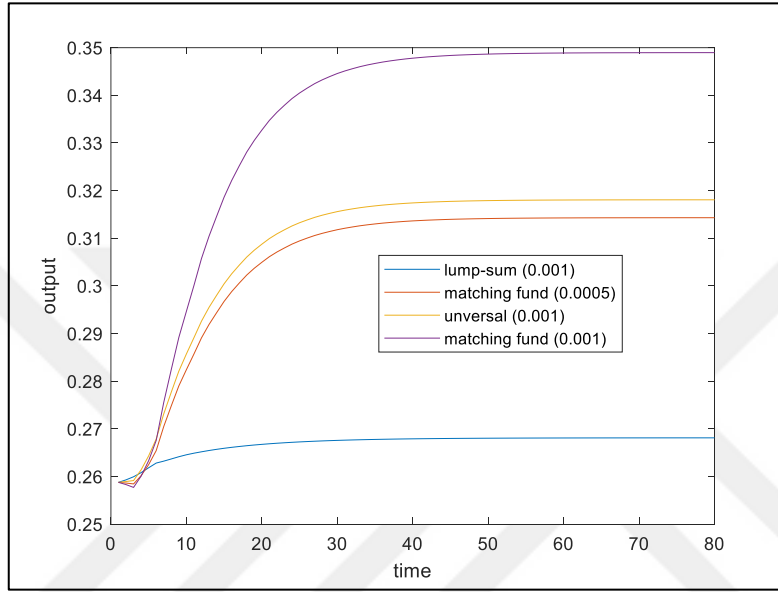


Figure 6.1: Transition Path of the Output in Lump-Sum, Matching Funds, and Universal Child Benefit Policies

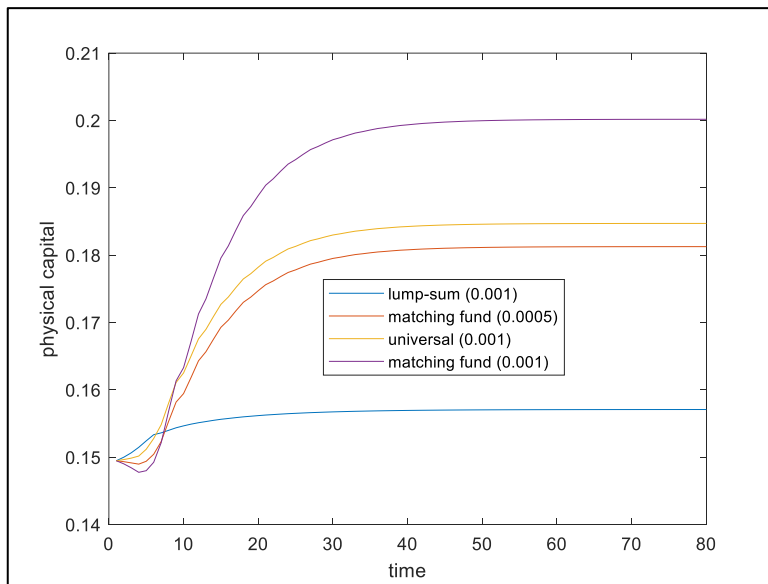


Figure 6.2: Transition Path of The Aggregate Physical Capital in Lump-Sum, Matching Funds, and Universal Child Benefit Policies

As shown in Figure 6.3 aggregate human capital is stable during the first three periods, and then it starts to increase. The stable part is attributed to the fact that children who receive investment after the implementation of policies begin to join the labor force after three periods. In the first three periods, the aggregate human capital accumulation in the economy consists of people in the workforce who have reached the steady-state level of human capital accumulation in the pre-policy economy. First scenario of the matching funds policy leads to the highest level of aggregate human capital, followed by the universal child benefit policy, then the second scenario of the matching funds policy. The lump-sum subsidy policy leads to the lowest level of aggregate human capital. CTC policy leads to lower outcomes, making it difficult to visually compare it with other policies in a single graph. In order to provide a clearer representation of the results, we separate the comparison of the transition path computations of the CTC policy and the lump sum subsidy policy from other policies to present the dynamics of the transition period more clearly.

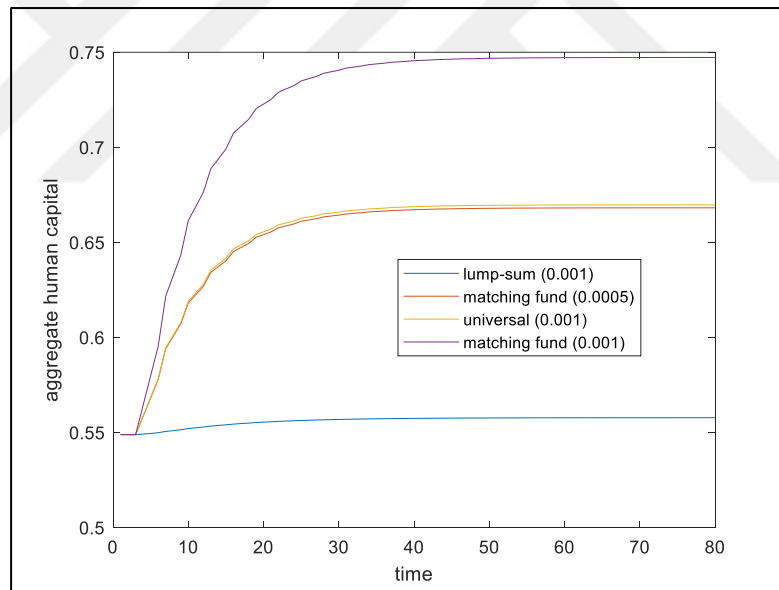


Figure 6.3: Transition Path of the Aggregate Human Capital in Lump-Sum, Matching Funds, and Universal Child Benefit Policies

In the child tax credit policy, the subsidy amount, which is initially given at the same level as the lump-sum subsidy, is reduced to half when the per capita wage in the economy exceeds a certain level. As seen in Figure 6.4, while the output amount is at the same level up to the threshold value in the two policies after the tax credit amount

given for ECD investment is reduced to half of this amount, the decrease in subsidy causes the output to increase at a slower rate initially, and then the level of output decreases and reaches the steady-state level at approximately half of the output level of the lump-sum subsidy policy.

Similarly, as seen in Figure 6.5, the physical capital in the child tax credit is at the same level as in the lump-sum subsidy policy up to the threshold value. When the amount of tax credit given decreases to half, physical capital increases at a slower rate, and then it decreases. Then, after a short fluctuation, it reaches approximately half of the steady-state level of physical capital of the lump-sum subsidy policy.

As seen in Figure 6.6, in the child tax credit policy, while the human capital level is at the same level as the lump-sum subsidy policy up to the threshold value when the tax credit provided for ECD investment is reduced to half, the human capital level increases at a slower rate and reaches approximately half of the steady-state level of aggregate human capital of the lump-sum subsidy policy.

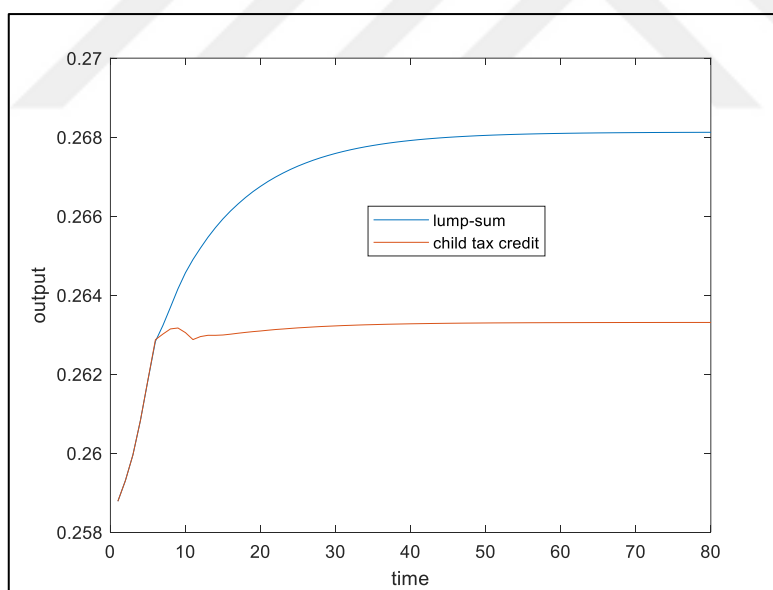


Figure 6.4: Transition Path of The Output in Lump-Sum and Child Tax Credit Policies

Since human capital accumulation is based on the parent who completed human capital accumulation three periods ago instead of the previous generation in each generation, the human capital accumulation graph has a staircase-like pattern.

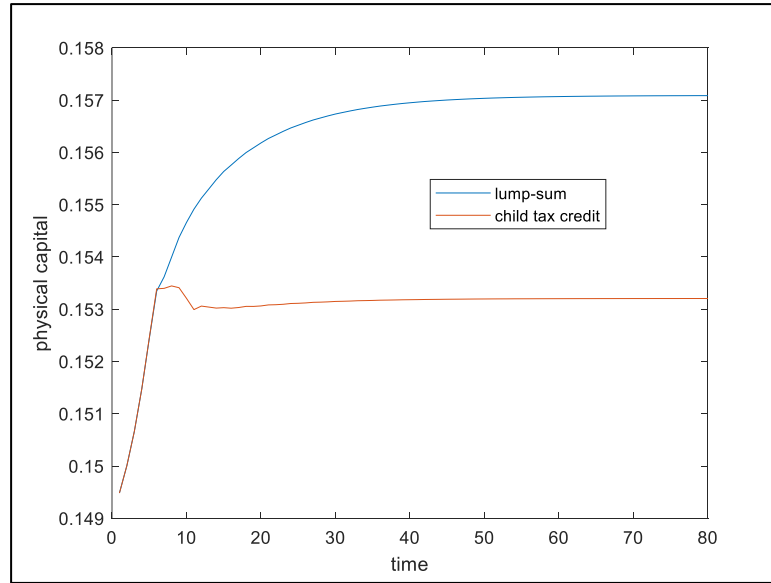


Figure 6.5: Transition Path of the Physical Capital in Lump-Sum and Child Tax Credit Policies

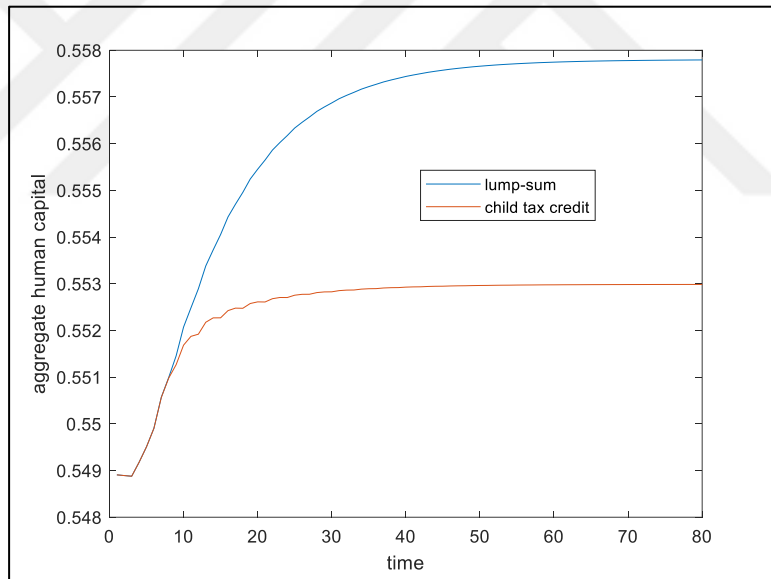


Figure 6.6: Transition Path of the Aggregate Human Capital in Lump-Sum and Child Tax Credit Policies

6.2.3. Effect of Policies on Consumption Tax Rate

The government increases the consumption tax rate when implementing an ECD investment subsidy policy since it maintains a balanced budget policy. However, as seen in the Figure 6.7, in all policy simulations, the effective tax rate initially increases, but it decreases after a short period of time. Since levels of consumption and child

investment expenditure increase as income levels increase, a lower consumption tax rate on higher consumption expenditure is sufficient to balance the same level of government expenditure. The scenario with the matching funds policy leads to the highest increase in output and expenditures, resulting in the most significant reduction in consumption tax. On the other hand, the lump-sum policy has the smallest increase in output, resulting in the smallest decrease in consumption tax.

