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TOTAL FACTOR PRODUCTIVITY GROWTH AND DEMOGRAPHICS: THE CASE OF TURKEY

Toplam Faktör Verimliliği Artışı ve Demografi: Türkiye Örneği

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Keywords:
Economic Growth, Total Factor Productivity, Demographics.

JEL Codes:
O40, J11, C22

Abstract

Total factor productivity plays a crucial role in explaining overall economic growth. One of the important factors affecting the total factor productivity is the demographic structure of countries. All countries in the world are likely to experience demographic transition at some point. There are many channels through which demographic transition may impact total factor productivity. If a country wants to take full advantage of the demographic transition, proper policies should be implemented. This paper attempts to investigate the relationship between demographic factors and the likelihood of total factor productivity growth over the period of 1986-2017 in Turkey. Probit regression is applied to analyze the link between total factor productivity and demographic structure. The results show that an increase in income per capita, urban population, life expectancy at birth, and population density increases the likelihood of total factor productivity growth whereas an increase in capital stock per capita, dependency ratio, young dependency ratio, and fertility rate decreases the probability of total factor productivity growth.

Anahtar kelimeler:
Ekonomik Büyüme, Toplam Faktör Verimliliği, Demografi.

JEL Kodları:
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Özet

Toplam faktör verimliliği ekonomik büyümeyi açıklamada önemli bir rol oynamaktadır. Toplam faktör verimliliğini etkileyen önemli faktörlerden biri de ülkelerin demografik yapısıdır. Tüm ülkeler belli bir noktada demografik dönüşüm yaşamaktadır. Bu demografik dönüşüm toplam faktör verimliliğini birçok kanal vasıtasıyla etkileyebilmektedir. Bununla birlikte, ülkelerin demografik geçiş sürecinden tam olarak faydalanması, uygulanacak uygun politikalara bağlıdır. Bu çalışmada, 1986-2017 döneminde demografik faktörler ile toplam faktör verimliliği artış olasılığı arasındaki ilişki incelenmektedir. Toplam faktör verimliliği artış olasılığı ve demografik yapı arasındaki ilişki probit regresyon modeli ile test edilmektedir. Analiz sonucunda elde edilen bulgulara göre, kişi başına gelir, kentleşme, beklenen yaşam süresi ve nüfus yoğunluğundaki artış toplam faktör verimliliği büyüme olasılığını artırırken; kişi başına sermaye stoku, bağımlılık oranı, genç bağımlılık oranı ve doğurganlık oranındaki artış ise toplam faktör verimliliği büyüme olasılığını azaltmaktadır. Diğer bir deyişle, analiz bulguları Türkiye'de demografik yapı ile toplam faktör verimliliği arasında güçlü bir ilişki olduğunu işaret etmektedir.

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1. Introduction

Total factor productivity (TFP) plays a crucial role in explaining overall economic growth. Therefore, what are the determinants of TFP growth and which policies should be developed to ensure TFP growth are important and noteworthy questions.

Many countries in the world experience demographic transition. Figure 1 shows the stages of demographic transition. Due to declining fertility and mortality rates and increasing working age population, population dividend has occurred in many developing countries. The demographic dividend may provide some opportunities to increase TFP growth (economic growth) in these countries.

