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POPULATION GROWTH AND SUSTAINABLE DEVELOPMENT IN DEVELOPED-DEVELOPING COUNTRIES: AN IV(2SLS) APPROACH

GELİŞMİŞ-GELİŞMEKTE OLAN ÜLKELERDE NÜFUS ARTIŞI VE SÜRDÜRÜLEBİLİR KALKINMA: BİR IV(2SLS) YAKLAŞIMI

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ABSTRACT

The purpose of this study is to analyze the impact of population growth on sustainable development. The population growth rate has a negative effect on sustainable development according to the estimates (Generalized Least Squares and instrumental variable) obtained with data from 146 countries covering 1990-2012 period. Accordingly, the increase in the population growth rate reduces the level of sustainable development. The population growth rate of 0-14 years has a negative effect on sustainable development, while the 15-64 years population growth rate and the population growth rate above 65 years have no significant effect on sustainable development. On the other hand, the impact of population growth on sustainable development varies according to the level of development of the countries. Population growth rate in developing countries affects sustainable development negatively, population growth rate in developed countries affects sustainable development positively.

Keywords: *Population Growth, Sustainable Development, Panel Data.*

Jel Codes: *Q56, Q01, C33.*.

ÖZ

Bu çalışmanın amacı nüfus artışının sürdürülebilir kalkınma üzerindeki etkisini analiz etmektir. 1990-2012 dönemini kapsayan 146 ülke verisi yardımıyla elde edilen tahmin (Genelleştirilmiş En Küçük Kareler ve araç değişken) sonuçlarına göre nüfus artış oranı sürdürülebilir kalkınma üzerinde negatif yönlü bir etkiye sahiptir. Buna göre nüfus artış oranının yükselmesi sürdürülebilir kalkınma düzeyini azaltmaktadır. Bununla birlikte, 0-14 yaş nüfus artış oranı sürdürülebilir kalkınma üzerinde negatif yönlü etkiye sahipken, 15-64 yaş nüfus artış oranı ve 65 yaş üstü nüfus artış oranı sürdürülebilir kalkınma üzerinde, anlamlı herhangi bir etkiye sahip değildir. Diğer yandan nüfus artışının sürdürülebilir kalkınma üzerindeki etkisi, ülkelerin gelişmişlik düzeyine göre farklılık göstermektedir. Gelişmekte olan ülkelerdeki nüfus artış oranı sürdürülebilir kalkınmayı negatif yönlü, gelişmiş ülkelerdeki nüfus artış oranı sürdürülebilir kalkınmayı pozitif yönlü etkilemektedir.

Anahtar Kelimeler: *Nüfus Artışı, Sürdürülebilir Kalkınma, Panel Veri.*

Jel Kodları: *Q56, Q01, C33.*

1. INTRODUCTION

Which part of the population has more impact on sustainable development (SD)? Since Thomas Malthus suggested that in 1798 the population could be reduced by hunger and diseases, the population has been addressed and continues to be

addressed for many economic variables[1]. According to Malthus (1976), population control is necessary for humanity in order not to overtake the world's carrying capacity[2]. Because the power of the population in this direction is unlimitedly greater than the power of the earth to provide for the livelihood of the human being. In this view, Thomas Malthus, together with Adam Smith, is one of the first to examine the relationship between population size and control of economic growth[3]. Nevertheless, the neo-Malthusianism movement argues that population is at the heart of all global problems and that population growth must be controlled. In his book, The Population Bomb, published in 1968, Paul Ehrlich, for example, emphasizes that in the near future the increase in human population will accelerate the depletion of resources, as competition for limited resources will increase. From a historical perspective, it is clear that this thought is correct. According to Jiang and Hardee (2011), economic growth, energy consumption and carbon emissions have increased in parallel with population growth between 1800 and 2000. In this 200-year period, energy consumption is 35 times, carbon emissions 20 times, and world population has increased 6 times. Global income has increased 70 times. Despite technological advances in these figures, it remains to be argued how exactly the population increase or consumption will cause exactly carbon emissions (Nakicenovic et al., 2007; Dietz et al., 2007; Meyerson, 1998; Ehrlich and Holden, 1971). On the other hand, in the world, the 'optimum population' in which standard life in European qualities is supported by the Earth planet is less than two billion (Anthony, 2004)[4]. In 2000, the world population was 6.1 billion and by 2015 it was 7.2 billion. These figures show that population growth is increasingly pressing on the environment, which provides both resources and resources. Moreover, the only problem is not pressure. Today more than one billion people live an extraordinary poverty. Some of these people live in slums (FAO, 2008; UN Habitat, 2010), while others are far from finding a good job to rescue their lives (ILO, 2011; 2012). Increasing human population also causes unbalanced distribution of resources, leading more people to food insufficiency. According to the Food and Agriculture Organization (FAO) estimates, agricultural production should not show less than 70 per cent growth in order to satisfy the world population in 2050 (FAO, 2009; 2010; 2010; Godfray et al., 2010; IFPRI, 2010). Therefore, the slowdown in population growth will contribute not only to reducing the pressure on the environment, but also to the further deterioration of resource allocation.

With the unstoppable growth of the population every day, the concept of 'sustainable development' ran to the aid of

[1] This study was presented at the The Turkish Economic Association (TEA) 5th International Conference on Economics in Bodrum, Turkey from 20 to 22 October 2016.

[1] The analysis suggested by Malthus that this theory was maintained by many researchers. From these analyzes, Malthus's theorem, according to the common sense, is not compatible with the present day. See Galor and Weil (2000) for this issue.

[2] For carrying capacity, see Daily and Ehrlich (1992).

[3] There are three different approaches in the literature for the relationship between population and economic growth. These are optimistic, pessimistic and neutral approaches. The optimist approach argues that population growth is an important input to the production of knowledge. Because as the population grows, the likelihood of new Newton's birth will increase. The most important advocates are Kuznets (1960; 1967), Boserup (1989), Jones (1999) and Tamura (2002). Studies such as Solow (1956), Becker and Barro (1988) Barro and Becker (1989) which are the most important advocates of the pessimist approach, think population is a threat to economic growth. Bloom et al. (2003) argues that the neutral approach is based on empirical findings. According to this approach, there is little empirical evidence that the population slows or increases economic growth.