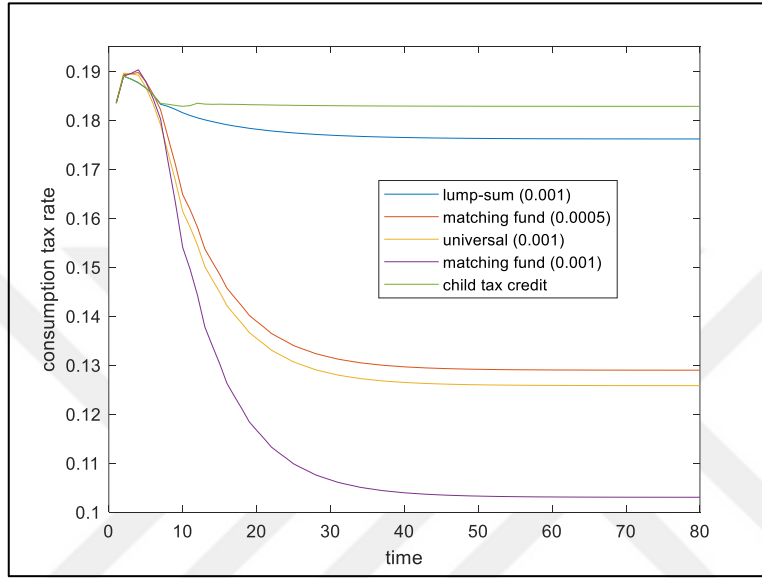


Figure 6.7: Consumption Tax Rate

6.3. Sensitivity Analyses

In this model, due to a lack of adequate data, we are unable to estimate the parameters that are used in the human capital production function for Türkiye. As a result, it is essential to conduct a sensitivity analysis to ensure the robustness of the model's results by varying the values of the parameters used in the model. These parameters are the ECD period skill multiplier (γ_1), school period skill multiplier (γ_2), elasticity parameter of the ECD period (θ_1), elasticity parameter of the schooling period (θ_2), CES parameter (η), parental contribution on a child in the ECD period (ζ_1), first schooling period (ζ_2), and second schooling period (ζ_3). Sensitivity analyses are conducted based on changing one parameter at a time. Two values are determined for each of the parameters, one higher and one lower. Sensitivity analyses of the parameters (ζ_1 , ζ_2 , ζ_3) showing how much the parent's human capital contributes to

the child's human capital are conducted in accordance with the results of empirical studies showing that the effect of the parent's human capital contribution on the child is higher at younger ages. The upper and lower values for these parameters are chosen so as not to violate these empirical findings.

The results of the sensitivity analyses are presented in from Table A.2 to A.17 in the Appendix. Sensitivity analysis shows that the results are robust on all parameters. In all analyses, the most effective policy in terms of increasing outcomes is the first scenario of the matching funds policy, followed by the universal child benefit policy and the second scenario of the matching funds policy. The least effective policy is the lump-sum subsidy policy. These results show that the policy recommendations developed according to the results obtained with the parameters used in the model are reliable.⁹

⁹ As the threshold level of per capita wage varies for each parameter value in the child tax credit policy, we exclude it from the sensitivity analysis to ensure the comparability of results.

CHAPTER 7

CONCLUSION

Investing in ECD provides high returns for both the individual and the society. It also ensures equality among individuals. Governments started to show a higher interest in investment in ECD, with the inclusion of the targets for this period in the 2030 SDGs, which is an international call. In Türkiye, Development Plans prepared by the Presidency of Strategy and Budget and the Strategic Plans of the MoNE, the MoH, and the MoFSS determine the aims, targets, and strategies for ECD. While there is a general understanding of the significance of the early childhood period among policymakers and researchers, there is a lack of research that analyzes the effects of various policies promoting ECD investment on macroeconomic indicators. Our study aims to address this gap and is driven by the necessity to provide policy recommendations that are informed by the outcomes of policy simulations.

In this thesis, we examine the impact of alternative ECD investment policies including lump-sum subsidy, matching funds, universal child benefits, and child tax credit on household decisions and macro-level outputs. To this end, we develop a 9-period overlapping generations model in a general equilibrium framework and calibrate it to the 2019 Turkish economy.

We modeled the life cycle based on schooling age, education system, and birth statistics (for the age with the highest number of births) in Türkiye. We use a multi-period human capital formation technology with parental human capital and physical input, which emphasizes the empirical evidence that investment in ECD has a higher return compared to subsequent periods. The lump-sum subsidy is an unconditional assistance given to households to boost ECD investment. In this policy, households decide how much of the assistance is spent on improving the child's human capital. The matching fund is a policy in which the government provides a subsidy that directly contributes to the child's human capital on the condition that the household makes an

equal investment. We examine two different scenarios for this policy. In the first scenario, the government provides a subsidy that is equal to that in the lump-sum subsidy. In the second scenario, the government provides a subsidy that is half of the lump-sum subsidy so that, together with the investment made by the household, an amount equal to the one in lump-sum subsidy policy is directly contributed to the child's human capital. The universal child benefit is a government payment that provides financial assistance to families to help the expenses associated with raising children regardless of their income level or socioeconomic status. In this policy, ECD investment is covered only by the government, and the subsidy directly contributes to the child's human capital.

The child tax credit is a policy that increases household income, like the lump-sum subsidy policy. However, in this policy, the subsidy (tax credit) is deducted from the tax payable instead of being given directly to the household. The most important difference of this policy, compared to the lump-sum subsidy policy, is that when the per capita wage income levels in the economy exceed a certain threshold value, it is reduced by half.

We find that the first scenario of the matching policy model is the most effective policy in terms of increasing all macroeconomic indicators as it directly increases human capital and is provided on the condition that the household makes the same investment. When we compare the second scenario of the matching funds policy and the universal child benefit policy where the direct subsidy provided to the child is at the same level, we find that the universal child benefit policy is more effective. The lump-sum subsidy policy is the least effective policy compared to the two scenarios of the matching fund policy and universal child benefit policy. Because the subsidy given in the lump-sum subsidy policy increases the household's income instead of directly contributing to the child's human capital, results shows that households spend a portion of the subsidy on consumption expenditure.

The child tax credit policy is similar to the lump-sum subsidy policy in that it allows households to make their own spending decisions. However, it is less effective than the lump-sum subsidy policy because the child tax credit subsidy is reduced by half after a certain income level is reached. In all policy simulations, a higher level of

ECD investment leads to an increase in household investment at formal schooling periods.

As a result of policy simulations, when implementing the most effective policies of matching fund and universal child benefit in which investment directly contributes child's human capital, we suggest that providing in-kind payments in the form of early childhood education and care services is a better option than giving cash payments. Parents may lack knowledge about childcare and may not use cash incentives efficiently. However, by purchasing early childhood education and care services with the fund, an expert can better contribute to the child's human capital. Studies show that providing childcare assistance to families leads to increased utilization of center-based services and has a positive effect on children's development in the US (Burchinal et al., 2000), in Canada (Crosby et al., 2005) and in Brazil (Leao et al., 2021). Governments considering short-term effects may favor cash subsidies like lump sum subsidies and child tax credits because they want to avoid reducing output by raising consumption taxes to fund matching funds and universal child benefit subsidies, which are provided as in-kind assistance to the child. However, in terms of their long-term impact, in-kind subsidies that directly contribute to the child's human capital are much more effective. Saraçoğlu and Karaoğlu (2019) analyzes the ECD investment status of Denmark, Finland, Iceland, Norway, and Sweden, and find that these countries have high levels of human capital and heavily subsidize ECD investment. In contrast, Türkiye lags behind in both ECD investment and human capital levels compared to these countries. Given the relatively low impact of the lump-sum subsidy, the current policy implemented in Türkiye is unlikely to have a significant effect in the long term. By investing in all children during the ECD period, regardless of their income level, Türkiye can catch up with countries that have higher income levels.

One limitation of the study is that we are unable to estimate the parameters in the human capital production function due to insufficient data. However, the sensitivity analysis we conducted shows that the effectiveness ranking of the policies is not affected. Therefore, we can safely conclude that the policy recommendations are still valid. Another limitation is the production function we employ. Formulating human capital as a separate factor of production rather than as a factor that increases efficiency

could have produced different results. Finally, the model does not consider labor market imperfections. It assumes that all individuals old enough to join the workforce are employed, but this assumption may not hold true because full employment is not always possible.

Future work will include the examination of the effects of alternative ECD investment policies with increased level of parental altruism due to parental awareness of ECD. Thus, it will be shown that the government can have an impact on human capital and economic growth not only through physical child investment but also through raising awareness. In addition, we will study the effect of ECD policies on economic growth through parents' tradeoff between labor, leisure, and child care by endogenizing the inelastic labor supply. A cost-benefit analysis by comparing policy-related expenditures and gains (in terms of output increase) will be another study that will guide policymakers. In an extension of this model, we differentiate between income groups instead of treating individuals as homogeneous. We plan to finance ECD investment subsidies for the low-income group with the higher tax rate applied to the high-income group. This will allow us to examine policies aimed at reducing income inequality in society.

