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Examining the Relationship between Preprimary Education and Economic Growth in Developing Countries

Gelişmekte Olan Ülkelerde Okul Öncesi Eğitim ve Ekonomik Büyüme Arasındaki İlişkinin Test Edilmesi

Sinem EYÜBOĞLU[1], Simge YILMAZ UYSAL[2]

Abstract

Purpose: The aim of the current study is to examine the relationship between preprimary education and economic growth in developing countries for the period 2004-2019.

Design/Methodology: In this study, making use of the relevant literature, two independent variables were added to Mankiw et al. (1992) neoclassical growth model and the extended model was used. The obtained model was estimated by the Generalized Moments Method.

Findings: The results revealed that human capital positively effects economic growth. Additionally, preprimary education has a significant impact on economic growth. The results also indicated that the elasticity of human capital investment is higher than physical capital investment. Therefore, it is concluded that human capital supports economic growth more than physical capital.

Limitations: Since the data used in the study were only available for 17 developing countries, the remaining developing countries were not included in the model estimation.

Originality/Value: Although the relationship between other stages of education and economic growth has been extensively studied in the literature, there are limited empirical studies between preprimary education and economic growth. For this reason, reaching the results that can contribute to the education policies of developing countries in the study constitutes the original value of the research.

Keywords: Economic Growth, Preprimary Education, Educational Policy, Developing Countries

Öz

Amaç: Mevcut araştırmanın amacı, 2004-2019 dönemi için gelişmekte olan ülkelerde okul öncesi eğitimi ile ekonomik büyüme arasındaki ilişkinin incelenmesidir.

Tasarım/Yöntem: Bu çalışmada, ilgili literatürden yararlanılarak Mankiw vd. (1992) neoklasik büyüme modeline iki bağımsız değişken eklenmiş ve genişletilmiş model kullanılmıştır. Elde edilen model Genelleştirilmiş Momentler Yöntemiyle tahmin edilmiştir.

Bulgular: Sonuçlar, beşeri sermayenin ekonomik büyümeyi olumlu etkilediğini ortaya koymuştur. İlaveten okul öncesi eğitim ekonomik büyüme üzerinde önemli bir etkiye sahiptir. Ayrıca sonuçlar beşeri sermaye yatırımının esnekliğinin fiziksel sermaye yatırımından daha yüksek olduğunu göstermiştir. Dolayısıyla beşeri sermayenin ekonomik büyümeyi fiziksel sermayeden daha fazla desteklediği sonucuna varılmıştır.

Sınırlılıklar: Çalışmada kullanılan veriler sadece 17 gelişmekte olan ülke için mevcut olduğundan model tahminin yapılmasında geriye kalan gelişmekte olan ülkelere yer verilmemiştir.

Özgünlük/Değer: Eğitimin diğer basamakları ve ekonomik büyüme arasındaki ilişki literatürde yoğun bir şekilde incelenmiş olmasına karşın, okul öncesi eğitim ve ekonomik büyüme arasında sınırlı sayıda ampirik çalışma mevcuttur. Bu nedenle çalışmada gelişmekte olan ülkelerin eğitim politikalarına katkı sağlayabilecek sonuçlara ulaşması araştırmanın özgün değerini oluşturmaktadır.

Anahtar Kelimeler: Ekonomik Büyüme, Okul Öncesi Eğitim, Eğitim Politikası, Gelişmekte olan Ülkeler

[1] Doç.Dr., Tarsus Üniversitesi, Uygulamalı Bilimler Fakültesi, Gümrük İşletme Bölümü, sinemeyuboglu@tarsus.edu.tr, ORCID:0000-0002-3525-9173
[2] Doç.Dr., Mersin Üniversitesi, Eğitim Fakültesi, Temel Eğitim Bölümü, simgeyilmaz@mersin.edu.tr, ORCID:0000-0002-5092-8670