[4] In 1996 Cornell University Ecologists suggested that the 'optimal population' should be defined and estimated, and that if the human population is not controlled, the population will be controlled only by hunger and epidemics for the next century (Pimentel, 1996).

our world, which has to feed more people with more scarce resources. Becoming known by our Common Future report, discussed in the 1970's and 1980's but prepared by the World Commission on Environment and Development (WCED, 1987)[5], SD has been able to meet the needs of today's society through the use of resources that will not deprive future generations of their ability to meet their own needs. The most important variables in this definition are the human population and scarce resources. For this reason, population according to UNFPA (2012) will always remain a very important variable for SD. As it is said in the first principle of the Rio Declaration, one is at the center of the SD (UNCED, 1992). The Action Plan agreed on in 1994 emphasizes the importance of population variability for a sustainable economic growth that will develop on the SD axis (ICPD, 1994). In other words, the involvement of both the present population and the population of future generations in the accounts constitutes the essence of SD.

As can be seen from the above explanations, the population growth and the SD relationship, which are tightly connected to one another, are worthy of being examined empirically. As can be seen from the third part of this study, the total population growth rate, the 0-14 year old population growth rate, the 15-64 year old population growth rate and the 65 year old population growth rate[6] effect on SD have not been discussed empirically in the literature. To help with this deficiency in the literature, this study examines the effect of other population growth rates on SD along with the intended population growth.

The parts of this work are organized as follows. In the second section of the study, the relationship of population growth, economy and environmental variables is explained. In the sixth section, literature is included. While the data and methods are included in the fourth section, the estimation results are given in the fifth section. In the sixth section, the conclusion part is included.

2. POPULATION GROWTH, ECONOMY AND ENVIRONMENT

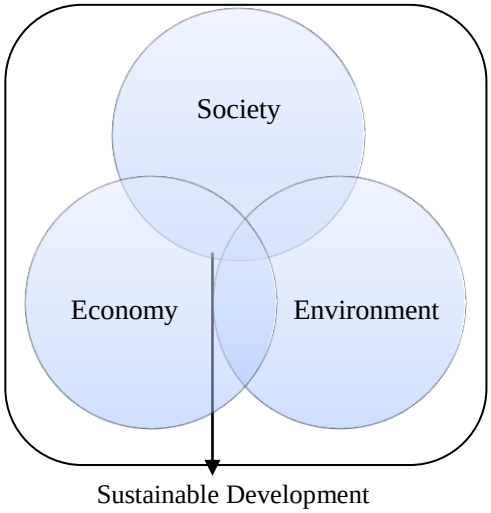
As seen in Figure 1, it is generally assumed that the SD concept is a social, environmental and economic infrastructure. Accordingly, the intersection of these three variables indicates the sustainability of the region's development. For this reason, sustainable development is often shown as overlapping regions of three variables. The concept of SD, which is located at the intersection of the triangle of economy, society and environment, can be a sign of the activity field of these three variables. With a clearer discourse, societies carrying out their economic activities carry out these activities within the framework of an ecosystem. In other words, the production man affects the atmosphere, oceans, waterways, forests, glaciers and biodiversity. Therefore, the ecosystem is the most important factor that attracts the burden of economic activities of societies.

[5] International organizations such as the World Bank (WB) and the United Nations (UN), along with WCED (1987), have increased interest in sustainable development and are publishing at specific intervals. For example, the World Bank (1984, 2008, 2010), United Nations (1994, 2010; 2011). United Nations (UN) made very important contributions in 1992 set out the scope of sustainable development with Rio Declaration on Environment Development (UNCED) and, in 1994 stressed the importance of population in sustainable development with the International Conference on Population And Development Program of Action (ICPD).

[6] The population aged 15-64 is called the working age population. The age group of 0-14 and over 65 is called dependent population. This study is called the age of 15-64 for the working age population and the age 65 and over for the dependent population by complying with the distinction of WB. Because not all of the population in the working age can be fully employed in any country, and some of the population over 65 in the dependent population may be located in the employed population, for example in developed countries. For this reason, this choice has been made on the desire to make a more accurate distinction in this study.

The "future generations" of the SD, as defined in the Brundtland Report, mean a very long time for human life. Thus, the use of resources that will not deprive future generations of their ability to meet their own needs is possible only if the ecosystem, ie the environment, is protected for a very long time (Parkin, 2010).In that case, the community should produce goods and services that will be used to meet the consumption need, and give at least the environment. However, environmental pollution, which is caused by the continuous increase of the population and the consumption, makes it difficult to protect today's environment day by day. When the activities of the social, economic and environmental variables are handled separately, it is known that the results to be produced by each are a problem for another variable in the long run. The figures given in the introduction to this study are examples.

Figure 1: Components of Sustainable Development



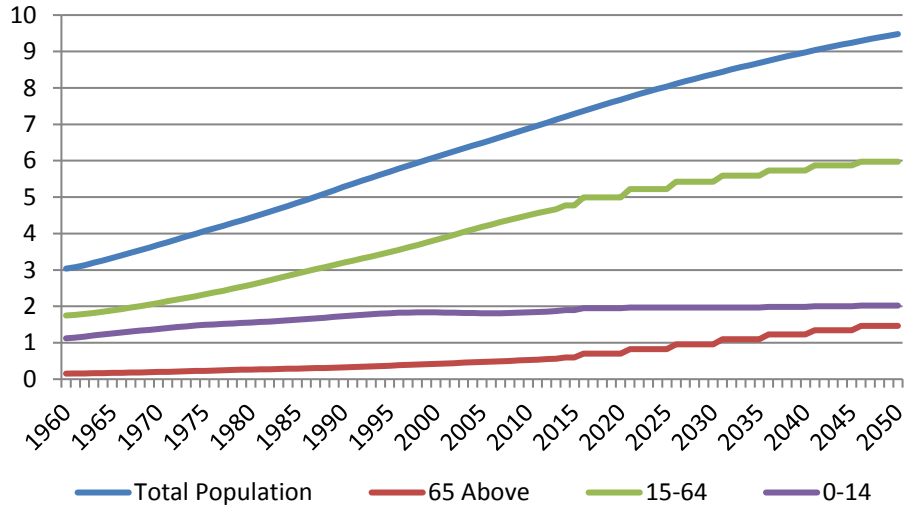
Source: Peeters, 2012: 293

The world population, which was 3 billion in 1960, now finds 7.2 billion. In other words, the world population has increased by 2 quarts from 1960 to 2015. It is clear that this increase will have an adverse effect on variables such as forests around the world, cultivated agricultural land, clean drinking water (Güney, 2016: 194). On the other hand, as can be seen from Figure 2, according to the Health Nutrition and Population Statistics (HNP) prepared by the World Bank (WB), the world population is estimated to be around 9 billion by 2050. Therefore, forests, cultivated agricultural land, clean drinking water will need to be protected more.