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APPENDICES

A. SUPPLEMENTARY TABLES

Table A.1 : Results of benchmark economy and policy simulations (with model data)

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal Child Benefit	Matching fund model
Output	0.2588	0.2676	0.3125	0.3164	0.3458
Physical capital	0.1495	0.1568	0.1802	0.1837	0.1981
Aggregate human capital	0.5489	0.5567	0.6647	0.6662	0.7414
Consumption	0.1988	0.2075	0.2517	0.2555	0.2839
Government expenditure	0.0592	0.0592	0.0592	0.0592	0.0592
Wage	0.1989	0.2028	0.1984	0.2004	0.1968
Interest rate (annual)	0.0906	0.0896	0.0907	0.0902	0.0911
Consumption tax rate	0.1835	0.1768	0.1283	0.1272	0.1052
Wage tax rate	0.2069	0.2069	0.2069	0.2069	0.2069
Subsidy	0	0.001	0.0005	0.001	0.001
ECD investment	0.0003008	0.0003201	0.0005	0	0.001
School 1 investment	0.0002729	0.0002886	0.0003258	0.0003337	0.0003552
School 2 investment	0.0002472	0.0002595	0.0002954	0.0003014	0.000323

Source: Authors' calculations

Table A.2: $\eta = 0.75$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	106.4366	137.6908	140.3451	155.4745
Physical capital	100	108.9655	137.0115	141.1494	153.3333
Aggregate human capital	100	103.0322	138.6996	139.2623	158.4870
Consumption	100	108.2973	148.3146	151.7718	170.5272

Table A.3: $\eta = 0.65$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	102.1238	112.2706	113.2407	122.1290
Physical capital	100	103.1307	112.2505	113.8385	121.5517
Aggregate human capital	100	100.7794	112.3469	112.4954	122.9618
Consumption	100	102.7645	115.7679	117.0307	128.2253

Table A.4: $\gamma_1 = 0.85$

	Benchmark model	Lumpsum subsidy model	Matching fund model (0.0005)	Universal (0.001)	Matching fund model (0.001)
Output	100	102.9683	118.4579	119.7202	131.9686
Physical capital	100	104.2503	118.2999	120.3660	131.1098
Aggregate human capital	100	101.2070	118.6353	118.7963	133.1188
Consumption	100	103.8632	123.7567	125.3552	140.8526

Table A.5: $\gamma_1 = 0.75$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	103.9046	122.6030	124.3384	134.6204
Physical capital	100	105.5597	122.2389	124.9437	133.3584
Aggregate human capital	100	101.6769	123.1493	123.5174	136.5031
Consumption	100	105.0311	128.9429	131.2606	144.0362

Table A.6: $\gamma_2 = 0.75$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	103.3846	120.6923	122.1538	133.5000
Physical capital	100	104.8602	120.4394	122.7696	132.4234
Aggregate human capital	100	101.4325	121.0154	121.2874	134.9773
Consumption	100	104.4066	126.5398	128.4427	142.7141

Table A.7: $\gamma_2 = 0.65$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	103.4109	120.8140	122.3256	133.6822
Physical capital	100	104.8993	120.6040	123.0201	132.6174
Aggregate human capital	100	101.4254	121.1623	121.4181	135.1425
Consumption	100	104.4422	126.7037	128.6724	142.9076

Table A.8: $\theta_1 = 0.15$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	103.3678	120.5894	122.0436	133.5630
Physical capital	100	104.8344	120.3311	122.6490	132.4503
Aggregate human capital	100	101.4074	120.8950	121.1296	134.9693
Consumption	100	104.3847	126.4076	128.3009	142.7504

Table A.9: $\theta_1 = 0.05$

	Benchmark model	Lumpsum subsidy model	Matching fund model (0.0005)	Universal (0.001)	Matching fund model (0.001)
Output	100	103.4335	120.9520	122.4737	133.6715
Physical capital	100	105.0000	120.7432	123.1757	132.6351
Aggregate human capital	100	101.4346	121.3169	121.5928	135.1665
Consumption	100	104.4715	126.8801	128.8618	142.8862

Table A.10: $\theta_2 = 0.25$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	103.4003	120.7883	122.2566	133.6167
Physical capital	100	104.8829	120.5351	122.8763	132.5084
Aggregate human capital	100	101.4392	121.1150	121.3700	135.0884
Consumption	100	104.4266	126.6097	128.5211	142.8068

Table A.11: $\theta_2 = 0.15$

	Benchmark model	Lumpsum subsidy model	Matching fund model (0.0005)	Universal	Matching fund model
Output	100	103.4003	120.7496	122.2566	133.5781
Physical capital	100	104.8829	120.5351	122.8763	132.5084
Aggregate human capital	100	101.4210	121.0967	121.3518	135.0701
Consumption	100	104.4288	126.6734	128.5858	142.8284

Table A.12: $\zeta_1 = 0.95$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	101.7628	112.2253	113.1181	118.3837
Physical capital	100	102.6482	112.0158	113.3992	117.6680
Aggregate human capital	100	100.5742	112.5339	112.6963	119.3912
Consumption	100	102.2937	115.6688	116.8305	123.3840

Table A.13: $\zeta_1 = 0.85$

	Benchmark model	Lumpsum subsidy model	Matching fund model	Universal	Matching fund model
Output	100	106.1453	132.1539	134.5127	152.0795
Physical capital	100	108.5129	131.7888	135.5603	150.4310
Aggregate human capital	100	102.9446	132.6531	133.0321	154.3440
Consumption	100	107.8416	141.1479	144.2199	166.2086

Table A.14: $\zeta_2 = 0.76$

	Benchmark model	Lumpsum subsidy model	Matching fund model (0.0005)	Universal (0.001)	Matching fund model (0.001)
Output	100	103.0972	119.2951	120.6479	132.0755
Physical capital	100	104.4978	119.1620	121.3185	131.1152
Aggregate human capital	100	101.2592	119.5601	119.7616	133.3445
Consumption	100	104.0315	124.7915	126.5060	140.8712

Table A.15: $\zeta_2 = 0.69$

	Benchmark model	Lumpsum subsidy model	Matching fund model (0.0005)	Universal (0.001)	Matching fund model (0.001)
Output	100	103.5501	121.3402	125.2493	134.2242
Physical capital	100	105.0414	121.0635	125.8978	133.0801
Aggregate human capital	100	101.4852	121.7146	124.2903	135.7398
Consumption	100	104.6234	127.3766	116.8831	143.5844

Table A.16: $\zeta_3 = 0.70$

	Benchmark model	Lumpsum subsidy model	Matching fund model (0.0005)	Universal (0.001)	Matching fund model (0.001)
Output	100	103.3549	120.5490	121.9977	133.3587
Physical capital	100	104.8185	120.3300	122.6403	132.3432
Aggregate human capital	100	101.3839	120.8303	121.0999	134.7771
Consumption	100	104.3176	126.3027	128.1886	142.4814

Table A.17 : $\zeta_3 = 0.63$

	Benchmark model	Lumpsum subsidy model	Matching fund model (0.0005)	Universal (0.001)	Matching fund model (0.001)
Output	100	103.5529	121.3573	122.9142	134.2116
Physical capital	100	105.0449	121.0781	123.5660	133.1030
Aggregate human capital	100	101.4866	121.7162	121.9985	135.7546
Consumption	100	104.5738	127.3389	129.3659	143.5551

B. CURRICULUM VITAE

Serap SAĞIR

E-mail: [REDACTED]

EDUCATION:

Ph.D. candidate in Economics, Middle East Technical University, Spring 2024

M.A. in Economics, Social Sciences University of Ankara, 2016

Thesis Title: Optimal Auditing for Tax Evasion

B.A. in Economics, Anadolu University, 2013

B.S. in Mathematics, Fatih University, 2013

RESEARCH INTERESTS:

Human capital accumulation, return on education, early childhood development, taxation

PROGRAMMING SOFTWARE:

MATLAB, Maple, STATA, C

EMPLOYMENT:

Research Assistant: “Factors Determining Early Childhood Development in Turkey and Investment an Early Childhood Development” Coordinator: Dürdane Şirin Saraçoğlu, Researchers: Meltem Dayıoğlu Tayfur, Çağaçan Değer, Hanife Deniz Karaoğlu, The Scientific and Technological Council of Turkey (TUBITAK) 1001 grant, 2022

Consultant (Voluntary): Early Childhood Development Knowledge Network, 2021-

Program Assistant: “National Early Childhood Development Policy Program” Coordinator: Müdriye Yıldız Bıçakçı, Senior Advisor: Nurper Ülküer, Collaboration of UNICEF and Association of Child Development and Educators, 2020-2021

Teaching Assistant: İpek University, 2015-2016

Research Assistant: “Asymmetric Guessing Games” Coordinator: Zafer Akın, The Scientific and Technological Council of Turkey (TUBITAK) 1001 grant, 2014

Research Assistant: “Theoretical and Empirical Analysis of the Independent Evaluation Process Conducted by Development Agencies” Coordinator: Esra Eren Bayındır, Researcher: İsmail Sağlam, The Scientific and Technological Council of Turkey (TUBITAK) 1001 grant, 2014

PUBLICATION:

“Unlevel Playing Field: Socioeconomic Determinants of Early Childhood Development in Türkiye. *Child Indicators Research*, 1-30.” (with Deniz Karaoğlu, Meltem Dayıoğlu, Dürdane Şirin Saraçoğlu)

PUBLISHED WORKING PAPER:

“The Growth Effects of Alternative Early Childhood Development Investment Policies in the Turkish Economy” (with Çağaçan Değer, Dürdane Şirin Saraçoğlu) 2023 METU Department of Economics, Economic Research Center (ERC) Working Papers No:23/4

“The Impact of Maternal Education on Early Childhood Development: The Case of Turkey” (with Hanife Deniz Karaoğlu, Meltem Dayıoğlu, Dürdane Şirin Saraçoğlu), 2023 METU Department of Economics, Economic Research Center (ERC) Working Papers No:23/3

PRESENTATION IN INTERNATIONAL CONFERENCES:

Gebze Technical University, Department of Economics Seminar Series, Türkiye, February 2024

Turkish Economic Association (TEA) 30th Conference on Economics (IceTEA2023), Türkiye November 2023

World Economic Research Institute (WERI) 4th International Conference in Economics (EconTR2023), Türkiye September 2023

Economic Research Forum (ERF) 29th Annual Conference, Cairo May 2023

SCHOLARSHIPS AND AWARDS:

Full Scholarship for Master Studies, İpek University (2014)

Honor Student, Fatih University, Department of Mathematics (2013)

Full Scholarship for Undergraduate Students, Fatih University, Department of Mathematics (2008)



C. TURKISH SUMMARY / TRKE ZET

Giriř

Ekonomik bymenin drt temel belirleyicisi fiziksel sermaye, insan sermayesi, doęal kaynaklar ve teknolojidir. Bunların arasında insan sermayesi, uzun vadeli ekonomik bymenin ve srdrlebilir kalkınmanın nemli bir itici gcdr. İnsan sermayesi genel olarak kiřinin eęitim dzeyi ve deneyimi, fiziksel ve zihinsel saęlıęı, iř ahlakı ve motivasyonu, yaratıcılıęı, yenilięe aıklıęı, iletiřim becerileri ve kiřinin yařam bařarısını etkileyen birok zellięi aracılıęıyla edindięi teknik ve sosyal becerileri kapsar. Beřeri sermayenin ekonomik byme zerindeki etkisini inceleyen modeller, daha iyi becerilere ve saęlıęa sahip bireylerin daha retken olma eęiliminde olduęunu ileri srmektedir (Lucas, 1988; Romer, 1990). Bu artan retkenlik, daha yksek kiřisel gelir ve ekonomik byme seviyelerine yansır. Uzun vadede bir lkenin reel ekonomik byme hızını artırmak iin o lkede insan sermayesi birikimini destekleyecek eęitim ve saęlık yatırımlarına ncelik verilmesi makroekonomik literatrn nemli sonularından biridir (bkz. Barro, 1991; Mankiw ve dięerleri, 1992; Barro ve Lee, 1993; Benhabib ve Spiegel, 1994).