1. INTRODUCTION

Education (EDU) is accepted as the primary mechanism of human capital, production, accumulation, and spread. Many economic theories and empirical analyses have emphasized that human capital, as a factor of production, is essential in explaining economic growth (EG). For instance, Solow (1956) who forms the basis of the Neoclassical Growth Model, states that the increase in physical capital stock along with the amount of labor, technological development level, EDU level, and many other factors constitutes the source of EG (Solow, 1957). The Mankiw, Romer, and Weil model, which is known as MRW (1992), emerged with the addition of human capital to the Solow model. According to this model, EDU contributes to the increase of labor productivity by promoting human capital inherent in the workforce. . Supporting this idea, Hanushek et al. (2015) revelaed that the basis of increasing labot productivity and increase in wages is related to accumulation of human capital. Also, high quality educated workforce is great importance for the creation and dissemination of new technologies. Thus, the output level moves towards the higher equilibrium level (Mankiw et al., 1992). In addition to these two models, Lucas (1988) and Romer (1990) also argued that EDU can increase knowledge of products, processes, and new technologies that can enhance EG and the innovative power of the economy.

Many researchers (e.g., Barro, 1991; Cooray, 2009; Goczek et al.,2021; Hanushek & Kimko, 2000; Nelson & Phelp, 1966; Schweisfurth, 2013; Solmon, 1986) have argued that there is a significant and positive nexus between EG and EDU. To illustrate, Hanushek and Kimko (2000) stated that getting a significant enhancement in productivity and national growth rates can be achieved through quality education. According to Nelson and Phelps (1996), EDU contributes to the understanding, monitoring, development, effective implementation, and dissemination of new information and innovative technologies required for EG. Similarly, Hanushek and Woessmann (2010) asserted that clear policy implementations as well as the high-quality education contribute to a country's economic growth

Bils and Klenow (2000), from a different perspective, emphasized that high school enrollment rates contribute to a rapid improvement in total factor productivity, which also accelerates the increase in per capita income. Barro (1991) asserted that an enhancement in the amount of human capital per capita will increase both the human and physical capital investment rates, which will increase the output per capita to higher levels. Denison (1974), on the other hand, focused on how personal performance at school and professional life can be affected by EDU. As a result, Denison (1974) implied that enhancing workforce quality, which has a significant effect on increasing output, can be achieved through EDU.

Young (1995) asserted that there is evidence in the literature about the relationship between EDU and EG and the factors that may affect this relationship. She also asserted the benefits of investment in human capital regardless of the developmental levels of the countries. According to Young (1995), these benefits are listed as a) an increase in the female labor force, b) a decrease in gender inequality, c) EG and development, d) a reduction in health-related costs, and e) efficiency in primary and higher EDU (Young, 1995). Parallel to these findings, Morris and Oldroyd (2020) emphasized the significant role of human capital in a countries economic growth by highlighting the increase in per capita income, welfare, and employment rates. In light of this information, the importance of investigating a qualified preprimary education (PPEDU) and the continuation of this quality at other levels of EDU emphasizes the significant effect of investment in human capital on EG. Heckman (2000) states that having a high-quality PPEDU will significantly affect the later stages of life and the effects of such an EDU will be positive and continuous.

The cost-benefit analysis tables obtained from people living in different disadvantaged parts of society show that access to a quality PPEDU program (e.g., High/Scope Perry Preschool Program, Carolina Abecedarian Project-ABC-, and Chicago Child-Parent Centers-CPC) may provide a return of 7-12 US dollars (Van-Huizen, Dumhs & Plantenga, 2019). From a more realistic perspective, Karoly (2016) stated that each dollar investment in PPEDU yields between 3-4 US dollars. Similarly, Carneiro and Heckman (2003) evaluated human capital investment and rate of return according to age, and stated that the return on PPEDU ranged from 1dollar to 8 dollar, while the return on investment at

later ages was very low. In both cases, it is clear that the investment in PPEDU provides high profits, in particular for disadvantaged people coming from low socio-economic backgrounds.

