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Educational Expansion and Economic Growth Nexus in Pakistan: Instrumental Variable Approach

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Abstract

This study examines the relationship between economic growth and the expansion of education in Pakistan. The study utilizes 2SLS and GMM estimators to estimate the growth equations with a potential issue of endogeneity using data for the period 1973-2018. Empirical results show that educational expansion at the primary and secondary level effect economic growth positively. The evidence is quite compelling that the effect of educational expansion on economic growth is low due to the poor quality of education. Also, the lower effect of physical capital is due to lower human capital embodied in the labor force.

Keywords: human capital; economic growth; GMM; Endogeneity; Pakistan.

JEL Classification*:* O47, I21, C26

1. Introduction

Education has become an indispensable tool for sustainable development. Its role is more profound and broad which is recognized for sustainable development goals (Sterling, 2016).

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Education is necessary for a country to have a knowledge-based economy. Endogenous growth models acknowledge education as a major element of human capital. Education is recognized as one of the most significant investments in human capital among all the factors influencing human capital. This investment improves the mental ability of people and increases their productivity. The importance of education as a critical input for human development has been underlined by several economists in the literature on human capital (e.g. Schultz, 1961; Barro, 1991: Mankiw, et al., 1992: Barro & Lee 2013; Benos & Zotou, 2014).

Neoclassical growth models did not pay much attention to education as input for economic growth. The new growth theory offer explanations on how educational expansion is imperative to economic growth (Aghion & Howitt, 1992; Lucas, 1988; Romer, 1990; Romer, 1986). In the existing empirical literature, a positive relationship between education and economic growth is reported by the studies (e.g. Lin 2003; Islam, et al., 2007; Pink-Harper, 2015; Teixeira & Queirós, 2016; Yu, et al., 2017; Siddique, et al., 2018). However, despite the strong theoretical basis for the effect of education on economic growth, some studies do not find a significant positive relationship between education and economic growth. The results of these studies show inconsistency in the findings (e.g. Benhabib & Spiegel 1994; De-Meulemeester & Rochat, 1995). This contradiction in results may be due to two reasons. Firstly, it has been identified that studies employ inadequate econometric estimation techniques which leads to spurious results (see Bils & Klenow, 2000; Jones, 1995; Loaning, 2005). Most importantly, the issue of endogeneity of independent variables in growth regression. Secondly, these studies are confined to use cross-country data of heterogeneous nature (Pritchett, 2001; Temple, 2001; Sial, et al., 2018).

In light of the above-mentioned limitations, the present study concentrates on these deficiencies in the existing empirical literature and chooses a research design that can handle such issues. Motivated by this interest, this study investigates the role of educational expansion in Pakistan's economic growth by considering the endogeneity issue and using time series data for estimation of empirical growth equations. This adds to the literature

on education and economic growth being one of the few country-specific studies conducted in this area. This study is important as it is one of the few studies which identify the shortcomings of using conventional techniques as it implements 2SLS and GMM to examine the link between economic growth and educational expansion in the context of Pakistan. Moreover, it is imperative to investigate this relationship as this would inform us about impact of educational policy.

The rest of the study proceeds as follows: the literature review is discussed in section 2. Section 3 outlines empirical models and the econometric methodology. The results of empirical growth equations are presented in section 4. The conclusion of the study is given in section 5.

2. Literature Review

A considerable number of studies have examined relationship between education and economic growth using time series data. Lin (2003) revealed that education has a positive and significant effect on economic growth in Taiwan. In a time series analysis for Guatemala, Loaning (2005) studied the relationship between education and economic growth for the period 1951-2002. The results showed that the educated labor force was positively related to economic growth. In another study, Lin (2006) proposed an alternative measure of education for the estimation of an empirical growth model. The results revealed a positive impact of education on economic growth at all levels of education during 1964-2000. Islam, et al. (2007) studied the relationship between education and growth for Bangladesh. The results showed long-run relationship between the variables for the period 1976-2003. Pradhan (2009) looked into the causal relationship between education and economic growth in India for the period 1951-2001. The finding of the study indicated the existence of a relationship between economic growth and education in long run. In a recent study, Dauda (2010) carried out an empirical investigation to find the association between education and economic growth in Nigeria for the period 1977-2007. Empirical results confirmed the long-run relationship between education and economic growth.

