İSTANBUL UNIVERSITY PRESS

Sosyal Siyaset Konferansları Dergisi / Journal of Social Policy Conferences
JSPC 2024, 86 , 18–25
DOI: 10.26650/jspc.2023.86.1358696

RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

The Effect of Efficiency and Cost Changes in Labor Factor on Physical Capital Investments: Dynamic Panel Data Analysis

Emek Faktöründeki Verimlilik ve Maliyet Değişimlerinin Fiziksel Sermaye Yatırımları Üzerindeki Etkisi: Dinamik Panel Veri Analizi

Ali İhsan ÖZTÜRK[1]

[1](Phd Student), Istanbul University, Department of Economics, Istanbul, Türkiye

ABSTRACT

Economic growth is simply the increase in the amount of goods and services produced as the production capacity of a country's economy increases. Production is possible by bringing together factors of production such as physical capital, human capital, labor, and natural resources by entrepreneurs. Labor, one of these factors, refers to the physical and mental human contribution used in the production process. The amount of labor to be used in the production process may vary depending on the efficiency and costs of this factor. In this paper, the effects of changes in efficiency and costs of the labor factor on physical capital investments are investigated. In the study where the Dynamic Panel Data Method was applied; annual data of 22 selected European Union member countries and Turkey covering the period between 2006-2019 were used. According to the results obtained with Two-Stage GMM and Two-Stage System GMM estimators, there is a positive relationship between physical capital investments and labor efficiency. On the other hand, the labor cost and the 2008 global financial crisis negatively affect physical capital investments. Especially in terms of labor efficiency, it is suggested that human capital and technology investments should be considered as priority policies.

ÖZ

İktisadi büyüme basitçe ülke ekonomisinin üretim kapasitesinin artmasıyla birlikte üretilen mal ve hizmet miktarının da artmasıdır. Üretimin yapılması ise; fiziki sermaye, beşeri sermaye, emek ve doğal kaynaklar gibi üretim faktörlerinin girişimciler tarafından bir araya getirilmesi ile mümkündür. Bu faktörlerden biri olan emek, üretim sürecinde kullanılan fiziksel ve zihinsel insan katkısını ifade eder. Üretim sürecinde kullanılacak olan emek miktarı, bu faktörün verimliliğine ve maliyetlerine bağlı olarak değişebilmektedir. Bu makalede, emek faktörünün verimlilik ve maliyetlerindeki değişimlerin fiziki sermaye yatırımlarına olan etkisi araştırılmaktadır. Dinamik Panel Veri Yönteminin uygulandığı çalışmada; seçilmiş Avrupa Birliği üyesi 22 ülke ve Türkiye'ye ait, 2006-2019 arası dönemi kapsayan yıllık veriler kullanılmıştır. İki Aşamalı GMM ve İki Aşamalı Sistem GMM tahmincileri ile elde edilen sonuçlara göre; fiziki sermaye yatırımları ile emeğin verimliliği arasında pozitif bir ilişki söz konusudur. Diğer taraftan, emeğin maliyeti ve 2008 küresel finansal krizi fiziki sermaye yatırımlarını negatif yönde etkilemektedir. Bilhassa emek verimliliği hususunda, beşeri sermaye ve teknoloji yatırımlarının öncelikli politikalar olarak değerlendirilmesi önerilmektedir.

Keywords: Physical Capital Investments, Labor Efficiency, Labor Cost, Production Function, Dynamic Panel Data Analysis

Anahtar Kelimeler: Fiziki Sermaye Yatırımları, Emek Verimliliği, Emek Maliyeti, Üretim Fonksiyonu, Dinamik Panel Veri Analiz

Introduction

The concept of economic growth has great importance for all developed or developing countries. Growth figures, which attract the attention of almost everyone living within the borders of the country, are one of the leading criteria in the performance evaluations of governments (Berber, 2006, p. 27). Economic growth can simply be defined as a right shift of the production possibilities curve with an increase in capacity and the production of goods and services (Parasız, 2003, p. 10-12). Production factors such as physical capital, human capital, labor force and natural resources should be brought together in different proportions by entrepreneurs in the light of technological knowledges to be able to occur the production in an economy (Kibritçioğlu, 1998, p. 207).