It has been known that the results of these projects, which are mainly carried out with the disadvantaged part of society, can predict the economic returns of the universal programs that can be implemented with different sections of society (Karoly & Bigelow, 2005; Lynch & Vaghul, 2015). However, the most important point to remember here is that it is not possible to implement the mentioned programs internationally. PPEDU programs may vary in terms of the content by country; this can lead to diversity among the earnings of those programs for countries (Van-Huizen et al., 2019). For example, Karoly and Bigelow (2005) found that the return /outcome of high-quality PPEDU programs is 100 % in children of low-income families who have never enrolled in such programs, and that is 50 % and 25 % for children of middle and high-income families, respectively. Parallel to this, Lynch and Vaghul (2015), in their study across the United States, showed that high-quality PPEDU programs have several benefits for all children; however, the factors that may affect this outcome may be different for children coming from middle and high-income families. The results of these studies may lead us to conclude that the return on investment in PPEDU may differ in developed and developing countries, where the income level and per capita income are varied. In particular, the fact that the income level and the opportunities for enrollment/ access to PPEDU are lower in developing countries, compared to developed ones. This may indicate that a sufficient level of investment in PPEDU can bring much more income to developing countries.

There are two different arguments related to investment in PPEDU. One of them is the fact that a high-quality PPEDU can nurture child development. According to several researchers (Caucutt & Lochner, 2020; Heckman et al., 2010; Karoly, 2016), a high-quality PPEDU contributes to economic development by providing short, medium, or long-term outcomes for children. These outcomes can be listed as the children's improvement in holistic development (social, emotional, cognitive development, etc.), better school readiness, increase in primary school success rate, lower need for special education, lower rate of class repetition and increase in psychological development rate, predicted high school graduation, employment rates (Karoly, 2016). In addition, Zhao et al (2019) reveal that the relationship between IQ and school performance is more important than other factors such as parental education and family wealth. Accordingly, if there is a difference of 1 SD between two children's IQs, their scores in mathematics may differ by more than 0.32 SD. To illustrate, school readiness refers increase in school success, and this, in turn, positive behaviors in adulthood (Elango et al., 2015; Reynolds & Ou, 2011). Another argument is that investment in PPEDU increases the parental employment rate. Attanasio, Low, and Sanchez-Marcos (2008) state that accessible and affordable PPEDU is one of the factors affecting the mothers who quit working for a while to return to work; and this promotes the increase of the female workforce in the economy. In addition, it is known that a high-quality PPEDU significantly reduces the rate of social and economic problems among youths and adolescents, such as young pregnancy, crime, and dependence on the state (Karoly, 2016).

It has been revealed by many researchers that the first level of EDU has more importance on EG than other levels, especially for developing countries. Several studies are testing the relationship between different EDU levels, including primary, secondary, and higher EDU) and EG. These studies generally found that primary EDU is more effective on EG than other levels of EDU for underdeveloped and developing countries (Loening et al., 2010; McMahon, 1998; Mingat & Tan, 1996; Petrakis & Stamatakis, 2002; Psacharopoulos, 1994; Psacharopoulos & Patrinos, 2018; Self & Grabowski, 2004). In addition to these levels of EDU, many researchers argue that the return rate of the investment made in PPEDU is much higher than the investments made in other levels of EDU (Blankenau & Youderian, 2015; Günsoy, 2009; Heckman, 2000; Mustard, 2007; Van der Gaag, 2002). Although the contribution of investment in other levels of EDU rather than PPEDU to EG is empirically tested in the literature, there is limited research empirically investigating how PPEDU contributes to EG (Delalibera & Ferreira, 2019; Ragoobur & Narsoo, 2022). To the author's knowledge, there is relatively no research investigating the relationship between PPEDU and EG specifically in developing countries. Hence, to fill this gap in the literature, the current research aimed to test the relationship between PPEDU and EG in developing countries. To achieve this goal, the

nexus between PPEDU and EG has been tested with the help of the Generalized Moments Method (GMM) introduced by Arellano and Bond (1991), using data from the period 2004-2019 for 40 developing countries. This study is also important as it is a pioneering study in the national and international literature to test the contributions of PPEDU to EG for developing countries.