According to the figure, the upward trend in the world population continues almost unchanged until 2040. According to the HNP estimate, the rate of increase after 2040 seems to have decreased relatively less. The population aged 15-64, which is almost parallel to the total population in the population increase, decreases the rate of increase before 2020. On the other hand, the population aged 15-64 constitutes the majority of the total population. In 2050 the working age population reaches 6 billion. The population of 0-14 years is about 20 billion years old until 2050, starting at around 2020. Starting at 2015, the 65+ age population has entered a relatively rapid upward trend. In 2050 the population over 65 years old is approaching the population of 0-14 years and it is over 1.5 billion.

According to the United Nations Procurement Department (UNPD) (2013), when the average fertility rate is taken into consideration, today's world population is 5.9 billion in developing countries. This number will rise to 8.2 billion in 2050 and 9.5 billion in 2100. These numbers will be 1.2 billion today for developed countries, 1.3 and 2.5 billion in 2050 and 2100 respectively. According to this, 82% of the world's population is now developing countries. This rate will be 86 percent in 2050 and 88 percent in 2100. Therefore, for the prosperity of present and future generations, the greatest task of controlling population growth and protecting the environment falls into the developing countries. Among the developing countries, especially the least developed ones are the worst in terms of the sustainability of development.

Figure 2: Population Growth Estimates and Projections

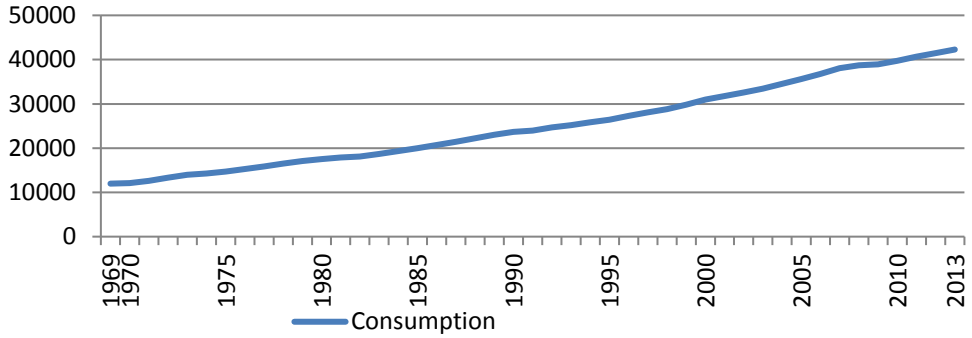


Source: HNP, 2016

The least developed countries according to Herrmann (2012) are the countries with the highest poverty and food insufficiency as they have the highest population growth. This is because the income level of these countries is not sufficient, as more education and health expenditures must be made for the rapidly increasing population. Besides, the proportion of the unemployed in the total population is relatively high, unemployment benefits are low, and most of the workers are lacking in job security (ILO, 2011). According to the United Nations Population Fund (UNFPA) (2011), up to 2050, 33.000 young people will be added daily to the workforce of these countries. Because the population will be doubled this year. These countries, which have to produce and consume to meet the needs of this population, will be very difficult in terms of sustainability of development due to the contradiction between consumption and sustainable development.

Consumption is not just a problem of developing countries. According to the HNP estimate, the consumption of the world population, which increases continuously until 2050, needs to increase.

Figure 3: Population and Consumption



Source: World Development Indicators (WDI)

Because at the very least, more and more people will consume agricultural products and drink water. Thus, population growth increases the consumption of the environment and increases the pressure on the environment. According to Figure 3, the world's final consumption has increased steadily since 1969. The estimated final consumption[7] of the population estimated to reach 9.5 billion by 2050 in HNP estimates is 42000 billion dollars. Moreover, consumption in the most developed countries is much higher than the goal of a sustainable consumption level, while it represents the present world population (The Royal Society, 2012).

Figure 4 shows the continuously increasing outlook of the six[8] emission scenarios from the Intergovernmental Panel on Climate Change (IPCC, 2000) Special Report on Emissions (SRES), up to 2100 years. These six different scenarios refer to a future world where up to 2040 will have almost the same carbon emissions, while the vertical axis in the figure refers to the carbon emission concentration (parts per million by volume, ppmv). After 2040, the A2 and A1B emission scenarios differ from other emission scenarios, primarily A1FI. A1FI shows that in a future world where rapid economic growth is experienced with low population growth, carbon emissions will be highest compared to other scenarios. The A1B is the closest scenario to the A1FI emission level, which will be experienced by high population growth and low economic growth and low population growth and rapid economic growth. The common feature that stands out in this scenario is the relative rapid growth of population growth or economic growth.

B1 indicates the future world where the level of carbon emissions will be at a relatively low level. The B1 scenario shows the rapid growth of the population but the declining population after the middle of the century and remains close to the B2 and A1T scenarios until 2100. The common point of these three scenarios is that scenarios are relatively slower in population. It is clear from these six scenarios that economic growth and the relatively high population growth up to 2100 will speed up the carbon emissions and pollute the environment of the future world more than today's level and cause

[7] By 2013 consumption is meant. The final consumption in Figure 3 was taken from World Development Indicators (WDI). Final consumption expenditures, final consumption expenditures and overall movement are the sum of final consumption expenditures. The data were provided in 2005 US dollars.

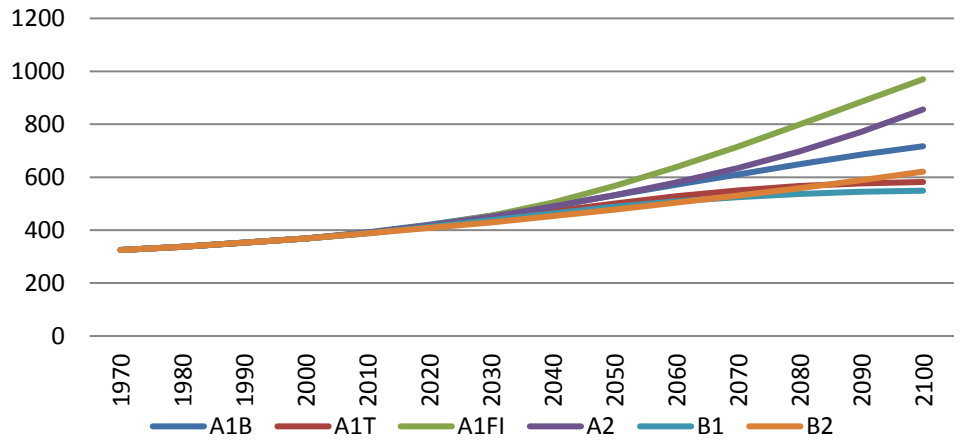
[8] The A1B, A1T and A1FI emission scenarios have been made for the future world, which will have a high population growth and low economic development, for the future world, where rapid economic growth, low population growth will be rapid and effective technological development, B1 for rapid economic growth, for the future world where peaking in the middle of the century and then declining population, and B2 for the future world where population growth will be less than A2 scenario.

future generations to live with less scarce resources.