Corresponding author: Ali İhsan ÖZTÜRK **E-mail:** aliihsan27ozturk@gmail.com

Submitted: 12.09.2023 • **Revision Requested:** 07.10.2023 • **Last Revision Received:** 27.01.2024 • **Accepted:** 29.01.2024

Physical capital accumulation, which is one of these production factors, is considered as one of the important factors affecting economic growth with its contribution to employment and productivity increase. While the physical capital stock consists of elements such as machinery, equipment and buildings used in the production process; it also includes infrastructure investments, dams, highway-airline-railway investments in the macro framework (Songur,2017, p. 202). Many economists working on economic growth and development theory such as Harrod, Domar, Lucas, Rebelo, Rostow and Lewis agree that rapid economic growth cannot be achieved in the long term without an increase in physical capital investments (Çetin, 2012, p. 212).

Human capital, on the other hand, is a concept that expresses all the education, health status, abilities, knowledge, and skills that individuals or societies have and is considered as another important factor of growth. It can occur spontaneously either "learning by doing" together with the study or at the end of the training process (Taban & Kar, 2006, p. 163). It was with the contributions of Lucas (1988) and Rebelo (1991) that human capital was included in the production function and accepted as a production factor like physical capital.

Another factor, Technology, was initially accepted as an exogenous variable in the neoclassical models pioneered by Solow's work in (1956) and (1957) but was internalized in Endogenous Growth Theories with together Romer's (1994) work. This means that technology is the factor that ensures continuity in growth by increasing the efficiency of inputs. Thus, while technical progress is primarily considered one of the factors of production, R&D and other activities that produce knowledge determine technological innovations (Özsağır, 2008, p. 332-347).

When it comes to labor factor, the degree of contribution of this factor, which expresses the physical and mental human contribution in the production process, varies according to the production technology used and the efficiency of labor (Karagül, 2014, p. 2-3). By the way; as it forms the main axis of the study, It would be beneficial to elaborate on the concepts of efficiency of the labor and the cost of labor. Labor efficiency is the added value per unit of each employee input. Factors such as human capital, technological change and economies of scale determine labor efficiency. The higher the amount of accumulated human capital and the level of technology, the higher the labor efficiency and more quality products are produced in less time (Greenlaw & Shapiro, 2011, p. 167-168). The cost advantages or disadvantages that arise because of companies increasing their production scale are called economies of scale. In the case of positive economies of scale where firms provide cost advantages, as the rising scale of production also increases the amount of capital per worker, it both increases the efficiency of labor and reduces fixed costs. However, In the case of negative economies of scale, monotony and job dissatisfaction caused by over-specialization reduce efficiency and leads to increased costs (Bilgili, 2017, p. 417-418). The main cost of the labor factor is in the labor market, it is the total labor cost that arises depending on the price at the point where labor supply and labor demand come into balance. The total labor cost consists of the sum of wages and social rights (Greenlaw & Shapiro, 2011, p. 84-85).

So far, brief information about the factors used in the production process has been provided. When the literature is viewed, it stands out that much research and analysis has been carried out on the effect of each mentioned factor on economic growth and real output. In this paper, it is investigated how the efficiency and cost of the labor factor affect physical capital investments. The idea of contributing to fill the gap in the literature regarding the relationship constitutes the motivation of this study. After this point, the literature review will be included in the second section, and econometric methods and empirical findings will be included in the third section. In the fourth and last section, results and policy implications will be interpreted.

Literature Review

In empirical studies, no study has been found that investigates the effect of labor factor on physical capital investments by using variables representing labor efficiency and cost. It has been determined that the studies on the efficiency of labor focus on the effects of factors such as human capital and technology investments on the efficiency of labor and the relationship of foreign direct investments with the efficiency of labor. On the other hand, the relationship between labor cost and investment is examined at the point of foreign direct investments. However, as mentioned above, while factors such as human capital, technology, and economies of scale affect labor efficiency, in the labor cost, wages and salaries are generally taken into account. Therefore, since it is thought that these factors that affect efficiency and costs indirectly affect both physical capital investments and the real output and growth performance produced in the whole economy, analyzes including these factors will also be mentioned while reviewing the literature. Thus, the constraint arising from the scarcity of studies directly related to the content of this study was tried to be eliminated by determining an empirical framework over the studies that indirectly form the basis.