The relationship between different EDU levels including primary, secondary, and higher EDU, and EG, has been frequently tested in the literature. For instance, Barro (1991) stated that the percentage rise in primary and secondary school enrollment rates led to an increase in the per capita growth rate from 2.5% to 3.0%. Similar findings were obtained by other researchers (Lin, 2006; Ogundari & Awokuse, 2018; Sala-i-Martin et al. 2004; Shleifer & Vishny 1991). In another study, Englander and Gurney (1994) revealed that a 1% raise in secondary EDU enrollment results in an approximately 1.5% increase in productivity growth. Similar findings were obtained by Pereira and Aubyn (2009). Asteriou and Agiomirgianakis (2001) denoted that there is a cointegration between primary, secondary, and higher EDU enrollment rates and GDP per capita. In addition, they found that, except for higher EDU, causality from educational variables to EG. Adawo (2011) found that primary EDU positively affects EG, but secondary and higher EDU negatively affects it. Contrary to these findings, Tallman and Wang (1994) found that higher EDU has more impact on EG than primary and secondary EDU. Parallel to that finding, many researchers (Chatterji, 1998; Dineri & Gölpek, 2021; Gemmel, 1996; Krueger & Lindahl, 2001; Maneejuk & Yamaka, 2021; Neycheva & Joensen, 2019; Pegkas & Tsamadias, 2014;) emphasized that higher EDU provides an increase in GDP growth rate. Omojimite (2010), found no causality between primary school enrollment rate and EG for Nigeria. In another study, Gyimah-Bremponh et al. (2006), tested the relationship between all levels of EDU and EG, except PPEDU. As a result of the study, it was concluded that higher EDU is twice as effective as physical capital over EG (Gyimah-Bremponh et al., 2006). Portela et al. (2004), stated that the impact of EDU on GDP in the short term may vary between 4.2% and 6.5%, whereas this effect is about 54% and 56% in the long term (approximately 75-99 years).

In addition to the relationship between enrollment rates and EG at different educational levels, the relationship between EG and gender has also been one of the topics studied in the literature. Hanushek and Kim (1995) emphasized that 0.36% increase in GDP per capita with only one additional male student enrolling in secondary school EDU. Using average attainment years for men aged 25 and over, Barro (1997) estimated that the contribution of EDU to EG in secondary and higher schools was 1.2%.

With a different perspective, Petrakis and Stamatakis (2002) investigated the relationship between EG and EDU levels by considering the development levels of countries. Their results showed that in underdeveloped countries, primary and secondary EDU contributes more to growth than higher EDU in less developed countries. Helpman and Hoffmaister (1997) stated that developing countries with high levels of EDU and high research and development allocations obtain positive externalities when they trade with developed countries and increase factor productivity by producing new technologies. Widarni and Bawono (2021) also revealed the short and long term contributions of human capital and technology on EG. In addition, Erk et al. (1998), stated that the slope rates that give the unit exchange rate in human capital and physical capital are high for developed countries, whereas they are low for developing countries.

As can be seen from the aforementioned literature, studies are still lacking on the contribution of PPEDU to EG. However, recent studies on educational investments (e.g., Rolnick & Grunewald, 2003; Schweinhart, 2004) have shown that investment in PPEDU supports all cognitive and non-cognitive developmental areas of children. Furthermore, there are many researchers focused on the importance of the contribution of PPEDU to the EG of nations. Concerning these results, the current research tested the relationship between PPEDU and EG for developing countries.

2. DATA AND METHODOLOGY

Mankiw et al. (1992)'s augmented neoclassical growth model was estimated to test the effect of PPEDU on EG in developing countries. The general form of the neoclassic growth model which is based on the Cobb-Douglas production function is explained as:

$$Y_t = K^{\alpha} H^{\beta} (AL)^{1-\alpha-\beta} \quad (1)$$

Where Y= GDP per capita, K= the physical capital, H= human capital, L= labor supply, A= the level of technology, α and β are output elasticity considering physical and human capital.

Human capital has lots of dimensions. But it is assumed that human capital varies in direct proportion to educational attainment. This model is extended to include two additional variables from the related literature: a) the total population growth (Blanchet, 1991; Bloom & Freeman, 1988; Brander & Dowrick, 1994; Kelley & Schmidt, 1995) b) depreciation and technical progress (Ayres, 1996; Gould et al. 2001; Solow, 1962). The data of the study belongs to 17 developing countries during the period 2004 to 2019. The data of the study was limited to 17 developing countries since there was no available data for all developing countries. The inclusion of preprimary, primary, secondary, and higher EDU levels in the model can be explained by the fact that the effects of EDU on growth may differ according to EDU levels (Petrakis & Stamatakis, 2002). 17 developing countries were included in the study, as data were not available at preprimary, primary, secondary, and higher EDU levels for other developing countries.