As a result, according to UNFPA (2012), clean water, food and energy will be more threatened if governments, business communities and non-governmental organizations fail to prevent population growth in order for the SD target to be successful. Economic growth, health services, social development and social security will be negatively affected, climate change will accelerate, immigration will increase, political instability and conflicts will increase. If population growth is to be controlled, the likelihood of our world going away from these threats will increase. Because the reduction of fertility and the stopping of the population increase will allow to slow down the increase of the young population. In this way, human, physical and natural capital investments will increase and thanks to these investments, more sustainable growth will be supported.

On the other hand, at the end of 2015, at the 21st United Nations Conference on Climate Change (COP21) held in Paris, the capital of France, according to the agreement supported by 195 countries, an agreement has been reached to limit the global average temperature rise limit to 1.5 to 2 degrees.While it is envisaged that the national level plans will be audited every five years as regards the reduction of greenhouse gas emissions in the deal, it is targeted that developing countries will receive at least $ 100 billion annually in support for this purpose. However, no arrangements have been made regarding the control of population growth in these countries.

Figure 4: Carbon Emissions and Scenario of IPCC SRES [9]



Source: IPCC

[9] The vertical axis represents the carbon emission concentration (ppmv).

3. RELATED LITERATURE: POPULATION GROWTH DEBATE

It is clear from the studies in the literature that the impact of population growth on variables such as economic growth, development and SD is controversial[10]. Some economists argue that population growth will have a positive impact on natural resources and therefore SD, but as Gupta et al. (2011) pointed out, the scientific evidence available does not fully support this idea. Referring to the positive effect of population growth on resources through technological innovation, Kuznets (1960) suggests that increasing population will increase the likelihood of inclusion in the world. These inclusions will help to increase and accelerate technological innovation, and thanks to these innovations, resources will be supported more effectively using SD. On the other hand, the great majority of the world's daily population of the past belongs to developing countries. In the developing countries, if the Kuznets have come to their minds, the likelihood of geniuses coming to the world is much higher than in developed countries. However, these countries are still far behind many developed countries and still lack the technological innovations that will save them from this backwardness.

Simon (1981, 1996), supporting Kuznets' (1960) thought, stated that innovation has increased with population growth and that the standard of living has increased continuously since history. Potter and Christy (1962), Barnett and Morse (1963), Galor and Weil (2000), and Simon (1996). According to Potter and Christy (1962) and Barnett and Morse (1963), population growth is accompanied by an increase in industrial product and innovations that will reduce the price of products produced with scarce resources. Similarly, Boserup (1965) suggested that population growth would stimulate agricultural innovation, leading to increased productivity. In addition to these studies, Ehrlich (1968) and Meadows et al. (1972) noted that technological innovations and population growth could reduce the pressure on resources.

According to the World Bank (2010) and The Royal Society (2012), population growth[11] is accompanied by an increase in food demand, and therefore both productivity and environmental protection regulations must be equalized in the studies analyzing the population increase by the data of variables such as environment, population and poverty. The low population growth by employment leads to an increase in the real wealth per capita. Dasgupta (2010), which also benefits from the study of Arrow et al. (2004), showed that per capita welfare is diminishing in spite of increasing GDP, per capita income and Human Development Index (HDI), when population growth and SD are taken together.

Similar to Arrow et al. (2004) and Dasgupta (2010), Hamilton and Atkinson (2006) compared the population growth rate with the total welfare change rate. According to the study, the per capita income was moderate while the calculated total welfare rate was below the population growth rate. The fact that the total welfare ratio is continuously below the population growth rate proves that this trend is unsustainable. For sustainability, it depends on countries raising saving rates to very high levels. On the other hand, when the SD is measured by Adjusted Net Saving, the effect of the population on SD is not clear. For example, Güney (2015a) found that there is a positive but meaningless relationship between

[10] Hummel et al. (2013) and Gupta et al. (2011) are very useful for the literature on the relationship between population and sustainable development. Hummel et al. (2013) examined the relationship between population and sustainable development by choosing interdisciplinary and transdisciplinary approaches. Gupta et al. (2011) examined studies that take into account population growth and sustainable development as well as poverty.

[11] In addition to population growth, national and international migrations can also reduce the level of sustainable development by causing environmental pollution and climate change. This can be seen in Adamo and Izazola (2010), Laczko and Aghazarm (2009), World Bank (2010) and McNicoll (1984).

population growth and SD in developing countries, negative and significant in developed countries, and developed countries in the study of relationship between governance and SD. In the study Carbonnier et al. (2011) analyzed dependence on natural resources and the impact of governance on SD, there is a negative relationship between SD and population growth, and a positive but meaningless relationship with population density and rural population ratio. According to Aidt (2009), which examines the relationship between institutional quality and SD, there is a negative relationship between population growth and SD between 1970 and 2000, but this relationship is not significant.

Reducing the population growth rate contributes to SD by lowering carbon emissions. Dyson (2005) predicted that the reduction in fertility rates and the decrease in the flux of resources could reduce the pressure on carbon emissions by 2050 by 40 percent. O'Neill et al. (2010) found that the carbon emission rate decreased significantly in the case of population growth. South (2015) emphasized that there is a negative relationship between population growth and environmental sustainability. Population growth by employment alone has a positive and significant impact on environmental sustainability only in OECD member countries.