Arařtırmalar, oęu saęlık ve eęitim gstergesinin ekonomik byme zerinde olumlu bir etkiye sahip olduęunu gstermektedir; ancak son yirmi yılda sinir bilimi, psikoloji ve ekonomi alanında yapılan arařtırmalar, insan sermayesi birikiminin rgn eęitimden ok nce bařladıęını gstermektedir. Bu alıřmalar, doęum ncesi dnemden resmi eęitim dnemine kadar insan sermayesi birikiminin ok daha hızlı olduęunu gstermektedir (bkz. Heckman, 2000; Campbell ve dięerleri, 2001; Thompson ve Nelson, 2001; Rolnick ve Grunewald, 2003; Heckman, 2011; Garcıa ve dięerleri, 2017). Bu dnem, erken ocukluk geliřimi (EG) dnemi olarak tanımlanmakta ve ocuęun dllenmeden okul ncesi aęa kadar olan biliřsel, fiziksel, dil, miza, sosyo-duygusal ve motor geliřim srecini ifade etmektedir. Erken ocukluk programlarına yatırım yapmak, ekonomik kalkınma iin dięer yksek riskli ekonomik kalkınma programlarından ok daha gvenli bir aratır (Rolnick ve Grunewald, 2007). Ayrıca, ocukluęun ilk yıllarına yatırım yapmada zsermaye verimlilięi aısından bir

değiş-tokuş yoktur, ancak daha sonraki yıllarda böyle bir değiş-tokuş vardır (Cunha ve diğerleri, 2006).

Birleşmiş Milletler de EÇG'nin önemini kabul ederek 2030 Sürdürülebilir Kalkınma Hedeflerine (SKH) bununla ilgili bir hedef ekledi. EÇG'nin SKH'lara dahil edilmesi, ulusal ve uluslararası düzeyde yüksek kaliteli EÇG hizmetlerini teşvik eden politikaların oluşturulması ihtiyacını vurgulamaktadır. Bu amaçla Türkiye, üst politika belgelerinde EÇG'ye yönelik amaç, hedef ve stratejiler ortaya koymuştur.

Bu dönemde yapılan çalışmalar EÇG'nin insan sermayesi birikimi ve yatırımın yüksek getirisi açısından önemini ortaya koymuş olsa da bu dönemde yatırımları teşvik eden alternatif politikaların uzun vadeli ekonomik etkilerine ilişkin araştırma eksikliği bulunmaktadır. Bu açığı kapatmak amacıyla, Türkiye'de uygulanan mevcut götürü ödeme politikasını ebeveynlerin EÇG yatırımlarını teşvik etmeyi amaçlayan alternatif hükümet politikalarıyla karşılaştıran bir çalışma gerçekleştirdik. Çalışmamız sonucunda, Türkiye'yi uzun vadede daha yüksek bir büyüme yoluna taşıyacak özel ve kamu EÇG yatırımları arasındaki dengeyi temel alan politika önerilerinde bulunuyoruz.

Model

Ebeveynlerin çocuklarının beşerî sermayesine yaptığı yatırımını incelemek için genel denge çerçevesinde 9 dönemlik bir örtüşen nesiller (overlapping generations (OLG)) modeli oluşturulmuştur. Bu modelde ekonomi dış dünyaya kapalıdır ve zaman, aralıklı zamandır. Ekonomide zaman 0'dan sonsuza kadar gitmektedir, ancak modeldeki bireylerin sınırlı bir ömrü vardır. Her dönem sekiz yıldır ve bireyler ölmeden önce dokuz dönem yaşarlar. Her dönemde yeni bir nesil doğmaktadır ve her neslin büyüklüğü sabitlenip bire normalleştirilmiştir. Böylece tüm nesillerin toplam ölçüsü 9'a eşit olmaktadır.

Modelde kişinin yaşam döngüsü doğumdan iki yıl önce başlamaktadır. Çünkü doğum öncesi dönemden 6 yaşına kadar uzanan EÇG döneminin yanı sıra annenin hamilelik öncesindeki sağlık durumunun da çocuğun sonuçlarını etkilediğini gösteren kanıtlar vardır. Örneğin, Stephenson vd. (2018), hamilelik öncesi anne sağlığının çocuk sağlığı açısından önemine ilişkin farklı gelir düzeylerine sahip ülkelerden elde edilen kanıtları

inceleyerek, hamilelik öncesi sağlık ile anne ve çocuk sağlığı sonuçları arasında güçlü bağlantılar olduğunu ve sonuçların nesillere yayılabileceğini göstermektedir. Liu vd. (2016) ise hamilelikten önce aşırı kilolu veya obez olan annelerin daha yüksek ölü doğum riski taşıdığını, gebelik yaşına göre beklenenden daha büyük bir bebeğe sahip olabildiğini, bebeğin yenidoğan yoğun bakım ünitesine yatırılabilirliğini ya da bebeğin düşük doğum ağırlığına sahip olabildiğini göstermektedirler. Öte yandan, bu çalışma hamilelikten önce düşük kilolu olmanın, bebeğin prematüre doğma riski, bebeğin gebelik haftasına göre beklenenden küçük olması, erken doğum ve düşük doğum ağırlığı riskinin yüksek olmasıyla ilişkili olduğunu göstermiştir.

Yaşamın ilk dönemi, doğumdan önceki iki yıldan altı yaşına kadar uzanan gebelik öncesi, hamilelik ve çocuğun EÇG aşamalarını kapsamaktadır. Model Türkiye ekonomisine göre kalibre edildiği için eğitim basamakları da Türkiye'deki eğitim sistemine göre tasarlanmıştır. 4+4+4 sistemine göre bir birey ilk ve orta öğrenimini modelin ikinci dönemindeki sekiz yıllık sürede tamamlamaktadır. Yine sekiz yıldan oluşan üçüncü dönemde birey lise ve üniversite eğitimini tamamlar. Bu üç dönemde birey, yetişkin bir ebeveynin çocuğudur ve herhangi bir ekonomik karar almamaktadır, sadece ebeveyninden yatırım almaktadır.

Ebeveynin hanedeki karar verici olduğu varsayıldığından, çocuk pasif bir şekilde yatırımı kabul eder ve kendi tüketimi ebeveynlerinin tüketimine dahil edilir¹⁰ veya göz ardı edilir¹¹. Dördüncü dönemde birey, yetişkin yaşamının ilk döneminde işgücüne girer ve bir birim emeğini esnek olmayan bir şekilde sağlar. Birey 22 yaşında bu döneme girer ve 24 yaşında çocuk sahibi olmadan önce iki yıl boyunca gebelik öncesi hazırlık dönemini ve hamilelik dönemini geçirir. Annenin doğum yaptığı yaş belirlenirken sekiz yıllık dönem dönem aralıkları ve doğum istatistikleri dikkate alınmıştır. Türkiye'de Sağlık Bakanlığı verilerine göre 2019 yılında en fazla doğumun gerçekleştiği yaş aralığı 25-29 olmuştur. Bu dönemde işgücüne katılarak ücret geliri elde etmeye başlayan birey, çocuğunun EÇG dönemine yatırım yapar.

Beşinci dönemde birey, ilkokul ve ortaokul boyunca çocuğunun beşerî sermayesine yatırım yapar. Altıncı dönemde, çocuğunun lise ve üniversite eğitimine yatırım yapar.

¹⁰ De La Croix and Michel (2002) tarafından önerildiği gibi

¹¹ Heckman and Mosso (2014) tarafından yapılan çalışmada olduğu gibi

Yedinci dönemde birey ebeveynlik sonrası dönemdedir; çocuğu haneden ayrılmıştır ancak kendisi hâlâ iş gücündedir. Bu dönemde bireyin çocuğu eğitimini tamamlar, işgücüne katılır ve çocuk sahibi olur. Sekizinci ve dokuzuncu dönemlerde birey iş gücünden ayrılıp emekli olurken, bireyin çocuğu iki dönem boyunca kendi çocuğunun beşerî sermayesine yatırım yapmaktadır. Birey, çocuğunun torunu doğmadan önce dokuzuncu dönemin sonunda ölür. Bireyin ölmeden önce herhangi bir fiziksel miras saiki yoktur. Emeklilik sırasında tüm birikimlerini tüketir. Modelde nüfus artışı yoktur yani her neslin ölçüsü sabittir.

Ancak beşerî sermaye şeklindeki miras, beşerî sermaye birikim teknolojisi aracılığıyla nesilden nesile aktarılmaktadır. Yaşamlarının son aşamasında ebeveynler, yatırımları ve kendi beşerî sermayelerinin katkısının sonucunda çocuklarının sahip olacakları beşerî sermaye düzeyinden zaman iskonto oranı ve özgecilik (altruizm) parametresi ile indirgenmiş düzeyinden fayda sağlarlar.

Çocuğun gelişimine yapılan yatırım bir firmanın fiziksel sermaye yatırımına benzetilmemelidir, getirisi marjinal verimlilik ile ölçülemez. Hanehalkı bir yandan çocuğun maddi ihtiyaçlarını karşılarken, gelişimine yatırım yaparken bir yandan da onun zihinsel ve duygusal gelişimini tamamlaması için zaman ayırarak birebir ilgi göstermelidir. Bu noktada kaçınılmaz olarak anne-babanın beşerî sermaye seviyesi önemli rol oynamaktadır, ebeveynler ne kadar eğitilirse çocuklarına yapacakları aynı seviyede yatırımla düşük eğitim seviyesine sahip ebeveynlerden daha fazla fayda elde edeceklerdir. Diğer taraftan, çocuğun gelişimine yapılan yatırımın getirisi, fiziksel sermayeye tasarruflar yoluyla yapılan yatırım gibi hemen izleyen dönemde marjinal verimlilik olarak gerçekleşmez. Çocuğun gelişimine dolayısıyla beşerî sermayeye yapılan yatırım, çocuğun yetişkinlikteki kazancına veya ücretine yansır, hanehalkına herhangi bir tasarruf aracı gibi getirisi yoktur.