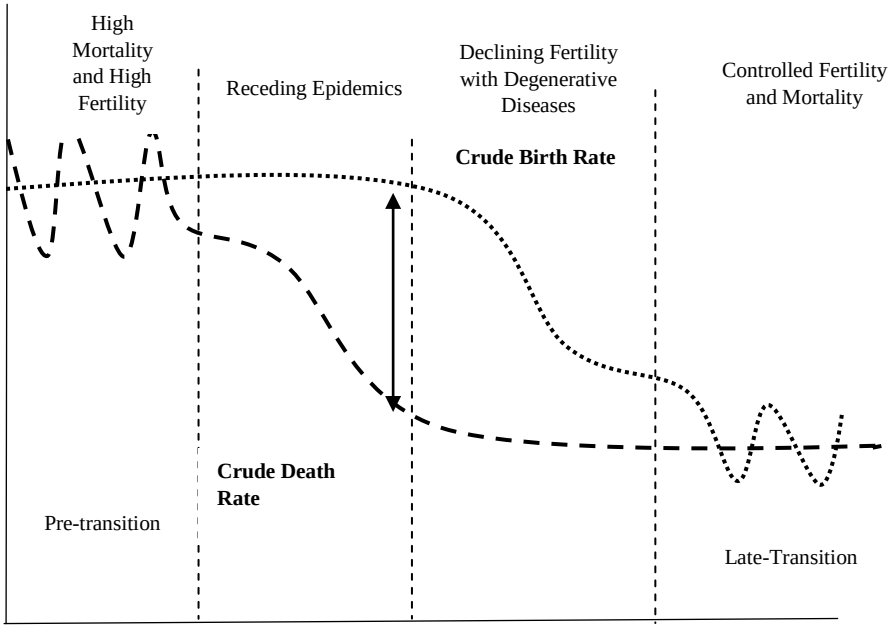

Figure 1. Stages of Demographic Transition
Source: Lundquist, Anderton and Yaukey, 2015, p. 57

The demographic transition impact on a country's age structure. Since economic needs of people and their contributions to the economy vary at various stages of life, changes in the age structure of population may have a significant impact on economic growth and productivity. Total labor supply, consumption, saving, productivity vary depending on the age group in the life cycle and this situation directly affects the productivity and economic growth. For example, while the ratio of consumption to production tends to higher for old and young people, it is low for working-age adults. Besides, accumulation of experience, depreciation of skills, physical and mental capabilities vary over working life (Bloom, Canning and Fink, 2010; Bloom, Canning and Sevilla, 2003; Disney, 1996; Isaksson, 2007).

There are many other channels through which demographic conditions may impact total factor productivity. For example, urbanization leads to agglomeration and agglomeration effect enables to lower cost of production by decreasing transaction cost and economies of scale which provides specialization between firms. Education affects the capacity of a country to improve new technologies and it contributes to effectively benefit existing technology. While poor health

conditions hamper acquiring and adopting newer technologies and decrease the availability of workers, good health conditions increase the capacity of workers (Kumar and Kober, 2012, p. 14).

Turkey is one of the countries experiencing demographic transition. The working age population rose 1.8 percent last year almost 55 million. Figure 1 shows the working age population (% of total population) in Turkey.