Hardin (1968), Fearnside (1986), Meadows et al. (1972), Ehrlich and Holdren (1971) emphasize that population growth is the only cause of environmental pollution and malnutrition, with an ecologist[12] approach based on the world's transport capacity and economic growth. Ehrlich and Holdren (1971) have been a pioneering work in this regard, demonstrating the impact of population (P), consumption (A) and technology (T) on the environment (I) with the I-PAT[13] model[14]. According to Ehrlich and Holdren (1971) and Kaya (1990), economic development is the fundamental variable of technological development and population growth, energy consumption and carbon emissions.

4. DATA AND METHOD

In this study, the following model is estimated using the unbalanced panel data method:

$$\text{Saving}_{it} = \alpha_i + \gamma_t + \beta_1 \text{Population}_{it} + \beta_2 \text{Gdpgrowth}_{it} + \beta_3 \text{Corruption}_{it} + \beta_4 \text{Consumption}_{it} + \beta_5 \text{Openness}_{it} + \varepsilon_{it}, \quad (1)$$

in equation (1), i is the number of units, t is the time interval, and ε is the error value. Saving represents to adjusted net saving, Population represents to population growth rate, Gdpgrowth represents to GDP growth rate, Corruption represents to corruption level, Consumption represents to consumption expenditure and Openness (trade openness) represents to ratio of imports and exports to GDP. As an SD variable, Saving, in other words "genuine investment" is used. Saving aims to measure the capital stock of the economy. It is frequently used and calculated by economists as the SD indicator (Aidt, 2010). Saving manufacturing industry, human, social and natural capital variables are calculated with their current prices. Saving, defined and calculated by WB, is calculated by subtracting the reduction in rent (R) and carbon dioxide emissions (CD) from the net capital used after the consumption of natural capital[15] (E), after the expenditures of the national net savings (Gs-Dep) as seen in equation (2).The national net saving is obtained by

[12] For other interdisciplinary and transdisciplinary approaches, see Hummel et al. (2013).

[13] For the literature, Liddle (2014) and Hummel et al. (2013) can be looked at.

[14] The STIRPAT (Stochastic Impacts by Regression on Population, Affluence, and Technology) model, developed with the development of the I-PAT model, is a stochastic metric used to analyze environmental impacts.

[15] Natural capital exchanges include minerals such as bauxite, copper, gold, iron ore, lead, nickel, phosphate rock, silver, tin and zinc, as well as oil, coal, gas and forest variables.

subtracting the wear amount (Dep) of the capital produced from gross saving (Gs).

Saving =(Gs-Dep)+E-R-Cd (2)

Two types of Saving are calculated by WB, ratio to GDP and value in dollars, and Saving in terms of GDP is used in this study. Saving covers 146 countries between 1990 and 2012. Population refers to the annual rate of population growth. The total amount of consumption will increase with increasing population and the level of environmental pollution will increase. For this reason, population growth is expected to negatively affect on Saving. Data from 1990 to 2012 were taken from WB.

Gdpgrowth represents the GDP growth rate of the previous period. Economic growth in the light of Aidt (2009), Aidt (2010) and Güney (2016; 2017) studies are expected to negatively affect Saving. Corruption shows the level of corruption control. Parallel to the findings of Welsch (2004), Meon and Sekkat (2005) and Aidt (2010), corruption is expected to negatively affect Saving[16].Consumption shows the increase in total consumption expenditures of households and the public. In parallel with the findings of Lefin (2009), consumption is expected to negatively affect on Saving. Openness refers to the ratio of imports and exports to GDP (trade openness). In parallel with the findings of Aidt (2010) and Güney (2015b), Openness is expected to positively affect Saving. The data covering these periods are taken from WB.

Equation (1) is estimated by the generalized least squares (GLS) method used in estimating one-way panel data. The panel has two dimensions, horizontal and time, as well as units or effects that are not observed over time. Models that deal with these two effects are called bi-directional panel data, whereas those that take only the unit or time-only dimension are called unidirectional panel data. The unidirectional unit effect has two effects, fixed and random. In both of these cases, the GLS method can provide consistent and efficient predictors even in cases of varying variance and auto-correlation problems. Thus, in models where one-way unit effects are valid, the GLS estimator can be used with a fixed effect assumption (Hsiao, 2003: 35).

Equation (1) is estimated by means of the instrumental variable IV(2SLS) method to overcome the problem of potential endogeneity between population variables and Saving when the equation is estimated by GLS method. Even geographical and historical variables that are used to overcome the problem of endogeneity and that do not change over time may be related to variables such as corporate quality, economic growth and economic development[17]. So it is quite difficult to find the appropriate instrumental variable. The best way to overcome this problem is to include the instrumental variables used in the literature by following the literature. For this reason, ethno-linguistic fractionalization (ELF), latitude (Latitude) and legal structure (Common Law)[18] can be used as instrumental variable in the literature. In this study, ELF, Lattitude and Common Law variables were used as a instrumental variable. The Common Law is given by La Porta et al. (1997). ELF ethnicity consists of variables of language and religion. The value of the variable is taken as Alesina et al. (2003). Latitude represents the distance from the equator and data are obtained from La Porta et al. (1999). In addition to these variables, the

[16] According to WB data, the corruption variable is between 0 and 10. 10 indicates the lowest level of corruption, while 0 indicates the highest level of corruption. So the higher the values, the lower the level of corruption. For this reason, the sign of the statistical effect on the Saving of the corruption variable is positive. Control of corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

[17] Acemoglu et al. (2001), Rodrik et al. (2004) and Glaeser et al. (2004) have shown that variables such as geographic location, ethnicity, language differences used as variables may be related to economic growth.

[18] This can be seen in Mauro (1995), La Porta et al. (1998), Hall and Jones (1999), Gupta et al. (2002), Aidt (2010) and South (2017).

political stability (Polsta) and voice and accountability (Va) level of the country was also used as a variable. The data are from the PRS.

In this study, number of observations is more than 20. For this reason, Levin, Lin and Chu t test (LLC), Im, Pesaran and Shin W test (IPS), ADF-Fisher Chi-square test (ADF-F) and the PP-Fisher Chi-square test (PP-F) were performed for the unit root tests of the variables. The F test was used to select the appropriate model between the pooled model and one-way and two-way random effect models, and the LM test in the presence of random effects, between the pooled model and one-way and two-way random effects models. The Hausman test was used to select FE and RE models. White cross-section weights are used for potential heteroskedasticity and autocorrelation problems in models.

In the IV(2SLS) estimates, the Hausman test was used to determine if the population variables were endogen, the Anderson Canon LM test was used to determine whether instrumental variables were associated with the endogen variable, the Cragg-Donald Wald F test to determine if the instrumental variables were weak or strong, and the Sargan test to determine if valid instrumental variables were used.