Hanehalkı modülü

Yaşamının ilk üç dönemini bitirip yetişkin olan bir birey bu dönemden itibaren iş gücüne katılıp ekonomik kararlar almaya başlar. Yaşamının dördüncü döneminde vergi sonrası ücret gelirini tüketimine çocuğunun EÇG dönemine yapacağı yatırıma harcar ve kalan kısmı tasarrufunu oluşturur. Beşinci dönemde vergi sonrası ücret gelirini, bir önceki dönem yaptığı tasarrufunu ve faiz gelirini tüketimine çocuğunun birinci okul

dönemine yapacağı yatırımına harcar ve kalan kısmı tasarrufunu oluşturur. Altıncı dönemde vergi sonrası ücret gelirini, bir önceki dönem yaptığı tasarrufunu ve faiz gelirini tüketimine çocuğunun ikinci okul dönemi yatırımına harcar ve kalan kısmı tasarrufunu oluşturur. Yedinci dönemde yetişkin bireyin çocuğu haneden ayrılmıştır ve artık çocuğuna yatırım yapmamaktadır vergi sonrası ücret gelirini, bir önceki dönem yaptığı tasarrufunu ve faiz gelirini tüketimine harcar ve kalan kısmı tasarrufunu oluşturur. Sekizinci ve dokuzuncu dönemde emekli olmuştur ve artık ücret geliri elde etmemektedir. Bu iki dönemde tasarruflarını tüketir ve ölür.

Ebeveynler, zaman tercihi parametresi ile indirimli tüketimlerinden ve aynı zamanda özgecilik düzeylerine bağlı olarak çocuklarının beşerî sermayesinden fayda elde ederler. Fayda fonksiyonunun logaritmik olduğunu varsayılmaktadır, dolayısıyla faiz oranının gelir ve ikame etkileri eşit olmaktadır.

Bireylerin ebeveynlerinden üç dönem boyunca aldıkları yatırım ve ebeveynlerinin beşerî sermayelerinin katkısı sonucunda elde ettikleri beşerî sermaye düzeyleri ekonomiye işgücü sağladıkları yani ekonomik olarak aktif oldukları dönemler boyunca sabit kalmaktadır.

Ebeveynin beşerî sermaye düzeyi çocuğun beşerî sermaye üretim fonksiyonuna dahil edilmiştir. Çünkü ebeveynin (genellikle annenin) genellikle eğitim düzeyiyle ölçülen beşerî sermayesinin, çocuğun sonuçları üzerindeki olumlu etkisi bir dizi çalışmayla gösterilmiştir. Cunha vd. (2010), Cunha ve Heckman (2008), Attanasio vd. (2020), Cuartas (2022) ebeveynlerin beşerî sermayesinin çocuğun beşerî sermayesi düzeyini doğrudan etkilediğini göstermektedir. Fiziksel yatırımın verimliliği, ebeveynin beşerî sermaye düzeyi arttıkça artar.

Firma ve üretim modülü

Modelde temsili bir firma ekonomide tek bir mal üretir. Standart genel denge modellerinde olduğu gibi, firma dengesi kar maksimizasyonu ile nitelendirilir. Firma ekonomideki tek malı üretmede fiziksel sermaye ve işgücü kullanır. İşgücünün üretkenliği, birikmiş olan beşerî sermaye ile belirlenir: Birikmiş olan beşerî sermaye ne kadar yüksekse, işgücünün marjinal verimliliği de o denli yüksek olacaktır. Bu anlamda modelde beşerî sermaye herhangi bir diğer üretim faktörü olarak değil de

iřgücünün etkinliđini artıran bir unsur olarak üretimde yer almaktadır (Heer and Maussner, 2009; Voyvoda and Yeldan, 2005).Firma dengesinde her bir üretim faktörünün fiyatı, o faktörün marjinal verimliliđi ile belirlenir. Buna göre dengede reel faiz (fiziksel sermaye birim fiyatı) fiziksel sermayenin marjinal getirisine, reel ücret ise iřgücünün marjinal verimliliđine eřit olacaktır. İřgücünün marjinal verimliliđi, birikmiř olan beřerı sermayeye bađlıdır. Bu anlamda, beřerı sermaye birikimi ne denli yüksekse, iřgücü reel ücreti de buna bađlı olarak o denli yüksek olacaktır.

Devlet modülü

Baz veya temel modelde, devlet hanehalkı tüketim ve diđer hanehalkı harcamaları ile ücretlerden vergi alır, bütçe denk olacak řekilde de devlet harcamasında bulunur. Ancak alıřmamızda devletin en önemli iřlevi, hanehalkının EG yatırımlarını (ya da harcamalarını) eřitli alternatif politikalar yolu ile teřvik etmektir. Bu alternatif politikalara bađlı olarak devletin bütçe denkliđi denklemi deđiřmektedir ancak her alternatif durumda ekonominin dengesinde devlet bütçesinin denk olduđu varsayımı vardır.

Durađan Durum ve Geiř Yolu Hesabı

Ekonominin denge yolunu hesaplama süreci üç ařamadan oluřur. İlk olarak, referans ekonominin politikasız durađan durum dengesini özölmektedir. İkinci olarak, bir politika uygulandıktan sonra ekonominin yakınsadıđı durađan durumu özölmekte ve son olarak ekonominin bu iki durađan durum dengesi arasındaki geiř yolunu bulmaktayız.

Karřılařtırma modeli için bařlangı durađan durum dengesini özmek için dengeyi karakterize eden denklem sistemini eř zamanlı olarak özmekteyiz. Bu denklem sistemi, Gauss-Seidel yöntemi adı verilen ve Auerbach ve Kotlikoff (1987) tarafından benimsenen sayısal bir özüm yöntemi olan bir teknik kullanılarak özmekteyiz. özüm sürecinde öncelikle modeldeki bazı iřsel deđiřkenler tahmin edilmektedir. Bu deđerlere dayanarak, bařlangıta tahmin edilenler de dahil olmak üzere modelin diđer iřsel deđiřkenleri hesaplanır. Tahmin edilen deđiřkenlere iliřkin bařlangıta elde edilen deđerler, hesaplama sonunda elde edilen deđerlerle eřleřiyorsa bu, denklem sisteminin özöldüđünü gösterir. Ancak hesaplanan deđerlerin ilk tahmin deđerleri ile

eşleşmiyorsa önceki hesaplama sonunda elde edilen değerler kullanılarak işlem tekrarlanır. Bu yinelemeli süreç tutarlı bir sonuç elde edilene kadar devam etmektedir.

Bu çalışmada kurulan modelin algoritması şu şekilde çalışmaktadır: Algoritma başlangıçtaki fiziksel ve beşeri sermaye seviyelerinin tahmin edilmesiyle başlamaktadır. Faktör fiyatları bu ilk tahmine göre hesaplanır. Bu faktör fiyatlarına ve beşeri sermaye düzeyine göre hane halkının problemi çözülür. Çözüm, modelin hiçbir fiziksel varlığın bireylere aktarılmadığı ve temsilcilerin borç alamadıkları varsayımı ile uyumlu olacak şekilde formüle edilmektedir. Hanehalkı problemi kök bulma yöntemlerinden “sekant yöntemi” ile çözülür (Mathews ve Fink, 2004).

Bu yöntem şu şekilde uygulanır: Tüketim ve tasarruflara yönelik optimal yolu hesaplamak için öncelikle tasarruf miktarı için iki başlangıç noktasını tahmin etmekteyiz. İlk başlangıç noktasını (son dönemden önceki döneme ait tasarruf miktarı) kullanarak, bütçe kısıtları ve tüketicinin Euler denklemleri yardımıyla diğer dönemlere ait tasarruf ve tüketim miktarları hesaplanır. İkinci başlangıç noktası kullanılarak diğer dönemlerdeki tasarruf ve tüketim miktarları için başka bir hesaplama yapılır. Daha sonra önceki iki nokta kullanılarak bir sonraki başlangıç noktası sekant yöntemi yardımıyla hesaplanır. Daha sonra, tasarruf miktarının yeni başlangıç değerini kullanarak yeni tasarruf ve tüketim miktarları hesaplanır. Hesaplama, ilk dönem tasarruf miktarını sıfır (veya bir tolerans değerine göre sıfıra çok yakın) olarak buluncaya kadar yeni başlangıç noktaları bulmak için sekant yöntemi uygulanarak tekrarlanır. İlk girdisi sıfır olan bir varlık matrisi bulduğumuzda hanehalkı probleminin hesaplanması sona erer ve yeni fiziki ve beşeri sermayenin hesaplanmasına devam edilir.

Yetişkin bireylerin ekonomideki tasarruflarının toplamı o dönemde toplam fiziki sermayeyi oluşturacağından bu değer yeni fiziki sermaye tahmini haline gelir. Hanehalkı sorununun çözümü sonucunda da bulunan beşeri sermaye yatırımı seviyeleri ile yeni neslin beşeri sermaye düzeyi bulunur. Hesaplanan fiziksel ve beşeri sermaye değeri, tahmin edilen değere (belirli bir tolerans değerine göre) yakınsa, algoritma sonlandırılır. Aksi takdirde süreç yeni bir tahminle başlar. Sayısal analizin doğruluğunu artırmak amacıyla, fiziksel ve beşeri sermaye seviyelerinin yanı sıra

tüketim ve tasarruf seviyelerini hesaplamak için çok düşük bir tolerans değeri seçmekteyiz.

Alternatif politikalarla durağan durum dengesinin hesaplanmasında, bir politika uygulandıktan sonra durağan durum dengesini hesaplamak için kullandığımız yöntem, temelde politikadan önce kararlı durumu hesaplamak için kullanılan yöntemlerle aynıdır. İki yöntem arasındaki fark, baz modelinde dışsal olarak belirlenen tüketim vergisi oranının politika simülasyonlarında içsel olarak belirlenmesidir. Hükümet, EÇG yatırımlarına yönelik sübvansiyonu hane halkına uygulanan tüketim vergisi oranını artırarak finanse etmektedir. Devlet harcamaları referans modeldeki seviyede sabit kalırken, sübvansiyonlardaki artışı için bütçede tüketim vergisi oranıyla dengelenmektedir. Bu nedenle, her hesaplamanın sonunda tüketim vergisi oranı, bütçe dengesini koruyacak şekilde hesaplanmaktadır.

Geçiş dönemi hesaplaması, ekonomide dışsal bir değişim olarak ortaya çıkan politikanın uygulanmasıyla başlar.

Hükümetin uyguladığı EÇG politikası uygulanmaya başlandığı dönemde ve sonrasında doğan çocukların insan sermayesi üzerinde etkilidir. Politikanın uygulandığı dönemde hayatta olan ve "eski nesil" olarak adlandırılan beş yetişkin birey bulunmaktadır. Ancak bu kuşakların küçük çocukları olmadığı için EÇG desteği alamamaktadırlar. Hükümet, küçük çocuklu hanelere yönelik sübvansiyonları bütçedeki tüketim vergisi oranlarındaki artışla dengeleyeceğinden, politika yalnızca tüketim vergisi oranlarının artması yoluyla eski nesilleri etkemektedir. Bu eski kuşakların verdiği kararların sonuçları ayrı ayrı hesaplanmaktadır.