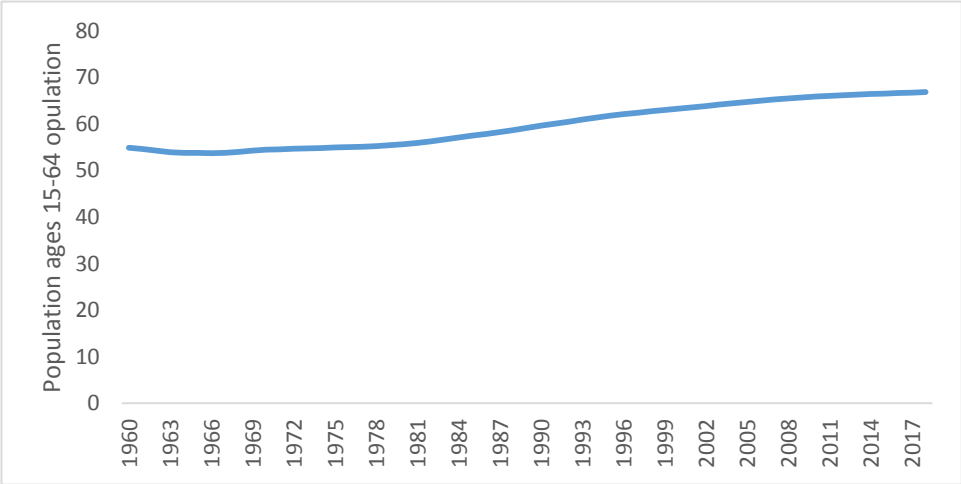

Figure 2. Working Age Population in Turkey
Source: World Bank

Due to decreasing fertility rates and increasing working age population, demographic dividend occurred in Turkey and it still exists. The demographic dividend may provide some opportunities to increase total factor productivity growth or economic growth. The aim of this study is to empirically assess the impact of demographic factors on the likelihood of TFP growth in Turkey. To do so, I use probit model to analyze the relationship between demographics and TFP and data covers the period of 1986-2017.

The remainder of the study is structured as follows. Section two explains the literature on demographics and TFP. Section three describes data, the empirical methodology, section four presents the empirical results and finally section five concludes.

2. Literature Review

The link between TFP and demographics is widely discussed in the literature. In the majority of the studies examining the relationship between demographics and TFP, it is emphasized that demographic structure has a significant effect on TFP.

Most of the studies examining the relationship between demographics and TFP focus on the dependency ratio and population aging. Kögel (2005) investigates the relationship between youth dependency ratio and TFP growth for 70 countries over the period 1965-1990 by using panel data econometric method. According to results, there is a negative and significant link between TFP growth and the youth dependency ratio.

Tang and MacLeod (2006), analyze the impact of labor force ageing on productivity for the period of 1981-2001 in 10 Canadian provinces by using panel data. The test results show that ageing has negative effect on productivity growth since 1996. However, workers aged under 55 tend to be more productive than workers aged 55 and over.

By using a panel of 87 countries, Feyrer (2007) finds that workforce demographics and productivity are strongly correlated. According to test results, 40-49-year age group is associated with higher productivity in all other age groups in a large sample of countries.

Mahlberg, Freund and Prskawetz (2013) analyze the link between labor productivity and age structure of labor force for over 2002-2007 in Austrian economy, including mining, market oriented services and manufacturing. The authors find that there is a positive relationship between the labor productivity and the share of employees 50 years and older.

Aiyar, Ebeke and Shao (2016) estimate the effect of aging on productivity in EU28 countries for the period of 1950-2014 by using panel estimation techniques. It is concluded that workforce aging reduces labor productivity growth. Liu and Westelius (2016) investigate the link between productivity, demographics and inflation in Japan between 1990-2007. It is concluded in the paper that there is a negative relationship between TFP and aging of the working age population in Japan. The tests results indicate that one percentage shift from the 30-year to 40-year age group increases the TFP by approximately 4.4%, however, a shift from 40 to 50-year age group decreases TFP by 1.3%.

Maestas, Mullen and Powell (2016) investigate the impact of aging on output per capita for the period 1980-2010 in US states. The results show that a 10% increase in the fraction of the population ages60+ decreases the growth rate of Gross Domestic Product (GDP) per capita by 5.5%.

Nişancı, Doker, Türkmen and Emsen (2016) investigate the demographic determinants of labor productivity for 34 countries over the period 1960-2010. According to results, capital and export are strongly related to productivity. However, the results show that life expectancy and dependency ratio negatively affect productivity.

Some of the studies examining the relationship between demographics and TFP focus on other demographic variables such as labor force, health, urbanization etc. Danquah, Moral-Benito and Quattara (2011) investigate the determinants of TFP growth for 67 countries over the period of 1960-2000. The authors conclude that initial GDP level and trade openness are the most robust determinants of TFP growth. When the sample is split as OECD and non-OECD, the results show that labor force, trade openness, investment price and consumption share variables are correlated with TFP growth for OECD countries. In non-OECD countries, population density is also correlated with TFP growth.

Kumar and Kober (2012) analyze the relationship between health, education, urbanization and TFP for a large sample over the period of 1960-2005. It is concluded in the paper that urbanization and health significantly affect TFP, however, there is no significant relationship between education and TFP.