Accordingly, the 2nd equation based on the MRW growth model has been estimated as follows:

$$Y = \alpha_0 + \alpha_1 preprimary + \alpha_2 primary + \alpha_3 secondary + \alpha_4 higher + \alpha_5 k + \alpha_6 p + \alpha_7 l + \varepsilon \quad (2)$$

The variables in the 2nd growth equation are introduced in Table 1.

Table 1: Data Set

Variables	Explanations
Y	GDP per capita (in constant 2010 US$)
preprimary	Preprimary enrollment rate
primary	Primary enrollment rate
secondary	Secondary enrollment rate
higher	Higher enrollment rate
k	Gross capital formation (% of GDP)
p	Population growth
l	Labor force

The dependent variable which is shown as Y reflects the GDP per capita in the models. Y, which is used as a measure of EG, is the real value obtained in dollars based on 2010. Gross capital formation (k), preprimary, primary, secondary, and higher EDU symbolize human capital, p is the sum of the average growth rate of the population, and depreciation and technical progress are given as explanatory variables in the models. Depending on MRW, we evaluate the sum of depreciation and technical progress as 0.05. Thus, p is taken as the sum of the population growth rate and 0.05. Finally, l is the total labor force. All variables are included in the model by making logarithmic transformations. All data are gathered from the World Bank World Development Indicators (WDI) database.

There have been different approaches to evaluate EDU in empirical research on EG. Enrollment rates, population rates reaching a certain level of EDU, and EDU expenditures are the most frequently used criteria in the literature. However, Gyimah-Bremponh et al. (2006), argued that the effect of schooling rate and EDU expenditures on EG is more advantageous compared to other EDU criteria in comparing different countries. Because it is known that both criteria do not measure EDU -oriented human capital for production purposes. As indicated by Solow (2003), enrollment rates

and expenditures on EDU are input to the production of educational human capital, not human capital itself. Moreover, since EDU expenditures and enrollment rates will accurately reflect the temporal differences between countries, enrollment rates are taken into consideration as a human capital criterion.

The focus of the current research is PPEDU human capital. Preprimary, primary, secondary, and higher EDU school enrollment rates were taken as human capital variables. The second number of the growth equation has been estimated by using the GMM estimator introduced by Arellano and Bond (1991) and Arellano–Bover/Blundell-Bond System GMM. This estimator is one of the dynamic panel data methods and is used for 17 developing countries during the period 2004- 2019. The countries and their GDP per capita in 2019 are shown in Table 2.

Table 2: Countries in the Sample and GDP per capita (2019)

Country	**GDP per capita (USD) 2019**	**Country**	**GDP per capita (USD) 2019**
Argentina	12712.97	Kyrgyz Republic	1226.824
Brunei	30646.109	Lao PDR	2579.253
Burundi	278.319	Malaysia	11414.58
Cameroon	1449.277	Mauritius	10643.771
Chile	13866.955	Mexico	9820.448
Egypt	3964.987	Morocco	3044.906
El Salvador	3993.529	Panama	15073.000
Indonesia	3877.382	Uzbekistan	3161.415
Iran Islamic Rep.	4785.027		

GDP per capita data for 2019 was obtained from the World Bank WDI database.

The use of the GMM method, which is utilized in the estimation of dynamic models, provides several advantages. The use of this model provides an advantage to take account of emerging issues that arise due to the intangible effects of the country and the endogeneity of the independent variables in the lagged dependent variable models. The dependent variable's lagged values can be added to the model as independent variables, allowing for the elimination of the aforementioned problems. The inclusion of both time constant and country fixed effects with the GMM estimators plays an important role to achieve more robust results since they provide additional information about the time-dependent change of growth determinants. Therefore, the GMM method is frequently used in estimating growth equations (Mhadhbi, 2014).