Ekonominin geçiş dengesi hesaplamaları, durağan durum denge hesaplamalarına benzemektedir. Ancak geçiş yolu hesaplanırken ekonomideki aktörler tercihlerini yaparken dinamik bir yapıda değişecek faktör fiyatları ve tüketim vergisi oranını dikkate alacakları için tüm dönemler aynı anda çözülmektedir. Geçiş dengelerini hesaplamasına başlamadan önce, ekonominin durağan durum dengesine ulaşması için hesaplamada kullanılacak dönem sayısına karar verilmesi gerekir. Ekonominin kararlı durum dengesine ulaşması için yeterince uzun bir süre belirlemek önemlidir, çünkü bu süre yetersizse, ekonomi kararlı durum dengesine zamanından önce yaklaşacağından

hesaplamalar yanlış olacaktır. Geçiş dönemi olarak belirlenen dönem sayısına eşit olarak fiziki sermaye, beşeri sermaye ve tüketim vergisi oranlarının başlangıç değerini tahmin ederek hesaplamalara başlamaktayız. Bu endojen değişkenlerin başlangıç değerlerini, ilk ve son kararlı durum arasında doğrusal enterpolasyon yaparak tahmin etmekteyiz. Durağan durum hesaplamalarında olduğu gibi, bu ilk tahmini kullanarak, önce faktör fiyatlarını, ardından bütçe kısıtları ve Euler denklemlerinden hane halkı tüketimini, beşeri sermaye yatırımı ve tasarruf düzeylerini ve hükümetin bütçe dengesinden tüketim vergisi oranını hesaplamaktayız. Bu iki seviyenin yardımıyla fiziksel sermaye, beşeri sermaye ve tüketim vergisi için yeni tahminler elde edip ve bu tahminleri kullanılarak hesaplamaları yeniden yapmaktayız.

Ancak bu prosedürü yalnızca bir politika uygulandıktan sonra küçük çocuklu yetişkin olan bireyin kararlarının sonuçlarını hesaplamak için kullanılmaktayız. Politika uygulanmadan önce ekonominin önceki durağan durumunda devam edeceğini varsayarak karar almaya başlayan ve politika sonrasında kararlarını buna göre değiştiren eski nesiller için de hesaplamaları ayrıca yapmaktayız. Politika öncesi tasarruf ve yatırım kararlarını dikkate alarak, politika sonrasında ekonomide faktör fiyatları ve tüketim vergisi oranları altında eski kuşakların problemlerini çözmekteyiz.

Eski kuşakların problemleri alternatif bir kök bulma yöntemi olan “yanlış konum yöntemi” ile çözülmektedir (Mathews ve Fink, 2004).

Sosyal Hesaplar Matrisi

Modelin denge çözümünde kullanılacak parametrelerin kalibrasyonu için bir sosyal hesaplar matrisi (SHM) oluşturulmuştur. Matrisin oluşturulmasında gerekli olan çalışanlara yapılan ödemeler, sermayeye yapılan ödemeler, bireysel tüketim harcamaları ve ürün üzerinden alınan vergilere dair veriler 2019 Türkiye İstatistik Kurumu (TÜİK) Ulusal Hesaplardan, çocuğa yapılan yatırım harcamalarının toplam harcama içindeki payı 2019 TÜİK Hanehalkı Bütçe Anketi’nden (HBA), dolaylı ve dolaysız vergilerin oranı Hazine ve Maliye Bakanlığı Bütçe Finansmanı İstatistikleri’nden alınmıştır. HBA’dan sağlanan mikro veri seti temizlenmiş, analiz için kullanıma hazır hale getirilmiş ve özgecilik parametrenin kalibrasyonu için kullanılmıştır.

SHM'deki makroekonomik deęerler TÜİK Ulusal Hesaplardan elde edilmiştir. Gayri safi Yurtiçi Hasıla (GSYH), işgücüne yapılan ödemeler ve net işletme artığının toplamından elde edilmiştir. Sermaye gelirinin payı GSYH içindeki payı net işletme artığının GSYH'ya oranından elde edilmiştir. Devlet harcamaları satır ve sütun dengeleri ile tutarlı olacak şekilde hesaplanmıştır. Türkiye için hanelerin erken çocukluk gelişimine yapılan yatırımlarla ilgili detaylı veri bulunmadığı için bu veri Hanehalkı Bütçe Anketi'ndeki (HBA) 10101 kodlu “*okul öncesi eğitim*” harcaması üzerinden elde edilmiştir. Okul öncesi harcamasının hanelerin toplam tüketim harcamaları içindeki payı makroekonomik verilerden elde edilen tüketim deęerinin içinde çocuęa yapılan yatırımın oranını bulmak için kullanılmıştır. Özgeciliş parametresi bu orana göre kalibre edilmiştir. Hanehalkının zaman tercişini gösteren oranı, temel makro göstergelerle tutarlı olacak şekilde kalibre edilmiştir. Faiz sermayenin marjinal getirisi olarak, etkin işgücü başına ücret etkin işgücünün marjinal getirisi olarak modelde içsel olarak hesaplanmıştır.

Modeldeki ücret geliri üzerinden alınan vergi doğrudan vergi geliri iken tüketim ve çocuęa yapılan yatırım üzerinden alınan vergi dolaylı vergidir. Bu vergi oranları Hazine ve Maliye Bakanlığı 2019 Bütçe Finansmanı İstatistiklerindeki dolaylı ve dolaysız vergi gelirlerinin birbirine oranı ve toplam vergi gelirinin GSYH'ye oranına göre kalibre edilmiştir.

Beşerî sermaye üretim fonksiyonundaki davranışsal ve teknik parametrelerin veri eksikliğinden dolayı kalibrasyonu yapılamamış, parametre deęerleri literatürde bu alanda yapılan çalışmalardan (Cunha ve Heckman, 2007; Lee ve Seshadri, 2019) alınmıştır. Modelde kullanılan parametre deęerleri Tablo 15'de sunulmuştur.

Uygulanan Politikalar

Politika simülasyonları anlamında hükümetin hanehalkı EÇG yatırımlarını desteklemek için uygulayabileceğı dört farklı politika seçilmiştir. Bu politikalar arasında götürü (lump-sum) sübvansiyon, fon eşleme (matching funds), üniversal çocuk yardımları ve çocuk vergisi kredisi (child tax credit) yer almaktadır. Mevcutta Türkiye'de sadece götürü sübvansiyon politikası uygulanmaktadır. Dięer politikaların etkileri Türkiye'de mevcutta uygulanan politikayla karşılaştırılarak devletin bu

politikalar arasında hanehalkının EÇG yatırımlarını teşvik etmek amacıyla uygulayabileceği en etkin politika belirlenmiştir.

Birinci politika götürü sübvansiyon politikasıdır. Bu politika, EÇG döneminde küçük çocuklu hanelere nakit transferi sağlanarak hane gelirinin doğrudan artırılmasını teşkil eder. Amaç, ebeveynlerin çocuklarının gelişimine daha fazla yatırım yapmalarını teşvik etmektir. Verilen yardım şarta bağlı olmayıp, hane halkları transferin ne kadarının çocuklara ne kadarının diğer harcamalara harcanacağına karar verme özgürlüğüne sahiptir. Amerika Birleşik Devletleri'nde hane halkı gelirini artıran götürü yardımın etkileri birçok çalışma ile ortaya konulmuştur (Dahl and Lochner, 2012; Duncan et al., 2014; Maxfield, 2013). Bu politika, Türkiye'de çocuklu evli bulunan devlet memurlarına maddi yardım sağlayan 657 sayılı Devlet Memurları Kanunu'nun 202-206 maddeleri kapsamında uygulanmaktadır (aile yardımı ödeneği). Bu kanun çerçevesinde “Evli bulunan Devlet memurlarına aile yardımı ödeneği verilir. Bu yardım, memurun her ne şekilde olursa olsun menfaat karşılığı çalışmayan veya herhangi bir sosyal güvenlik kuruluşundan aylık almayan eşi için 1500, çocuklarından herbiri için de 250 gösterge rakamının (72nci ay dahil olmak üzere 0-6 yaş grubunda yer alan çocuklar için bir kat artırımlı) aylık katsayısı ile çarpılması sonucu elde edilecek miktar üzerinden ödenir. Eşlerden birine iş akdi veya toplu sözleşme gereği çocukları için yapılan aile yardımı ödeneği daha düşük ise, yalnız aradaki fark ödenir. Bu fıkra yer alan gösterge rakamlarını 3 katına kadar artırmaya Bakanlar Kurulu yetkilidir.” Bu kanuna göre, Temmuz 2023'te Türkiye'de altı yaş üstü çocuğu olan hanelere fiilen 127,45 TL, altı yaş altı çocuğu olan hanelere ise fiilen 254,89 TL ödenmiştir. 2024 yılı itibarıyla bu miktarlar sırasıyla 190,22 TL ve 380,44 TL olmuştur.

Götürü sübvansiyon politikasında, devlet tarafından hanelere sağlanan EÇG sübvansiyonu miktarı, OECD ülkelerinde devletin okul öncesi eğitime yaptığı harcamanın milli hasılaya oranı olan ortalama yüzde 0,8 seviyesinin muhafazakar olarak yaklaşık yarısına (0,039) denk gelecek şekilde seçilmiştir (OECD, 2019).

İkinci politika olan eşleşen fon politikası, çeşitli kaynaklardan elde edilen fonlarla orantılı olarak sağlanan fonları ifade etmektedir. Bu modelde çocuğa yapılacak yatırım devlet ve hanehalkı tarafından sağlanmaktadır. Bu politika farklı oranlarda

uygulanabilse de bu uygulamanın en yaygın şekli olan 1:1 finansman modelinin etkileri model çerçevesinde incelenmiştir. Bu politikada devlet tarafından sağlanacak fon, ailenin de çocuğa aynı miktarda yatırım yapması koşuluyla ödenir.

Ambler vd. (2015), eşleşen fonun eğitim yatırımlarını artırdığını ve okul çağındaki gençler arasında işgücüne katılımı azalttığını göstermektedir. Ayrıca devlet yardımlarının şartlı olmadığı durumlarda da yapılan bu yardımın hanehalkı yatırımlarını artırdığını belirtmiştir.

Devlet, bu politika altında yardımları hane gelirine aktarmak yerine doğrudan çocuğun gelişimine yardımcı olacak şekilde sağlamaktadır. Bu politika için iki farklı senaryoda simülasyonlar yapılmıştır. Birinci senaryoda, götürü ödeme sübvansiyon politikası ile aynı miktarda sübvansiyon sağlanmıştır. İlk senaryoda ise sübvansiyon değeri olarak götürü sübvansiyon değerinin yarısı seçilmiştir. Bu miktar, hane halkının yaptığı yatırım miktarıyla birleştirildiğinde götürü sübvansiyon politikasında devlet tarafından sağlanan yardıma eşit olmaktadır.