Table 1 shows summary statistics and correlation coefficients for the variables used in this study. Saving refers to net savings adjusted as a percentage of GDP. Four separate population growth variables are used in the study[19]. Population (0-14) Population (15-64) Population (15-64) Population (65+) is the increase rate of population over 65 years old. According to the correlation coefficients of the variables, the increase in Population and Population (0-14) age population is negatively related to Saving. Other population growth variables are positively related. The relation of Gdpgrowth variable to Saving is positive direction rather than negative direction, and Corruption, Consumption and Openness variables of other variables are expected to be related to Saving.

[19] The data for Population (0-14), Population (15-64) and Population (65+) are published as the ratio of WB total population. Population (0-14), Population (15-64) and Population (65+) population were calculated for each country first with the aid of this data. Then the rates of increase in these populations were calculated.

Table 1: Summary Statistics and Correlation Matrix

	Mean	Max.	Min.	Std. Dev.	N
Saving	6.169	75.923	-170.448	13.491	2956
Population	1.459	11.180	-7.597	1.332	3349
Population(0-14)	31.371	49.991	13.113	10.684	3358
Population(15-64)	61.236	78.129	47.403	6.670	3358
Population(65+)	7.392	24.397	1.459	4.927	3358
Gdpgrowth	3.488	38.200	-50.248	5.281	3288
Corruption	0.014	2.585	-2.057	1.012	2026
Consumption	3.651	50.617	-58.446	6.494	2725
Openness	83.840	562.06	10.830	48.170	3295

Saving	1							
Population	-0.169	1						
Population(0-14)	-0.268	0.762	1					
Population(15-64)	0.329	-0.664	-0.927	1				
Population(65+)	0.144	-0.732	-0.893	0.662	1			
Gdpgrowth	0.013	0.176	0.206	-0.108	-0.284	1		
Corruption	0.326	-0.312	-0.610	0.479	0.651	-0.235	1	
Consumption	-0.076	0.142	0.147	-0.073	-0.207	0.554	-0.185	1
Openness	0.223	-0.088	-0.264	0.321	0.144	0.044	0.248	0.023

5. ESTIMATION RESULTS

Table 2 shows the unit root test results for the variables used in this study. According to LLC test results, Saving, Population, Population (0-14), Population (15-64), Population (65+), Gdpgrowth, Corruption, Consumption, Openness are at the first level. According to IPS and ADF-F test results, these variables are stable at the first level. According to PP-F test results, the Population (65+) variable 1. Difference, other variables are still at the first level. Table 3 provides estimates for all countries included in the analyzes, showing the relationship between independent variables and Saving.

According to the table, the Hausman test implies that the fixed effect (FE) model should be used. In the fixed effects model, F_{period} shows the existence of one side fixed effects. Population (0-14) and the effect of the other independent variables on Saving in the second column, Population (15-64), the increase rate of the 15-64 age group, while the estimation results of (1) and other independent variables on the Saving. In column 3, the increase in the population over 65 years, ie Population (65+), and the effect of the other independent variables on Saving, are reported in the fourth column.

As can be seen in the first column of Table 3, the population growth rate, Population, has a negative statistically significant effect on Saving, indicating the level of SD. Accordingly, the population increase reduces the SD. Gdpgrowth indicating the GDP growth rate of the previous period, Corruption indicating the level of corruption control and Openness variables indicating the ratio of imports and exports to GDP have a positive effect on Saving and this effect is statistically significant. Consumption, which shows the sum of household consumption and final consumption expenditures of the house, has a negative and also statistically significant

effect on Saving. As seen in column 2, the effect of Population (0-14) on Saving is negative and statistically significant. According to this, the SD level decreases when the population increase rate of 0-14 age group increases.

The other independent variables, as in column 1, have statistical significance. According to the estimation results in the third column, countries have a negative influence on the population growth rate of 15-64 years. However, this negative effect has no statistical significance. Likewise, as seen in column 4, the positive effect of Population (65+) on the Saving is not statistically significant.

Table 2: Unit Root Test Results

	LLC	IPS	ADF-F	PP-F	
	Level	Level	Level	Level	1. Diff.
Saving	-4.1766	-3.2364	*389.174*	*440.482*	
	(0.0000)	(0.0006)	(0.0001)	(0.0000)	
Population	-18.1513	-25.6937	*1455.78*	*521.312*	
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Population(0-14)	-25.7033	-23.7246	*1343.18*	*437.268*	
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Population(15-64)	-23.1588	-26.3536	*1671.65*	*342.063*	
	(0.0000)	(0.0000)	(0.0000)	(0.0232)	
Population(65+)	-27.9940	-25.8629	*1343.67*		*723.709*
	(0.0000)	(0.0000)	(0.0000)		(0.0000)
Gdpgrowth	-16.5724	-17.2787	*854.258*	*1355.86*	
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Corruption	-11.1134	-3.4155	*399.739*	*670.914*	
	(0.0000)	(0.0003)	(0.0000)	(0.0000)	
Consumption	-13.5243	-16.3884	*802.954*	*1400.06*	
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Openness	-4.9425	-3.5962	*427.036*	*474.640*	
	(0.0000)	(0.0002)	(0.0000)	(0.0000)	

Note: Italic values are test statistics, parenthesized values are p-estimates.

In columns 3 and 4, Gdpgrowth, Corruption, Openness variables have positive and statistical significance on Saving, and Consumption is negative on Saving and again statistically significant effect. Therefore, for all countries, the SD level decreases when the GDP growth rate, the trade openness rate and the level of corruption control increase in the previous period, while the SD level decreases when the increase in the total consumption expenditures of the household and the public increases. Table 4 shows IV(2SLS) estimates for all countries considering the potential endogeneity problem between population variables and Saving. The Hausman test shows that population variables are endogen. According to Anderson Canon LM test results, instrumental variables are related to endogen variables.