Griliches (1969) confirmed the hypothesis for the United States (USA) that skilled or educated labor is more complementary with physical capital than unskilled or uneducated labor and introduced the capital-ability complementarity hypothesis by obtaining the educational status of industrial workers from the 1960 census data and the capital per worker data from the annual manufacturing survey for the year 1964. Accordingly, with the advancement of human capital, the complementarity relationship of labor, whose equipment and skills increase, with physical capital will also increase, and as a result, this will encourage more physical capital investment.

Berndt et al. (1995) performed Multiple Regression Analysis for the period 1968-1986 by using data from 20 American manufacturing industries within the scope of the standard industrial classification (SIC). In the study, the empirical relationship between high technology information capital investments and the distribution of employment by occupation and education level was examined. According to the results, findings that support both the capital-ability complementarity hypothesis and the advanced technology-capital complementarity were reached.

Lopez-Bazo and Moreno (2008), in their study for Spain covering the period between 1980 and 2000, measured the effect of human capital accumulation on physical capital investments. Due to the advantage of measuring the human capital flexibility of physical capital, in the analysis in which the Duality Theory approach is used, the semi-elasticity of the optimum physical capital demand compared to human capital is calculated. According to the result obtained, it has been observed that human capital stimulates the physical capital stock.

Altıntaş and Çetintaş (2010) investigated the relationship between fixed capital, human capital, exports, and economic growth for Turkey with the annual data of the 1970-2007 period, using Cointegration and Error Correction Models and tested the long and short-term causality relationships between the variables. According to the empirical results obtained; it has been concluded that human capital accumulation consisting of qualified workforce supports economic growth by stimulating physical capital and exports.

Hsin et al. (2015), using the Panel Data Analysis Method for the period 2002-2012, investigated how compulsory benefits, various reforms related to social insurance and worker welfare affected the capital investments of companies traded in Taiwan Stock Exchange. According to the results acquired from the empirical analysis, the increase in the compulsory aid rates leads to a decrease in the fixed capital investments of the firms.

Songur (2017), in his study carried out with the data of Turkey covering the period between 1950 and 2014, calculated the output and substitution elasticities between human and physical capital by using the Translog Production Function Approach and Ridge Regression Methods. According to the results obtained, the output elasticity of human capital is higher than the output elasticity of physical capital. For the period in question, while physical capital output elasticity showed a stable increase from 0.415 to 0.494; human capital output elasticity significantly rose from 1.235 to 1.839. The elasticity of substitution between physical capital and human capital, on the other hand, slightly deviated downward from 1 level. This means that there is a serious substitution relationship between the two factors. These factors also have an important complementarity relationship.

Haepp and Lin (2017) investigated how the minimum wage affects human and physical capital investments of firms, based on the panel data set consisting of Chinese public and private sector companies and covering the period between 2000 and 2007. According to the results of the regression estimation using Dynamic Panel Data Analysis, while the Chinese minimum wage policy decreased human capital investments, it didn't cause a change in physical capital investment rates.

Geng et al (2017) used the Baseline Regression Method in their study covering Chinese manufacturing companies for the period 1998-2008. According to the findings, the capital-labor substitution hypothesis was confirmed. When there is a negative workforce shock, firms move away from the old labor-intensive working model and adopt a new capital-intensive working model. Thus, minimum wage increases direct firms to more fixed capital and technology investments to offset the increased labor costs resulting from higher wages.

Garcia - Macia (2020) conducted Panel Data Analysis at micro and macro level for the Italian economy for the period between 2003 and 2017. According to the analysis results, in Italy, there has been a reduction in fixed capital formation as rising labor costs restrict returns on capital and firm profits. The reached empirical findings support this result both at the Firm-Sector level and at the macro level.

Econometric Analysis

Data Set and Variables Used in the Study

In this study that the effect of the efficiency and cost of the labor factor on physical capital investments is examined; sample countries studied are consists of 22 European Union member countries including Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Slovakia, Spain, Sweden, Estonia, Latvia, Lithuania, Slovenia and additionally Turkey. Annual data for the period between 2006 and 2019 were used in the analysis.