3. Data and Methods

Empirical analyses employ yearly data for Turkey for the period of 1986-2017. The data is obtained from World Development Indicators (WDI), Penn World Table (PWT) (9.1) databases. The variables used in this study are TFP at constant national prices (2011=1), GDP per capita, PPP (constant 2011 international $); capital stock per capita (constant 2011 national prices, in mil. 2011 US $); age dependency ratio (% of working age-population); age dependency ratio, old (% of working age-population); age dependency ratio, young (% of working age-population); fertility rate; total (births per woman); urban population (% of total population); life expectancy at birth; total (years), and population density (people per sq. km of land area).

Table 1. Summary Statistics of Variables

Variable	Mean	Std. Dev.	Min	Max
Income Per Capita	15780.29	4438.581	10155.2	25583.35
Capital Stock Per Capita	46601	15953	25251	81992
Age Dependency Ratio	58.36509	7.072876	49.83174	72.84551
Age Dependency Ratio, Old	9.689952	1.496246	7.64112	12.36968
Age Dependency Ratio, Young	48.67514	8.525619	37.46207	65.18368
Fertility Rate	2.551063	0.444329	2.081	3.598
Urban Population	43.014.496	9684813	27.034.322	60.537.696
Life Expectancy At Birth	70.25609	4.672972	62.231	77.161
Population Density	84.19638	11.78016	65.1333	105.3778

Binary dependent variable models are widely used in the literature. The binary response model is a regression model in which dependent variable takes only the values one or zero. Logit, probit, and gambit are standard binary dependent variable models.

One of the most commonly used binary response models in the literature is the probit model. Probit model with normal cumulative distribution function is expressed as (Greene, 2003; Wooldridge, 2001).

$$G(z) \equiv \phi(z) \equiv \int_{-\infty}^{z} \phi(v)dv \quad (1)$$

$\phi(z)$ is the standard normal density:

$$\phi(z) = (2\pi)^{-1/2} \exp(-z^2/2) \quad (2)$$

In this study, a probit model is used in order to link total factor productivity growth with several demographic variables. If TFP in year "t" is higher than year "t-1", I assign the value of 1 on the year "t" and 0 otherwise. Therefore, dependent variable represents the likelihood of TFP growth.

4. Empirical Results

The results of probit regression for demographic variables are displayed below in Table 2.

Table 2. Demography

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Income P.C.	0.001**	0.001**	0.001**	0.001*	0.000*	0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Capital P.C.	-28.487**	-28.644**	-19.592**	-23.593**	-15.609**	-14.643*
	(12.609)	(12.560)	(8.865)	(9.261)	(7.477)	(8.044)
Dependency	-0.636**					
	(0.299)					
Old Dep.		0.470				
		(1.039)				
Young Dep.		-0.621*				
		(0.326)				
Fertility Rate			-5.967**			
			(2.849)			
Urban Pop.				22.186**		
				(8.740)		
Life Exp.					0.657**	
					(0.327)	
Pop. Den.						0.331*
						(0.190)
AIC	44.314	46.292	46.462	46.811	47.706	48.514
Log –L.	-18.157	-18.146	-19.231	-19.406	-19.853	-20.257
R^2	0.172	0.172	0.123	0.115	0.095	0.076

Note: Numbers in parentheses are robust standard errors. *, **, *** indicate significance at the 10% level, 5% level, 1% level, respectively.

As shown in Table 2, income per capita and capital stock per capita are the most important variables: both income and capital per capita are significant. The results suggest that while income per capita increases the likelihood of total TFP growth, capital stock per capita decreases the likelihood.

The probit analysis finds that the dependency ratio, dependency ratio (young), fertility rate, urban population, life expectancy at birth, population density are significantly related to TFP growth probabilities. The dependency rate and fertility rate might reduce the likelihood of TFP growth, while urban population, life expectancy at birth, population density might increase the likelihood. Interestingly, when the dependency ratio old and young enter the model separately, old dependency ratio variable is not statistically significant but young dependency ratio enters negatively and significantly.