Table 3: GLS Estimates: All Countries

	1	2	3	4
Population	-0.7983** (0.2499)			
Population(0-14)		-80.7125* (15.5593)		
Population(15-64)			-15.5743 (22.7630)	
Population(65+)				11.4554 (12.4578)
Gdpgrowth	0.4526* (0.0900)	0.4234* (0.0891)	0.4343* (0.0904)	0.4309* (0.0900)
Corruption	3.2796* (0.2946)	3.3267* (0.2856)	3.4564* (0.3059)	3.5240* (0.2859)
Consumption	-0.2017* (0.0581)	-0.2060* (0.0578)	-0.2064* (0.0583)	-0.2066* (0.0584)
Openness	0.0326* (0.0058)	0.0288* (0.0058)	0.0329* (0.0058)	0.0324* (0.0058)
Constant	4.2273* (0.7075)	3.7519* (0.6409)	3.4873* (0.7168)	2.9842* (0.7074)
R^2	0.152	0.160	0.146	0.146
Adj.R^2	0.142	0.151	0.137	0.137
F-statistics	15.8667*	16.9387*	15.2174*	15.1801*
Hausman	7.960**	11.060*	9.793*	8.077**
F_{period}	36.4641*	36.1581*	38.7911*	38.2500*
N	1607	1610	1610	1606
Countries	136	136	136	136

Note: Values in parentheses are standard error estimates.* $p< 0.001$, ** $p < 0.01$, *** $p <0.05$

The Cragg-Donald Wald F statistic results show that the instrumental variables used are very strong, according to Stock and Yogo (2005)[20]. According to the results of the sargan test, valid instrumental variables were used to solve the problem of endogeneity.

IV(2SLS) estimation results and GLS results are very close to each other. As in GLS estimates, Population and Population (0-14) variables are negatively and statistically significant on Saving. According to this, the total population increase and the increase rate of 0-14 year-old population decrease the SD. There is no significant effect on the population aged 15-64 and the population aged 65 or older. Consumption still has a negative and significant effect, while Gdpgrowth, Corruption and Openness of other arguments, as in GLS estimates, continue to have a positive effect on Saving in all columns.

[20] If the Cragg-Donald F statistic exceeds the 10% maximum IV reported in Stock and Yogo (2005), the instrument variables used are very strong, between 10% and 15% strong, between 15% and 20% middle, between 20% and 25% is considered weak. The values of these percentiles are respectively 19.93, 11.59, 8.75 and 7.25.

Table 4. IV(2SLS) Estimates: All Countries

	1	2	3	4
Population	-4.7518* (0.7087)			
Population(0-14)		-262.3059* (37.8637)		
Population(15-64)			43.3301 (39.2974)	
Population(65+)				-1.7906 (68.8378)
Gdpgrowth	0.5307* (0.0912)	0.3813* (0.0862)	0.4024* (0.0894)	0.4178* (0.0837)
Corruption	2.0364* (0.3753)	2.8646* (0.3065)	3.6901* (0.3429)	3.4757* (0.2865)
Consumption	-0.1615** (0.0619)	-0.1940** (0.0593)	-0.2134* (0.0661)	-0.2079* (0.0582)
Openness	0.0294* (0.0062)	0.0184** (0.0062)	0.0311* (0.0058)	0.0316* (0.0062)
Constant	-267.5465*** (0.7075)	-484.2975* (0.6409)	-393.4115** (126.4971)	-365.3883** (127.5922)
R^2	0.286	0.339	0.145	0.148
F-statistics	41.60*	44.87*	39.62*	39.47*
Anderson Canon LM	226.642*	288.535*	527.056*	52.283*
Cragg-Donald Wald F	131.227	174.855	391.006	26.875
Sargan *p*	0.9684	0.4859	0.6554	0.3177
Hausman	41.589*	29.635*	10.114**	3.862***
Instruments	ELF, Common Law	ELF, Common Law	Latitude, Polsta	Latitude, Polsta
N	1604	1607	1598	1594

Note: Values in parentheses are standard error estimates. In all estimates, years and countries are included as dummy variables. * $p< 0.001$, ** $p < 0.01$, *** $p <0.05$

Table 5 shows IV(2SLS) estimates for developed countries, taking into account the potential endogeneity problem between population variables and Saving. The Hausman test shows that population variables are endogen. According to Anderson Canon LM test results, instrumental variables are related to endogen variables. The results of the Cragg-Donald Wald F statistic show that the instrumental variables used in the first, third and fourth columns are very strong according to Stock and Yogo (2005) and the instrumental variables used in the second column are strong. According to the results of the Sargan test, valid instrument variables were used to solve the problem of endogeneity. As can be seen in the first column of the estimation results for (1) model, the Population variant has a positive effect on Saving. Moreover, this positive effect is statistically significant. According to this, when population growth rate in developed countries increases, SD level increases. This result is the opposite of the estimates for all countries.

Table 5: IV(2SLS) Estimates: Developed Countries

	1	2	3	4
Population	2.5879** (0.9276)			
Population(0-14)		216.8823** (79.9519)		
Population(15-64)			195.8032** (71.4474)	
Population(65+)				-62.4893*** (30.4267)
Gdpgrowth	0.2704** (0.0949)	0.4031* (0.1085)	0.2329*** (0.0963)	0.2696** (0.0922)
Corruption	3.5986** (0.3707)	2.8429* (0.5816)	3.9804* (0.3124)	4.1682* (0.2887)
Consumption	-0.1709 (0.0874)	-0.0781 (0.0738)	-0.1793*** (0.0903)	-0.0643 (0.0722)
Openness	0.0411* (0.0050)	0.0482* (0.0039)	0.0412* (0.0050)	0.0523* (0.0039)
Constant	224.1443 (126.1748)	413.1627*** (163.0798)	98.3499 (120.7534)	108.035 (116.6024)
R^2	0.444	0.455	0.430	0.483
F-statistics	65.70*	67.10*	64.18*	69.82*
Anderson Canon LM	42.467*	30.178*	47.077*	65.216*
Cragg-Donald Wald F	22.674	15.720	25.368	36.526
Sargan *p*	0.8408	0.4661	0.8690	0.3403
Hausman	13.464*	12.233*	19.087*	52.303*
Instruments	ELF, Va	ELF, Va	ELF, Va	Latitude, Va
N	536	537	537	533

Note: Values in parentheses are standard error estimates. In all estimates, years and countries are included as dummy variables. * $p< 0.001$, ** $p < 0.01$, *** $p <0.05$.

The other independent variables, Gdpgrowth, Corruption and Openness, have positive and statistically significant effects on Saving, as they are in the estimates obtained for all countries. Consumption has a negative effect, but this effect is not significant. As shown in Table 5, this meaningless effect of the Consumption variable continues in the other columns except the third column. In the third column Consumption variable has a negative and significant effect on Saving.