The error term in the 2nd equation is the compound error term that contains specific components for countries. In this equation, the first difference model is transformed by using the instrumental variable matrix; the transformed matrix was then analyzed by the Generalized Least Squares Method. For this reason, the Generalized Moments Estimator is also known as the Two-Stage Instrumental Variable Estimator (Baum et al., 2003). The dynamic panel estimator is included in the 3rd equation.

$$\hat{\theta} = (\bar{X}'ZA_NZ'\bar{X})^{-1}\bar{X}'ZA_NZ'\bar{Y} \quad (3)$$

Herein, θˆ is the vector of the coefficient estimates on both endogenous and exogenous regressors. $\bar{X}$ and $\bar{Y}$ represents the first differences of all explanatory variables. While Z is the

instrumental variables vector, A_N is the vector used to weigh instrumental variables. The instrumental variables used are associated with endogenous regressors but have no error terms.

The Arellano Bond estimator is weak if the autoregressive parameters are too large or the ratio of the variance of the unit effect to the variance of the residual error is too high. In addition, the first difference transform remains weak when working with unbalanced panel data or when T is small. Arellano and Bover (1995), Blundell and Bond (1998) proposed a system estimator that minimizes the data loss caused by the first difference method.

3. FINDINGS

Descriptive statistics are presented in Table 3. Annual per capita income per country for the sample period was determined as 8.321 on average and it is below the world average (9.306).

Table 3: Descriptive Statistics

Variable	Mean	Std. Deviation	Minimum	Maximum
Y	8.321	1.127	5.628	10.476
p	0.296	0.596	-2.498	1.209
k	3.181	0.337	2.175	3.828
l	15.733	1.564	12.065	18.729
Preprimary	3.769	0.741	0.286	4.738
Primary	4.668	0.076	4.334	4.947
Secondary	4.300	0.371	2.482	4.688
Higher	3.232	0.802	0.894	4.558

However, the table also represents that the population growth is above the world average (0.062) with an average of 0.296. The table also shows that PPEDU enrollment rate (3.769) was lower than PEDU enrollment rate (4.668). The coefficients for the EG equation are presented in Table 4. The second column includes the coefficients obtained from the Arellano–Bond Difference GMM method. The coefficient of the p-value was negative and was statistically significant at 0.10, whereas the coefficient of k value was positive and was statistically significant at 0.01. The flexibility of EG relative to physical capital has been achieved to be around 0.065 (Table 4). Therefore, it can be concluded that investments in physical capital have a statistically significant positive impact on the EG of developing countries. Similarly, Li et al., (2015) and Funke and Strulik (2000) stated that physical capital has a positive effect on EG.

The coefficient for PPEDU is significant and positive. The flexibility of EG considering the PPEDU enrollment rate was 0.013. The coefficient for primary EDU was negative and not statistically significant. Also, while the model has first-order serial autocorrelation, there is no second-order autocorrelation. The first-line autocorrelation is considered insignificant due to the nature of the model. Sargan test, on the other hand, shows that the model is not well constructed. In terms of preprimary coefficient, the coefficients value obtained from the Arellano–Bover/Blundell-Bond System GMM method and Arellano–Bond Difference GMM method were negative and not statistically significant. However, the results obtained from the same two methods in terms of the primary coefficient showed that the findings of the Arellano– Bover/Blundell-Bond System GMM method was higher than the findings obtained from the Arellano–Bond Difference GMM method. On the other hand, the secondary EDU coefficient was found to be positive but statistically insignificant in the Arellano-Bond Difference GMM method, while it was statistically significant at 10% in the Arellano-Bover/Blundell-Bond System GMM method. Similarly, the higher EDU coefficient was also obtained as positive, and statistically insignificant in Arellano–Bond Difference GMM method but it was statistically significant at 10% in Arellano–Bover/Blundell-Bond System GMM method.

According to Arellano–Bover/Blundell-Bond System GMM method, Sargan test statistics show that the model is well specified. Since the results of the Arellano–Bover/Blundell-Bond System GMM method was more efficient than the other method, in the current study the researchers considered this method.

The 3rd column in Table 4 includes the coefficients obtained from the Arellano–Bover /Blundell-Bond System GMM method. The coefficient of the p-value and primary EDU had a negative direction, whereas the coefficients of k value, labor force, preprimary, secondary and higher EDU had a positive one. Coefficients of l value and primary EDU were found to be statistically insignificant. On the other hand, coefficients of p-value and secondary EDU were statistically significant at 10% level, preprimary and higher EDU were statistically significant at 5% level ($\alpha = 0.05$), and coefficients of k value were statistically significant at 1% level ($\alpha = 0.01$). The flexibility of EG considering physical capital was obtained at approximately 0.09. Therefore, investments in physical capital positively affect developing countries' EG.