5. Conclusion and Discussion

This paper attempts to determine the demographic factors and the likelihood of TFP growth over the period of 1986 -2017 in Turkey by using probit regression method. The results presented in the paper show that the demographics are correlated with the likelihood of TFP growth.

Income per capita and capital stock per capita variables are used as control variables in all regression models. The results show that an increase in per capita income increases the likelihood of TFP growth. This result may be explained by the fact that the scale effect increases with higher income per capita. The capital stock per capita which is another control variable reduces the likelihood of TFP growth. This relationship can be explained by the fact that there is a diminishing returns on capital (Jajri, 2007).

It is concluded that an increase in dependency ratio decreases the probability of TFP growth. Unlike the working age population, old and young population consume more than they produce. Besides, the working age population tends to save more. Therefore, increasing dependency ratio reduces savings and low savings affect the productivity in a negative way (Bloom et al. 2003; Bloom, Canning and Sevilla, 2001; Mason, 2003).

When the dependency ratio old and young enter the model separately, old dependency ratio variable is not statistically significant but young dependency ratio enters negatively and significantly. Kögel (2005) emphasizes that aggregate savings are lower due to higher youth dependency ratio. Since developing countries have access to international markets; lower savings cause lesser funding opportunities for R&D. Consequently, this situation leads to lower TFP growth. In the study examining the relationship between demographic structure and economic growth in China, Wei and Hao (2010) point out that the important contribution of demographic structure to growth is widely attributable to the lower young dependency ratio. In terms of the way of working age population and fertility rate, China and Turkey are similar. From this point of view, our result is consistent with the result by Wei and Hao (2010).

Fertility rate is another demographic variable examined in relation to likelihood of TFP growth. The most important factor which changes the age structure of population is fertility rate. Fertility preferences of women determine labor supply in future. Hence, fertility rate is directly related to productivity. According to regression results (3), an increase in fertility rate decreases the probability of TFP growth. Women's supply of labor increases due to decrease in fertility rate. The decrease in fertility rate may also increase education and health investment for each child (Bloom et al., 2003; Bloom, Canning, Fink and Finlay, 2009). Besides an increase in fertility rate may increase the young dependency ratio, and then increasing young dependency ratio may negatively affect productivity.

The regression analysis (4), which examines the effect of urbanization on the likelihood of TFP growth, shows that there is a positive link between urbanization and the likelihood. Urbanization improves the human capital by ensuring that people get better education and health care services in cities. Urbanization contains the agglomeration of companies and people and decreases the costs. Urbanization provides economies to have advantages on an external scale and decreases transaction costs. It also reduces costs by providing internal specialization at enterprises (Kumar and Kober, 2012; Nguyen and Nguyen, 2018).

In this paper it is concluded that there is a positive relationship between the probability of TFP growth and life expectancy which represents health conditions. Health affects TFP growth in two ways, directly and indirectly. While health affects TFP growth directly through wealth and household income, it affects TFP growth indirectly through demography, saving and investment and labour productivity, by reducing various forms of capital and technology adoption (Isaksson, 2007, p.25).

The last demographic variable examined in relation to likelihood of TFP growth is population density. The regression result (6) shows that population density increases the probability of TFP growth. According to Becker, Glaeser and Murphy (1999), population density has a positive effect in knowledge sector and human capital. Greater population density tends to enhance human capital by increasing rates of return on investment in schooling and other human capital.

Many countries in the world experience demographic transformation. The contribution of this change to the economy depends on the policies to be adopted. Turkey is one of the countries experiencing demographic transformation and Turkey's economic performance is closely related to this process. In order to reap demographic dividend, Turkey should adopt employment, health and education policies that will increase the efficiency of the working age population.

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