The positive and statistically significant effect of the Gdpgrowth, Corruption and Openness variables on Saving continues to exist in the other columns. Accordingly, the SD level also increases for developed countries when the GDP growth rate, trade openness ratio and the level of corruption control increase in the previous period. According to the estimation results in Table 5, Population (0-14) and Population (15-64) variables positive and significant effects on Saving.

Table 6: IV(2SLS)Estimates: Developing Countries

	1	2	3	4
Population	-1.9360** (.5750)			
Population(0-14)		-122.0222** (36.4620)		
Population(15-64)			-200.1841** (61.7771)	
Population(65+)				164.5485** (56.8103)
Gdpgrowth	0.3529** (0.1058)	0.3041** (0.1046)	0.3626** (0.1076)	0.4002* (0.1136)
Corruption	8.9445* (0.7369)	8.8684* (0.7396)	8.8422* (0.7562)	9.5008* (0.8355)
Consumption	-0.2144** (0.0692)	-0.2141** (0.0688)	-0.2148** (0.0701)	-0.2143** (0.0739)
Openness	-0.0152 (0.0114)	-0.0194 (0.0117)	-0.0124 (0.0112)	-0.0044 (0.0113)
Constant	-634.4462* (181.785)	-716.5807* (163.9557)	-568.1912** (172.6844)	-790.4624* (178.5029)
R^2	0.208	0.216	0.187	0.134
F-statistics	33.78*	34.20*	32.94*	33.73*
Anderson Canon LM	404.437*	342.251*	328.208*	65.216*
Cragg-Donald Wald F	324.383	250.469	235.588	36.526
Sargan *p*	0.7297	0.9900	0.5837	0.3232
Hausman	31.040*	23.085*	8.021**	10.772**
Instruments	ELF, Polsta	ELF, Polsta	ELF, Polsta	Latitude, Polsta
N	1059	1061	1061	1033

Note: Values in parentheses are standard error estimates. In all estimates, years and countries are included as dummy variables.* $p< 0.001$, ** $p < 0.01$, *** $p <0.05$

According to this result, in the developed countries, when the increase rate of population between 0-14 years and 15-64 years increases, SD level increases. On the other hand, Population (65+) in developed countries has a negative and statistically significant effect on Saving. According to this, when the increase rate of age population over 65 is increased, SD level of developed countries decreases. Considering the fact that the developed countries are aging as population, it seems that it is understandable that 0-14 age group and 15-64 age group, which tend to decrease in these countries, have a positive effect on SD.

Table 6 shows IV(2SLS) estimates for developing countries, taking into account the potential endogeneity problem between population variables and Saving. The Hausman test shows that population variables are endogen. According to Anderson Canon LM test results, instrumental variables are related to endogen variables. The results of the Cragg-Donald Wald F statistic show that the instrumental variables used are very strong according to Stock and Yogo (2005). According to the results of the Sargan test, valid instrumental variables were used to solve the problem of endogeneity. Unlike developed countries according to the table,

population change in developing countries negatively affects SD. As can be seen in the first column of the estimation results of the (1) model, the Population variant has a negative effect on the Saving. This negative effect is statistically significant, below the 1% significance level. Accordingly, when the population growth rate in developing countries increases, the SD level decreases.

As shown in Table 6, unlike developed countries, the effects of Population (0-14) and Population (15-64) on Saving are negative and statistically significant in developing countries. According to this result, the SD level decreases in the developing countries when the increase rate of the population between 0-14 years and 15-64 years increases. On the other hand, Population (65+) has a positive and statistically significant effect on Saving. According to this, in the developing countries, the age increase rate of 65 years and over increases the SD. The other independent variables, Gdpgrowth and Corruption, have a positive and statistically significant effect on Saving in all the columns, as is the case for estimates obtained for all countries. It has a negative and statistically significant effect on Consumption Saving in all the columns, as is the case for all countries. The openness variable does not have a significant effect on Saving. Therefore, while the SD level increases when the GDP growth rate and the level of corruption control increase in the previous period for the developing countries, the SD level decreases when the increase rate of the total consumption expenditures of households and the public increases.

6. CONCLUSIONS

The purpose of this study is to analyze the impact of population growth on sustainable development for developed and developing countries. While today's society meets its needs, it must make use of today's resources, taking into account future generations. Because overuse of today's resources may cause future generations to be unable to meet their needs. One of the biggest threats to this situation, defined as sustainable development, is population growth. As mentioned in the introduction and the second part of this study, the planet's resources for the European quality of life can reach a maximum of two billion people. However, the world population in excess of 3 billion in 1960, about 6 billion in 2000, 2015, about 7 billion found. In order to feed the world population expected to be around 9 billion in 2050, agriculture production has to grow by 70 percent. Therefore, the relationship between population and sustainable development is as important for today's society as it is for future society. However, there is a significant difference between the distribution of the present and future world population between developed and developing countries. It is predicted that about 6 billion of the present population belongs to the developing countries and that more than 8 billion of the population of 2050 will belong to these countries again. These figures show that most of the population now and in the future belongs to developing countries. Therefore, developing countries are in a very important position in terms of population and sustainable development relationship. Estimates of results for all countries, developed countries and developing countries support this. According to the estimates obtained by data from 146 developing and developed countries, the total population growth rate in all countries and the increase in the population growth of 0-14 age negatively affect the sustainable development level. Accordingly, when the total population growth rate and the population growth rate of 0-14 age increase, sustainable development will decrease. The results obtained support the view that the literature suggests that the population will negatively affect sustainable development. Estimates for developing countries also support this view. According to the estimation results, total population increase in developing countries, 0-14 age population increase and 15-64 age population decrease the level of sustainable

development. Findings for developed countries support the view that the population will increase the level of sustainable development in the literature. According to this, the total population increase in developed countries, the 0-14 age population increase and the 15-64 age population increase the level of sustainable development. However, the increase in the population aged 65 and above in these countries reduces the sustainability of development. Estimation results for developed and developing countries, as well as for all countries included in the analyzes, are important for reducing the population growth rate of emerging countries, which constitute a large part of the world population (about 82% today, about 86% in 2050, about 88% in 2100), both in terms of protecting both current and future resources. Despite the views that population growth is useful for our world, we must take very serious measures to protect the land, water and natural system to feed the population that seems to have gone over seven billion and go to ten billion. This is particularly needed for developing countries to reduce their population growth rate, to increase the level of economic growth, trade openness and corruption control of all countries, and to reduce the final consumption expenditure of households and the public.

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