Some restrictions were effective in determining the data set in this way. In other words, when the time dimension is wanted to be increased, the number of units lost increases. In the case of increasing the unit size, countries with a loss of observation for some years lead to a further narrowing of the time dimension. For this reason, care was taken to make the most optimal choice while determining the unit and time size in the data set. In addition, because it causes some problems, high time dimension is not a desired situation in the Dynamic Panel Data Analysis method used in the estimation of the models in the study. That's why,

considering the number of units, it can be said that the 14 year time dimension is at a reasonable level. All data used in the study were obtained from the World Bank (The World Development Indicators) and OECD databases. (Dependent variable "capital" was obtained from the World Bank database and the independent variables "cost and hour" were obtained from the OECD database.)

Variables used in the analysis.

- The Dependent Variable:
  - **capital:** *Rate of Gross Fixed Capital Formation in GDP (%)*

(It implies that infrastructure investments, machinery and equipment purchases and the expenditure for facility, residence, building, school, hospital, road-railway construction etc.)

- The Independent Variables:
  - **cost:** *Labor Unit Cost per Employee (2015=100)*

(It is defined as the average labor cost of output per unit produced. It can be expressed as the ratio of total labor cost per hour worked to output per hour worked.)

  - **hour:** *GDP per Hour Worked (2015=100)*

(It reflects not only efficiency in terms of workers' personal capacities or the intensity of their efforts, but also of the existence or using of other inputs such as capital, intermediate inputs, economies of scale.)

  - **crisis:** *Dummy Variable Representing the 2008 Global Financial Crisis*

After logarithmic transformations, all variables were included in the model.

Method

In this study, The Autoregressive Panel Data Model, which is one of the dynamic panel data models, was used. The lagged value or values of the dependent variable are taking part in as the independent variable or variables in these models.

The notation of the Autoregressive Panel Data Model with a one lag is as follows.

$$Y_{it} = \delta Y_{it-1} + \beta X_{it}^{'} + \mu_i + u_{it} \tag{1}$$

Two different estimators were used in model estimation. The first of these; It is Arellano and Bond's (1991) Two-Stage Generalized Moments Estimator (GMM). The second one is the Arellano-Bover (1995) / Blundell-Bond (1998) Two-Stage System GMM Estimator. This estimator takes the difference of the mean of all possible future values of a variable by using the "orthogonal deviations" transformation method instead of the first difference transformation and thus, minimizing the data loss caused by the first difference transformation, especially in unbalanced panel data sets. In both models, the Two-Stage GMM Estimator was carried out by using the small sample correction suggested by Windmeijer (2005). The reason why using Two Stage GMM is because it corrects One Stage GMM Estimators against autocorrelation and heteroscedasticity (White 1980). The reason for using the robust standard errors of Windmeijer (2005) is the standard errors obtained from the Two-Stage GMM is significantly downward deviation. Thus, standard errors are corrected. The Two-Stage System GMM Estimator was applied using the command developed for Stata by Roodman (2006). (Yerdelen Tatoğlu, 2018, p. 113-143).

Empirical Findings

Primarily, the functional form of the model, which is estimated, is as follows.

$$lncapital_{it} = \beta_0 + \beta_1 lncapital_{it-1} + \beta_2 lncost_{it} + \beta_3 lnhour_{it} + \beta_4 crisis_{it} \tag{2}$$

Summary statistics of the variables used in the model are shown in Table 1.

Table 1. Summary Statistics of Variables

Variable	Observation	Mean	Std. Dev.	Min. Value	Max. Value
cost (lncost)	322	98.31979 (4.580663)	12.02026 (0.124687)	50.35987 (3.919195)	168.0545 (5.124289)
hour (lnhour)	322	97.32402 (4.574967)	7.448514 (0.079798)	67.55837 (4.212992)	118.1781 (4.772193)
capital (lncapital)	322	22.06737 (3.076302)	4.213517 (0.189869)	11.07356 (2.404561)	43.43991 (3.771379)

** Values in parentheses are the post-logarithmic values of the variables.*

When the minimum, maximum and average values and standard deviations of the variables in the raw state and after the logarithmic transformation are examined, it stands out that the difference between the minimum and maximum values of all three variables decreases with the logarithmic transformation. In addition, since two of the variables are index values, it was considered more appropriate to include the variables in the model by subjecting them to logarithmic transformation to facilitate interpretation. Then, the model converted into full logarithmic form was estimated.