Table 4: GMM Estimates of Economic Growth Equation

Variables	**Arellano –Bond Difference GMM Estimates**	**Arellano –Bover /Blundell-Bond System GMM Estimates**
p	-0.006*	-0.003*
k	0.065***	0.086***
l	0.045	0.209
Preprimary	0.013*	0.044**
Primary	-0.085	-0.058
Secondary	0.067	0.092*
Higher	0.003	0.002**
1st-order	-8.4304***	
ser. Cor. 2nd-order ser. Cor.	-0.431	
Sargan Test	140.601***	67.651
Wald Test+	3.53	9.15***
F	24.00***	55.84***

***, ** and * denotes significance at 1%, 5%, and 10% respectively. + Joint significance of preprimary, primary, secondary, and higher education.

4. DISCUSSION & CONCLUSION

The current research revealed the linkages between PPEDU and the EG of countries. It also showed that the investment made in PPEDU will have a higher contribution to EG after the primary EDU, especially for developing countries. Parallel to this research, there are also different research findings showing the relationship between PPEDU and EG (Conti & Heckman, 2010; Cooray, 2009; Delalibera & Ferreira, 2019; Dodge, 2004; Felipe & McCombie, 2005; Hertzman, 2010; Heyneman, 2009; Ragoobur & Narsoo, 2022; Richter et al., 2017; Solow, 1957). Based on these results, it would be meaningful to discuss what needs to be done in PPEDU, especially for underdeveloped and developing countries.

Keller (2006) emphasized that school enrollment rates should be increased, and public spending should be prioritized for low EDU levels. Additionally, she suggested that in parallel with the increase in enrollment rates, expenditures per student should also increase. When this result is

interpreted in the context of the current study results, the enhancement in school enrollment rates especially at the PPEDU level may reveal the necessity of focusing on PPEDU, which is the first step of public expenditures in EDU. Also, increasing demand for PPEDU and increasing enrollment rates may result in a higher share allocated for children at this stage of EDU in developing countries. In addition to this, the increase in female labor force participation rates, especially in developing countries, has revealed the necessity of promoting PPEDU and will contribute to the economic development of the countries (Hertzman, 2010; Jaumotte, 2003; Verick, 2014). At this point, according to the results of the current study, the investments of developing countries, especially in PPEDU, and making this level of EDU compulsory and widespread will contribute to the strengthening of the economies of the countries and the sustainable development of this strong economy (Aysan & Özdoğru, 2015; Geelhoed et al., 2022).

Armecin et al., (2006) emphasized in his large- scale study that children aged two or three who attended a PPEDU program were more successful in the later stages of EDU and in social life compared to their peers who did not receive PPEDU at this age. According to the authors, meeting the needs of children who grow up in disadvantaged regions with low socioeconomic levels will contribute to the social, emotional, and cognitive development of children (Eveans, 2018) and this will lead to rise in human capital across the country (Heckman, 2004). Therefore, investing in PPEDU by developing policies to provide families with this opportunity will have positive outcomes including future school success, EG, and crime reduction (Conti et al., 2012; Heckman et al., 2010).

However, although the importance of PPEDU on EG has been scientifically proven, PPEDU opportunities are still limited in developing countries today (Alderman, 2011). Therefore, to encourage PPEDU, which is so important for the holistic development of children, it is recommended to implement programs that provide EDU and care services to children aged 0-8 by providing educational incentives, especially in developing countries where preprimary enrollment rates are low. It is also recommended that children, especially girls, living in socio-economically disadvantaged regions have more access to school (Çobanoğlu & Sevim, 2019). Thus, an important step will be taken for the elimination of inequality of opportunity in EDU and the development of human capital by providing every child with the right to receive PPEDU at an equal level, regardless of the developmental level of the countries, gender, language, religion and race (Gürkan, 1978; Mialaret, 1974).