Üçüncü politika olan universal çocuk yardımı politikası, devletin ailelere çocuk yetiştirme masraflarını karşılamaları için yaptığı ödemedir. Gelir düzeyi veya sosyoekonomik durumu ne olursa olsun, belirli yaş aralığında çocuğu olan tüm ailelere bu yardım sunulmaktadır. Uygulamada aileler, nakit transferleri veya erken çocukluk bakımı ve eğitimi, sağlık hizmetleri, yiyecek veya barınma konularında aynı yardımlar gibi farklı yardımlardan yararlanabilmektedirler. Universal çocuk yardımı programlarının tasarımı ve uygulaması programların idari yapılarında, uygunluk kriterlerinde, fayda düzeylerinde ve finansman mekanizmalarına göre ülkeden ülkeye değişiklik göstermektedir. Universal çocuk yardımı programları, gelir testi veya diğer hedefleme kriterlerini kullanan transfer programlarıyla kıyaslandığında çocuk nüfusunun daha büyük bir bölümüne ulaşmaktadır. Universal çocuk yardımlarına katılım oranlarının yüksek olması, temel olarak, belirli bir yaşa kadar tüm çocukların dahil edilmesi gibi uygunluk kurallarının basitliğinden ve çocukların doğumda otomatik olarak çocuk yardımları programlarına kaydedilmesi gibi idari uygulamanın kolaylığından kaynaklanmaktadır (Bastagli et al., 2020). Bu çalışmada universal çocuk yardımı, eşleşen fon politikasında olduğu gibi doğrudan beşerî sermaye üretim fonksiyonunu etkileyen bir ayni yardım olarak modellenmiştir. Bu çalışma

kapsamında farklı gelir grupları arasında ayırım yapılmamakta ancak ekonomi büyüdükçe hane halkı gelir düzeyi artmaktadır. Bu nedenle bu politika ekonominin herhangi bir döneminde farklı gelir gruplarındaki çocukları kapsamak yerine, her zaman tüm çocukları kapsayan universal bir çocuk yardımı şeklinde kurgulanmıştır.

Her ne kadar universal çocuk yardımı nakdi ya da aynı olabilse de bu politika simülasyonunda sağlanan yardım doğrudan çocuğun beşerî sermaye üretim fonksiyonuna dahil olduğu için aynı yardımlarla daha uyumludur, dolayısıyla politikanın uygulanması aynı çocuk bakımı yardımı şeklinde düşünülebilir. Bu yardımla çocuklar, ebeveynlerinin gelir düzeyi ne olursa olsun, ücretsiz erken çocukluk eğitim ve bakım hizmetlerine ulaşabilmektedir. Araştırmalar bu tür hizmetlerin çocuk gelişimi üzerindeki olumlu etkilerini göstermiştir (García et al., 2017; J. J. Heckman, 2011).

Bu politikada, götürü sübvansiyon politikasında olduğu gibi, devlet tarafından ailelere verilen EÇG sübvansiyonu miktarı, götürü sübvansiyon modeli ile eşit olarak seçilmiştir.

Son politika çocuk vergi kredisi politikasıdır. Genel olarak vergi kredisi, vergi mükelleflerinin devlete vergi öderken vergi borçlarından herhangi bir sosyal yardım ödeneğini düşmelerine imkân tanınması olarak tanımlanabilir. İki tür vergi kredisinden söz edilebilir: Geri ödenebilir vergi kredileri ve geri ödenmeyen vergi kredileri. Geri ödenebilir vergi kredisi, vergiden düşülecek kredi tutarının ödenecek vergi tutarını aşması durumunda hükümetin aradaki farkı vergi mükellefine geri ödediği bir kredidir. Böylece düşük gelirli bir vergi mükellefi, vergi yükümlülüğünü aşan bir vergi kredisi almaya hak kazanarak negatif vergi ödeyebilecektir. Geri ödenmeyen vergi kredisinde, vergi mükellefleri, bu tutarın üzerinde hak sahibi olsalar bile, yalnızca ödeyecekleri vergi tutarı kadar vergi kredisi alırlar. Bu politika simülasyonunda verilen EÇG sübvansiyonu bireyin vergi yükümlülüğünün altında olduğundan, geri ödemesi olmayan vergi kredisine bir örnek teşkil etmektedir.

Bu politika, uygunluk esasına göre iki tür vergi kredisinin mevcut olduğu ABD'deki Çocuk Vergi Kredisi (ÇVK) örnek alınarak oluşturulmuştur. Bunlardan ilki, düşük gelirli vergi mükelleflerinin çocuk sahibi olsun veya olmasın yararlanabileceği bir

vergi kredisi türü olan kazanılmış gelir vergisi kredisidir (earned income tax credit). İkincisi ise bakmakla yükümlü oldukları 17 yaş altı çocukları olan vergi mükelleflerine yarayan bir vergi kredisi olan çocuk vergisi kredisidir (child tax credit). Ancak bu çalışmada uygulanan politikaların amacı EÇG döneminde çocuğu olan ailelerin beşerî sermaye yatırımlarını desteklemek olduğundan, politika sadece küçük çocukları olan hanelere uygulanacak şekilde tasarlanmıştır.

ÇVK, Amerika Birleşik Devletleri'nde 1997 yılında Vergi Mükellefi Yardım Yasası'nın bir parçası olarak uygulamaya konmuştur. Başlangıçta, çocuk başına 500 ABD doları tutarında geri ödemesiz vergi kredisi verilmekte iken, zamanla bu miktar artırılarak daha fazla vergi mükellefinin kullanımına sunulmuştur. 2003 yılında çocuk başına 1000 ABD dolarına çıkarılmıştır ve zaman içinde geri ödenebilir hale getirilmiştir. 2017 yılı itibarıyla çocuk başına 2000 ABD dolarına çıkarılmış ve 1400 ABD dolarına kadar geri ödeme yapılmıştır ve bu politikanın 2025'e kadar sürmesi planlanmıştır. Ancak COVID-19 salgını nedeniyle 2021 yılında kredi miktarı önemli ölçüde artırılmıştır. Kredi miktarı 6 yaş altı çocuklar için 3600 ABD dolarına, 6-17 yaş arası çocuklar için ise 3000 ABD dolarına çıkarılmıştır. Ayrıca bu dönemde ÇVK planına önemli başka değişiklikler de olmuştur. Daha önceki uygulamalarda düşük gelirli haneler için ÇVK planı iki aşamalı eşik değeri ile geri ödemesiz olarak sağlanmıştır. Kredi miktarı sabit düzeyde bir platoya ulaştıktan sonra, belirli bir gelir düzeyinde kademeli olarak azalma dönemine girer ve bir sonraki daha yüksek gelir düzeyine geçerek kredi miktarını sıfırlanır. Ancak COVID-19 döneminde planın düşük gelirli haneler için uygulanan aşamalı başlangıç kısmı kaldırılarak tamamen geri ödenebilir hale getirilmiştir. ABD'de 2021'de genişletilmiş ÇVK, çocuk yoksulluğu oranlarında yüzde 43'lük önemli bir düşüşe yol açarak bu oranları şimdiye kadar kaydedilen en düşük seviyeye getirmiştir. Bu azalmanın nedeni, daha önce geri ödemesiz vergi kredisi sistemi nedeniyle tam vergi kredisi alamayan düşük gelirli hanelerin, uygulanan yeni düzenlemeyle tam vergi kredisi alabilmesidir (Wimer vd., 2022). Uygulamada belli bir gelir seviyesinden sonra vergi kredisi aşamalı olarak azaltılıp daha yüksek gelir seviyelerinde bu yardım sonlandırılmaktadır. Ancak modelimizde hesaplama kolaylığı açısından belli bir gelir seviyesine kadar olan destek miktarı bu gelir seviyesinden sonra yarıya indirilmektedir. Destek miktarının yarıya indirildiği eşik değeri baz modeldeki ücret gelirlerinin yüzde 3,5 oranında arttığı

seviye olarak belirlenmiştir. Bu seviyeye kadar götürü sübvansiyon modeli ile aynı seviyede verilen sübvansiyon, bu eşik seviyesinden sonra yarı seviyesine indirilmiştir.

Politika Simülasyonları ve Tartışma

Baz modelin sonuçlarının yanı sıra götürü sübvansiyon, eşleşen fon (iki senaryolu) ve universal çocuk yardımı ve ÇVK politika simülasyonlarının sonuçları Ekte Tablo 16'da sunulmaktadır.

Çocuğa yapılan yatırımların getirisinin EÇG döneminde en yüksek olduğu ve daha sonraki eğitim dönemlerinde azaldığı yönündeki ampirik tespitlere dayanarak beşerî sermaye üretim fonksiyonu parametreleri belirlenmiştir. Modelin 8 yıllık dönemi için elde edilen faiz oranı, yıllık faiz oranına indirgenerek hesaplanmıştır. Devlet bütçesinin denk olduğu varsayıldığından, baz modelde devlet harcamaları tüketimden ve ücret gelirinden elde edilen toplam vergi gelirine eşittir. Tüm politika simülasyonlarında, devlet harcamaları baz modeldeki seviyede kalmakta, yatırım teşvikleri için gerekli finansman tüketim vergisi oranının artırılması yoluyla sağlanmaktadır.

Başlangıçta EÇG yatırım teşvikinin finansmanı tüketim vergisi oranının artırılmasını gerektirmektedir. Ancak tüm politika simülasyonlarında durağan durumda tüketim vergisi oranında düşüş görülmektedir. Bunun nedeni ekonomik büyüme dolayısıyla gelirden ve vergi matrahında artıştır. EÇG döneminde çocuklu ailenin toplam gelirini artıran götürü sübvansiyon politikası, baz modeldeki durağan durum değerine göre üretimi yüzde 3,4 artırmaktadır. Eşleşen fon politikasının birinci senaryosunda, aynı miktarda sübvansiyon doğrudan çocuğun beşerî sermaye üretim fonksiyonuna girmesi ve hane halkı tarafından eşit miktarda yatırım yapılması sebebiyle durağan durum üretim değerinde yüzde 33,6'lık bir artış sağlanmıştır. Eşleşen fon politikasının ikinci senaryosu altında durağan durumda üretim yüzde 20,8 artmıştır. Çocuğa yapılan toplam yatırımın bu politikadaki ile aynı düzeyde olduğu universal çocuk yardımı politikasında üretim durağan durumda yüzde 22,3 artmıştır. Benzer şekilde götürü sübvansiyon politikası, fiziki sermayede yüzde 4,9, beşerî sermayede yüzde 1,4 ve toplam tüketimde yüzde 4,4 artışa neden olurken, eşleşen fon politikasının birinci senaryosu fiziki sermayede yüzde 32,5, beşerî sermayede yüzde 35,1 ve toplam tüketimde yüzde 42,8 gibi çok daha yüksek bir artışa yol açmaktadır. Eşleşen fon

politikasının ikinci senaryosunda teşvik fiziki sermayeyi yüzde 20,5, toplam beşerî sermayeyi yüzde 21,1, toplam tüketimi ise yüzde 26,6 artırmaktadır. Çocuğa yapılan toplam yatırımın bu politika ile aynı seviyede olduğu üniversal çocuk yardımı politikası, fiziksel sermayeyi yüzde 22,9, toplam beşerî sermayeyi yüzde 21,4, toplam tüketimi ise yüzde 28,5 artırmaktadır.