Table 2. Arellano-Bond Two - Stage GMM Estimation Results

AR(1)	AR(2)	Sargan Test	Number of Obs.	Wald chi2(4)
-2.4016	-1.4938	17.07706	276	176.26
(0.0163)	(0.1352)	(0.1056)		(0.0000)

lncapital	Coefficient Values	Robust Standard Errors	z statistics	p > |z|
lncapital L.1	1.021543	0.0962547	10.61	0.000
lncost	-0.3067865	0.108758	-2.82	0.005
lnhour	0.6592181	0.2223976	2.96	0.003
crisis	-0.0494242	0.0219546	-2.25	0.024
constant coef.	-1.673371	0.7035909	-2.38	0.017

** Values in parentheses are the probability values of the tests.*

According to the results of the Arellano-Bond Two-Stage GMM Estimator which is used 16 instrumental variables; the lagged variable, labor unit cost per employee, GDP per hour worked, and the 2008 global financial crisis dummy variable are statistically significant at 95% confidence level in explaining the change on gross fixed capital formation. The Wald Test, which tests the significance of the model, shows that the model is generally significant. According to the Sargan Test result, which tests whether the instrumental variables used in the model are valid, over definition restrictions are valid. This means that the instrument variables used are valid. According to the Arellano-Bond Autocorrelation Test results, while there is first-order negative autocorrelation, there is no second-order autocorrelation. While the effects of other variables are constant, every 1% increase in the unit cost of labor per worker reduces the share of gross fixed capital formation in GDP by 0.30%. Every 1% increase in GDP per hour worked increases the share of gross fixed capital formation in GDP by 0.66%, with the effect of other variables constant. In 2008, 2009 and 2010, when the 2008 global financial crisis was effective, the share of gross fixed capital formation in GDP was 4.94% less than in other years without the crisis. In the case where all independent variables are zero, the share of gross fixed capital formation in GDP is about 19%.

Table 3. Arellano-Bover / Blundell-Bond Two Stage System GMM Estimation Results

AR(1)	AR(2)	Robust Hansen Test	Number of Obs.	Wald chi2(4)
-2.37	-1.45	19.57	299	446807.62
(0.018)	(0.147)	(0.076)		(0.0000)

lncapital	Coefficient Values	Robust Standard Errors	z statistics	p > |z|
lncapital L.1	0.8765107	0.1096395	7.99	0.000
lncost	-0.1535317	0.0422192	-3.64	0.000
lnhour	0.2437427	0.0739912	3.29	0.001
crisis	-0.0546803	0.0160024	-3.42	0.001
constant coef.	-0.0230196	0.4682661	-0.05	0.961

****** Values in parentheses are the probability values of the tests.*

According to the results of the Arellano-Bover / Blundell-Bond Two-Stage System GMM Estimator which is used 17 instrumental variables; the lagged variable, labor unit cost per employee, GDP per hour worked, and the 2008 global financial crisis dummy variable are statistically significant at 95% confidence level in explaining the change on gross fixed capital formation. The Wald Test, which tests the significance of the model, shows that the model is generally significant. According to the Robust Hansen Test result, which tests whether the instrumental variables used in the model are valid, the model includes over definition restrictions. This means that the instrument variables used are valid. According to the Arellano-Bond Autocorrelation Test results, while there is first-order negative autocorrelation, there is no second-order autocorrelation. With the effects of other variables constant, every 1% increase in the unit cost of labor per worker decreases the share of gross fixed capital formation in GDP by 0.15%. While the effects of other variables are constant, every 1% increase in GDP per hour worked increases the share of gross fixed capital formation in GDP by 0.24%. In 2008, 2009 and 2010, when the 2008 global financial crisis was effective, the share of gross fixed capital formation in GDP was 5.46% less than in other years without the crisis. The constant parameter was not interpreted because it was not statistically significant.

If attention, the results of the two tests are parallel to each other. While the parameter estimates are different, the direction of the relationships is the same for both estimators. As a result, the GDP per hour worked variable, which is included in the model as a labor efficiency measure, has a positive effect on gross fixed capital formation. On the other hand, as a measure of labor cost, the unit cost of labor per employee and the 2008 global financial crisis variables in the model affect negatively.