Many researchers indicated that this situation (e.g., Alderman, 2011; Walker et al., 2007) negatively affects the school readiness of children in developing countries compared to their peers in developed countries. In fact, it is not correct to limit school readiness to only cognitive development (Heckman, 2004). The definition of school readiness is a controversial issue among researchers (Bradshaw, 2015). It is not possible to separate the developmental domains of children (including language, social, cognitive, and physical development), especially in preprimary. Therefore, when talking about school readiness, it is important to emphasize the whole development or whole child approach, which emphasizes the importance of supporting all developmental areas of children together (OECD, 2008). The concept of holistic development refers to the support of all developmental areas of children. In holistic development, any development area cannot be prioritized over other developmental areas (Hendrick, 1992). At this point, cognitive development is one of the components that contribute to the readiness of the child by developing in coordination with all other developmental areas. In addition to cognitive development, it is emphasized in the literature that phenomena and behaviors such as the desire and need to communicate and cooperate, focus, control their emotions, curiosity and socialization also contribute to children's learning (Carothers, 2019; Heckman, 2004; Zigler & Bishop-Josef, 2004). Supporting this, Ramey and Ramey (2004) stated that cognitive development and language development should be provided for school readiness. These researchers also stated that learning opportunities that can support social, physical, and personality development should also be included in PPEDU programs. This statement reminds us again of the importance of supporting holistic development in PPEDU. Contributing to the child's school readiness, including executive functioning, social skills, and many other components of child development, which should be supported in early childhood years, children’s whole development creates a very solid foundation for their learning in the future (Bradshaw, 2015).

Another finding of the current research demonstrated the effect of physical capital investment and the elasticity of human capital on EG. This study showed that the elasticity of human capital is more effective in economic development compared to physical capital investment. At this point, it is emphasized that the contribution of investment in human capital to the countries' economy will be greater than the investment made in physical capital. For example, increasing the number of high-quality preprimary school institutions and making it accessible and affordable for each child (Barnett & Frede, 2007; Elliott, 2006; Karuppiah & Poon, 2022; McCabe & Frede, 2007) emphasizing the importance of increase in the number of children enrolled in these institutions or increasing the quality of preprimary school teacher training programs should be underlined (Aysan & Özdoğru, 2015). As a result, both the necessary steps should be taken to ensure these conditions and to regulate states' educational policies. Parallel to this, Hanushek (2013) stated that improving school quality will improve the long-term economic performance of developing countries and close the gap with developed countries.

As a result, it can be said that PPEDU for all children is a precondition for the development of the country's economy to become widespread and compulsory in developing countries. In addition, similar to the developed countries with strong economies, it is thought that growing high-quality preprimary teachers will contribute to the counties' national economy. It can be said that these important situations, which are stated to play a role in the development of the economy, are brought to the agenda as states' education policies in underdeveloped and developing countries and that necessary and final decisions are taken and enacted on the subject have become a necessity for the economic development and welfare of these countries.

The current research has certain limitations that need to be addressed; this research has only been applied to 17 developing countries due to the lack of an accessible data set. Therefore, it might be suggested to conduct comparative studies between developed countries and underdeveloped or developing countries.

Concerning the methodological approach used in this research, in future studies, the impact of PPEDU on EG can be predicted by the MRW model associated with the inclusion of more explanatory variables such as education expenditure in addition to human capital, physical capital, and population growth. Besides, the countries to be used in the study can be divided into two low-income and high-income countries according to their income levels and analyzed separately for future studies. In addition, the countries used in future studies can be divided into two according to the median income level and analyzed separately for low-income and high-income countries.

Since the early 1990s, in developing countries, access to PPEDU has been expanded and more qualified early education policies and programs have been developed; in turn, the focus is on increasing the quality of PPEDU. Based on this fact, the current study aimed to test the relationship between preprimary enrollment rates of developing countries and EG. In order to reach this aim, the researchers used the MRW model for the developing economies covering the period 2004–2019. This was the first attempt of this kind since PPEDU for developing countries has not been considered so far in the studies utilizing a similar approach. The key results of the current research were listed as follows: a) PPEDU increases GDP per capita, b) primary school EDU does not affect EG, c) secondary EDU is positively associated with EG d) higher EDU is positively associated with EG e) physical capital investments support EG, and f) elasticity of human capital investments is higher than physical capital investments.

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