Eşleşen fon politikasının ikinci senaryosu ile üniversal çocuk yardımı modelinde çocuğa yapılan doğrudan yatırım miktarı eşit olduğundan sonuçlar birbirine yakındır. Ancak üniversal çocuk yardımı politikasının sonucunda elde edilen çıktı düzeyleri bir miktar yüksektir. Bunun nedeni üniversal çocuk yardımı modelinde çocuklara yönelik yatırımın sadece devlet tarafından yapılması ve hanenin okul döneminde toplam giderlerinde azalma olması nedeniyle çocuğun okul dönemine daha fazla yatırım yapmasıdır. Bu da tüm sonuçlar üzerinde olumlu bir etki oluşturmaktadır. Ayrıca üniversal çocuk modelinde EÇG harcamalarındaki azalma nedeni ile tasarruflarda artış olduğu için bu da fiziksel sermaye birikiminde artışa sebep olarak sonuçları pozitif etkilemektedir.

Son olarak devletin EÇG yatırımlarını artırmaya yönelik verdiği teşvik sonucunda tüm modellerde ebeveynlerin çocuğa okullaşma döneminde yaptığı yatırımlarda artış söz konusudur. Erken çocukluktan sonraki ilköğretim dönemini oluşturan 8 yıllık dönemde ebeveyn tarafından yapılan yatırım, götürü sübvansiyon politikası sonucu birinci okul döneminde yüzde 5,8, ikinci okul döneminde ise yüzde 5,0 artarken, eşleşen fon politikasının birinci senaryosunda yatırım ilköğretim döneminde yatırım yüzde 30,2, ikinci okul döneminde ise yatırım yüzde 30,7 artmıştır. Çocuğa EÇG döneminde yapılan toplam yatırımın eşit olduğu eşleşen fon politikasının ikinci senaryosu ve üniversal çocuk yardımı politikaları karşılaştırıldığında ise şu sonuçlara ulaşılmıştır: Eşleşen fon politikasının ikinci senaryosunda ebeveyn ilköğretim dönemine yapılan yatırım yüzde 19,4 artarken, ikinci okul döneminde yapılan yatırım yüzde 19,5 artmıştır. Üniversal çocuk yardımında ise ilköğretim dönemine yapılan yatırım yüzde 22,3 artarken, ikinci okul dönemine yapılan yatırım yüzde 21,9 artmıştır.

İkinci politika karşılaştırması aynı miktarda yardımın tüm gelir seviyelerinde eşit olarak yapıldığı götürü sübvansiyon politikasıyla ÇVK arasında yapılmıştır. ÇVK politikası tıpkı götürü sübvansiyon gibi hanehalkı gelirini arttırıcı bir politikadır ve

yine götürü sübvansiyon politikasında olduğu gibi çocuğa yapılacak yatırım kararı ebeveynin tercihi bırakılmıştır. ÇVK politikasında verilen sübvansiyon miktarı başlangıçta götürü sübvansiyon politikası ile aynı seviyede iken ekonomi belirli bir büyüklüğe eriştikten sonra yarı miktarına düşmektedir. ÇVK politikası sonucu elde edilen tüm sonuçlar götürü sübvansiyon politikası sonuçlarına göre daha düşüktür. Örneğin, götürü sübvansiyon politikası durağan durum dengesinde üretimde yüzde 3,4 artış sağlarken ÇVK'daki artış yüzde 1,7 ile sınırlı kalmıştır. Benzer şekilde götürü sübvansiyon politikasında fiziksel sermaye ve toplam beşerî sermaye durağan durum denge değerlerindeki artışlar sırası ile yüzde 4,9 ve yüzde 1,4 olurken ÇVK politikasında sırası ile yüzde 2,5 ve yüzde 0,7 olmuştur. Toplam tüketimde ise götürü sübvansiyon politikası ile artış oranı yüzde 4,4 olurken ÇVK'da yüzde 2,2 olmuştur. Benzer bir durum okul dönemi yatırımında da görülmüştür. Devletin EÇG döneminde çocuğu olan hane halkına sağladığı sübvansiyondaki düşüşle beraber ebeveynin çocuğun okul dönemine yaptığı yatırımda da düşüş gözlenmiştir.

Hassasiyet analizleri

Bu modelde beşerî sermaye üretim fonksiyonunda kullanılan parametrelerin Türkiye için tahminleri veri eksikliğinden dolayı mümkün olmamıştır. Bu sebeple modelin sonuçlarının sağlamlığının modelde kullanılan parametrelerin değişen değerlerine göre hassasiyet analizi ile kontrol edilmesi gerekmektedir. Bu parametreler EÇG dönemi beceri (yetenek) çarpanı, okul dönemi beceri çarpanı, EÇG dönemi esneklik parametresi, okul dönemi esneklik parametresi, CES parametresi, ebeveynin çocuğa EÇG dönemindeki katkısı, ebeveynin çocuğa katkısı ilk okul dönemindeki katkısı, ebeveynin çocuğa katkısı ikinci okul dönemindeki katkısıdır. Hassasiyet analizleri her defasında bir parametrenin değiştirilmesi esasına göre yapılmıştır. Parametrelerden her biri için biri daha yüksek biri daha düşük olmak üzere iki değer belirlenip her defasında bir parametre değiştirilip diğerleri sabit tutularak analizler tekrar edilmiştir. Ebeveynin beşerî sermayesinin çocuğun beşerî sermaye üretimine ne kadar katkı sağladığını gösteren parametrelerin hassasiyet analizleri, modelin kurulma aşamasında dayanak noktası olarak kullandığımız ebeveynin beşerî sermaye katkısının çocuk üzerindeki etkisinin küçük yaşlarda daha yüksek olduğunu gösteren ampirik çalışma sonuçlarına uygun olarak yapılmıştır. Bu parametreler için üst ve alt değerler bu sıralamayı değiştirmeyecek şekilde seçilmiştir.

Yapılan hassasiyet analizleri sonuçları parametrelerin farklı değerlerinin politikaların etkinlik sıralamalarını değiştirmedğini göstermektedir. Yani sonuçlar tüm parametrelere göre yapılan testlere karşı sağlamdır.

Sonuç

Çalışmada çocuklara yapılacak yatırımı teşvik etmek için EÇG dönemini hedefleyen götürü sübvansiyon, eşleşen fon, universal çocuk yardımları ve çocuk vergisi kredisi politikalarının hanehalkı kararları ve makro değerler üzerindeki etkileri analiz edilmiştir. Sonuçlar tüm değerler üzerinde en etkili politikanın devletin ve hanehalkının çocuğun beşerî sermayesine doğrudan aktarılacak yatırımı temsil eden eşleşen fon politikası olduğunu göstermiştir. Eşleşen fon politikası, doğrudan insan sermayesini arttırdığı için götürü sübvansiyon politikasına göre daha yüksek getiri sağlar ve ebeveynin de aynı yatırımı yapması şartıyla verilir. Çocuğa doğrudan yapılan yardımın aynı seviyede olduğu eşleşen fon ve universal çocuk yardımı politikalarında ise universal çocuk yardımı politikasının daha etkin olduğu sonucuna ulaşılmıştır. Universal çocuk yardımı modelinde çocuklara yönelik yatırım sadece devlet tarafından yapıldığı için hanenin toplam giderlerinde azalmaya yol açarak ebeveynin okul döneminde çocuğuna daha fazla yatırım yapmasını sağlamaktadır. Bunun sonucunda tüm değerlerde artış meydana gelmektedir. Ayrıca, uygulanan tüm politikalar sayesinde EÇG'ye yapılan yatırımın artması, hane halkının her düzeyde eğitime yaptığı yatırımın artmasına yol açmaktadır. Eğitim yatırımlarındaki toplam artış, ekonominin toplam beşerî sermayesine katkıda bulunarak EÇG döneminde sağlanan teşvikin etkisini artırmaktadır.

Etkinliği yüksek olan eşleşen fon ve universal çocuk yardımı politikalarında yatırım doğrudan çocuğun beşerî sermaye üretim fonksiyonuna katıldığı için bu politikaların uygulamasında nakit ödemeler yerine erken çocukluk eğitimi (EÇE) hizmetleri şeklinde aynı ödemeler yapılmasını önerilebilir. Ebeveynler EÇE konusunda bilgi eksikliği yaşayabilir ve nakit teşviklerini verimli bir şekilde kullanamayabilir. Ancak verilecek teşvikle bir EÇE hizmetlerini satın alarak çocuğun beşerî sermayesine daha iyi katkıda bulunabilir. Araştırmalar, ailelere çocuk bakım yardımı sağlamanın, merkez tabanlı çocuk bakım hizmetlerinin kullanımının artmasına yol açtığını ve ABD'de (Burchinal et al., 2000), Kanada'da (Crosby et al., 2005) ve Brezilya'da (Leao

et al., 2021) çocukların gelişimi üzerinde olumlu bir etkiye sahip olduğunu göstermektedir. Götürü sübvansiyonun nispeten düşük etkisi göz önüne alındığında, Türkiye uygulanan mevcut politikanın uzun vadede önemli bir etki yaratması pek olası değildir. Bununla birlikte çocuk vergi kredisi politikasında, götürü sübvansiyon politikası ile eşit seviyede verilen sübvansiyon belirli bir eşik değerinden sonra yarıya düşürüldüğü için tüm değişkenlerde götürü sübvansiyona göre daha düşük değerlerin elde edilmesi böyle bir politikanın da Türkiye için etkili bir politika seçeneği olmadığını göstermektedir. Bunun yerine doğrudan EÇG dönemindeki çocuğun beşerî sermayesine katkı sağlayacak yatırımların yapılması bunun da devlet tarafından sağlanacak fonlarla yapılması uzun dönemde en etkili politika olacaktır.

Çalışmanın sınırlılıklarından biri, yetersiz veri nedeniyle beşeri sermaye üretim fonksiyonundaki parametreleri tahmin edemiyor olmamızdır. Ancak yaptığımız duyarlılık analizi politikaların etkinlik sıralamasının etkilenmediğini göstermektedir. Dolayısıyla rahatlıkla politika önerilerinin hala geçerli olduğu sonucuna varabiliriz.

Gelecekteki çalışmalarda, ebeveynlerin EÇG farkındalığına bağlı olarak artan ebeveyn fedakarlığı düzeyi ile alternatif EÇG yatırım politikalarının etkilerinin inceleyeceğiz. Böylece devletin sadece fiziksel çocuk yatırımı yoluyla değil aynı zamanda farkındalıkoluşturarak da beşeri sermaye ve ekonomik büyümeye etki edebileceği gösterilecektir. Ek olarak, esnek olmayan işgücü arzını içselleştirerek ebeveynlerin emek, boş zaman ve çocuk bakımı arasındaki tercihi yoluyla EÇG politikalarının ekonomik büyüme üzerindeki etkisini de inceleyeceğiz.

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