Conclusion and Suggestions

According to the results acquired from the model estimated using the Dynamic Panel Data Analysis Method; it has been determined that all independent variables added to the model have statistically significant relationships with the dependent variable of the model. In this section, it will be focused on what these relations mean economically.

Firstly, the own lagged value of the dependent variable is significant in explaining the dependent variable, implies that physical capital investments are affected by past physical capital investments. It would be useful to explain in a little more detail how this effect is realized through the efficiency and cost of labor. The firm's ability to increase production in the short term depends on increasing the amount of labor which is the variable factor. However, existing physical capital capacity limits labor growth. After a while, every additional worker leads to the law of diminishing returns and efficiency drops. The firm, at this stage, aims to increase the amount of physical capital per worker by increasing its physical capital investments and efficiency rises again. But, over time, when the firm wants to increase production again, it will increase the amount of labor again in the short run, and the amount of labor that exceeds the existing physical capital capacity will begin to reduce the efficiency of each additional worker employed again. The firm, which has experienced a similar situation before and exceeds that by increasing its physical capital investments, will act in the same way again. Thus, the efficiency-enhancing effect of physical capital investments in the past will have triggered today's physical capital investments.

Since physical capital investments made in the past provide a decrease in today's costs with the effect of positive scale economies, this triggers the expectations that today's investments will also reduce future costs and so physical capital investments increase. The relationship of the dependent variable with labor efficiency and cost through its own lag can be explained in this way. However, it will not be sufficient to explain the labor efficiency issue, which has a positive effect on physical capital investments, only through the lagged value of the dependent variable.

Since physical capital investments increase as labor efficiency increases, factors that will increase labor efficiency should also be mentioned. Factors such as human capital and technology are at the forefront of these. It is of great importance that these two factors are considered together and evaluated as priority economic policies. Because physical capital investments, human capital accumulation and technological development are parts of an inseparable whole in today's economies. It is recommended that policy makers take long term policy decisions by considering these issues.

Whereas the cost of labor acts as a deterrent to physical capital investments. Except for the costs caused by the law of diminishing returns that arise with the hiring of workers above the physical capital stock, wages and salaries paid to the labor force are the main cost elements of labor. Employment policies to be implemented should be arranged in a way to alleviate the deterrent effect of wages on investments. Expansionary monetary and fiscal policies provide higher employment rates. In this case, wages fall in the labor market and the inflationary environment resulting from expansionary policies adversely affects the real purchasing power of the labor force contracting at nominal wages. Therefore, policy decisions should be taken by considering together the deterrent effect of high wages and the real purchasing power of the workforce.

Finally, it was determined that the effects of the 2008 global financial crisis on the real economy were negative as expected. The implication of this result can be simply expressed as companies facing financial difficulties have to reduce their physical capital investments.

Peer Review: Externally peer-reviewed.
Conflict of Interest: The author has no conflict of interest to declare.
Grant Support: The author declared that this study has received no financial support.

ORCID ID of the author / Yazarn ORCID ID'si

Ali İhsan ÖZTÜRK 0000-0001-6003-5828

REFERENCES / KAYNAKLAR

Altıntaş, H., & Çetintaş, H. (2010). Türkiye'de Ekonomik Büyüme, Beşeri Sermaye ve İhracat Arasındaki İlişkilerin Ekonometrik Analizi 1970-2005. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*(36), 33-56.

Arellano , M., & Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-Compenents Models. *Journal of Econometrics, 68*, 29-51.

Arellano, M., & Bond, S. (1991, April). Some Test of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies, 58*(2), 277-297.

Berber, M. (2006). *İktisadi Büyüme ve Kalkınma* (3 b.). Trabzon: Derya Kitabevi.

Berndt, E., Morrison, C., & Rosenblum, L. (1995, January). High-Tech Capital Formation and Labor Composition in U.S. Manufacturing Industries: An Exploratory Analysis. *Journal of Econometrics, 65*(1), 9-43.

Bilgili, Y. (2017). *Mikro İktisat* (12 b.). İstanbul: 4T yayınevi.

Blundell, R., & Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics, 87*, 115-143.

Çetin, M. (2012). Sabit Sermaye Yatırımları ve Ekonomik Büyüme: Ampirik Bir Analiz. *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi, 7*(1), 211-230.

arcia-Macia, D. (2020, February). Labor Costs and Corporate Investment in Italy. *IMF Working Paper No. 20/38*.

Geng, H., Huang , Y., Lin, C., & Liu, S. (2017). Minimum Wage and Corporate Investment: Evidence from Manufacturing Firms in China. *Journal of Financial and Quantitative Analysis*.

Greenlaw, S., & Shapiro, D. (2011). *Principles of Macroeconomics 2e*. Houston, Texas: Openstax Rice University.

riliches, Z. (1969, November). Capital-Skill Complementarity. *The Review of Economics and Statistics, 51*(9), 465-468.

Haepp, T., & Lin, C. (2017, November). How Does the Minimum Wage Affect Firm Investments in Fixed and Human Capital? Evidence from China. *Review of Development Economics, 21*(4), 1057-1080.

Hsin, P.-L., Haepp, T., & Tsai, M.-Y. (2015). Mandated Benefits, Labor Costs, and Company Fixed Capital Investments. *Journal of Applied Economics*(97), 55-83.

Karagül, M. (2014). Kalkınma Sürecinde Üretim Faktörlerinin Yeniden Tanımlanması. *Leges Hukuk ve Araştırmalar Dergisi Yıl 1 Sayı 1*(1), 1-11.

Kibritçioğlu, A. (1998, Ocak-Aralık). İktisadi Büyümenin Belirleyicileri ve Yeni Büyüme Modellerinde Beşeri Sermayenin Yeri. *AÜ Siyasal Bilgiler Fakültesi Dergisi, 53*(1-4), 207-230.

opez-Bazo, E., & Moreno, R. (2008, November). Does Human Capital Stimulate Investment in Physical Capital? Evidence from A Cost System Framework. *Economic Modelling, Elsevier, 25*(6), 1295-1305.

Lucas, R. (1988). On The Mechanics of Economic Development. *Journal of Monetary Economic*(22).

Özsağır, A. (2008). Dünden Bugüne Büyümenin Dinamiği. *Karamanoğlu Mehmetbey Üniversitesi Sosyal ve Ekonomik Araştırmalar Dergisi, 2008*(1), 332-347.

Parasız, İ. (2003). *Ekonomik Büyüme Teorileri* (2 b.). Bursa: Ezgi Kitabevi.

Rebelo, S. (1991). Long-Run Policy Analysis and Long-Run Growth. *Journal of Political Economy*(99).

Romer, P. (1994). The Origins of Endogenous Growth. *The Journal of Economic Perspectives, 8*(1), 3-22.

Roodman, D. (2006, December). How to Do xtabond2: An Introduction to "Difference" and "System" GMM in Stata. *Center for Global Development Working Paper No. 103*, 86-136.

Solow, R. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics, 70*(1), 65-94.

Solow, R. (1957). Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics, 39*(3), 312-320.

Songur, M. (2017). Türkiye'de Beşeri Sermaye ve Fiziksel Sermaye Arasındaki İkame Olanakları: Translog Üretim Fonksiyonu Yaklaşımı. *Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 7*(2), 201-224.

Songur, M. (2017). Türkiye'de Beşeri Sermaye ve Fiziksel Sermaye Arasındaki İkame Olanakları: Translog Üretim Fonksiyonu Yaklaşımı. *Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 7*(2), 201-224.

Taban, S., & Kar, M. (2006). Beşeri Sermaye ve Ekonomik Büyüme Nedensellik Analizi, 1969-2001. *Anadolu Üniversitesi Sosyal Bilimler Dergisi, 6*(1), 159-182.

White, H. (1980, May). A Heteroskedasticity-Consistent Covariance Matrix Estimator and A Direct Test for Heteroskedasticity. *Econometrica, 4*, 817-838.

Windmeijer, F. (2005). A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators. *Journal of Econometrics, 126*(1), 25-51.

Yerdelen Tatoğlu, F. (2018). *İleri Panel Veri Analizi Stata Uygulamalı*. İstanbul: Beta Basım Yayım Dağıtım A.Ş.

How Cite This Article / Atıf Biçimi

Ozturk, A. I. (2024). The effect of efficiency and cost changes in labor factor on physical capital ınvestments: dynamic panel data analysis. *Sosyal Siyaset Konferansları Dergisi*, 86, 18-25. https://doi.org/10.26650/jspc.2023.86.1358696