Ganegodage and Rambaldi (2011) examined relation of education with economic growth for 1959–2008 period in Sri Lanka

and found a positive significant relationship. Mercan and Sezer (2014) found that a direct association of public educational expenditures and economic growth for Turkey from 1970 to 2012. Hassan and Cooray (2015) showed that the education of males and females have positive externality effects for economic growth for Asian economies. They suggested that Asian countries may grow faster by investing in the education of girls. Teixeira and Queirós (2016) reported that education's interaction with the structural change of the economy is critical for economic growth. However, the intensity of the relationship depends on the country and time considered for analysis. This effect is positive for OECD countries for the period 1960–2011 while the relationship is negative for transition and Mediterranean countries during 1990–2011. Moreover, education itself has a positive and significant impact on economic growth in these countries. More recently, Woo, Kim, and Lim (2017) estimated the effect of education on economic growth in South Korea in different regions using data for the period 1997-2009 and reported that education is positively related to economic growth in the regions. Liao, et al. (2019) explored the relationship of investment in education and sustainable economic growth using panel data of 21 cities of Chinese province Guangdong. The results indicate causality between education and sustainable economic growth and education has a positive and significant impact on sustainable economic growth.

In Pakistan, attempts have been made to identify the role of education for economic growth. For example, Abbas and Foreman-Peck (2008) investigated the relationship between economic growth and education for the period 1960-2000. The results of the study showed that human capital has a critical role in boosting the economy's capacity to absorb technological progress. Chaudhary, et al. (2009) examined the relationship of economic growth and higher education in Pakistan, for the period 1972-2005. The empirical results implied that higher education and economic growth have long run relationship but it was not significant. Qazi, et al. (2014) investigated the link between higher education and economic growth and found a positive of higher education on economic growth. Moreover, using data for the period 1972-2010, Afzal et al. (2012) found a positive relationship between education and

economic growth. These are the few studies from the literature on economic growth that used time series data.

Contrary to the verification of the above studies, the direction of causality remained an issue in the literature. That is, 'does a higher education level lead to higher GDP' or 'higher GDP leads to higher education'. Bils and Klenow (2000) argued that higher incomes allow nations to achieve higher levels of education. Islam et al. (2007) reported a bidirectional causality between education and GDP. Stengos and Aurangzeb (2008) indicated that primary education had no causal impact on growth while secondary as well as tertiary education had a strong causal impact on economic growth. The only primary enrollment rate for females had a significant effect on economic growth. Chaudhary et al. (2009) showed causality from economic growth to higher education but higher education did not cause economic growth. Pradhan (2009) reported uni-directional causality from economic growth to education but not from education to economic growth. Liao et al., (2019) reported two-way causality between education and sustainable economic growth in short run while there is uni-diresctional causality that runs from education to sustainable economic growth in long run in China.

Despite a strong theoretical basis for the effect of education on economic growth, some authors have noted a failure to detect a significant positive effect of human capital on economic growth (e.g. Barro & Sala-i-Martin, 1995; Bils & Klenow, 2000; Benhabib & Spiegel, 1994; Pritchett, 2001). However, Krueger and Lindahl (2001) argued that this failure may be attributed to improperly formulate econometric specifications.

Another strand of literature has focused upon the use of proxies for education and the role of outliers in growth regressions. For example, Cohen and Soto (2007) explain that the difference in results is due to usage of different proxy variables for education in growth regressions. The reason for this is that there is no clear-cut definition of human capital. They also highlighted that quality data is an additional problem faced by these studies. Moreover, Krueger and Lindahl (2001) emphasized on measurement errors of proxy variables for education, hence their estimated effect on economic growth. Temple (1999) discussed the role of outliers as a potential

cause for the significance of schooling. He provided evidence that the effect of schooling increases and becomes significant if some outliers are dropped from the data utilized by Benhabib and Spiegel (1994). Similarly, Temple (1998) has shown that the education variable in Mankiw et al. (1992) regressions may be significant because of some outliers in the data. Contrary to (Temple, 1998,1999; Cohen & Soto, 2007) have shown that the significant impact of education is not due to the presence of outliers.

3. Methodology

Empirical Models

Two growth equations are specified to investigate the relationship between economic growth and educational expansion, which is based on the growth model of Mankiw et al. (1992). Various functional forms of growth model are used to estimate the relationship between economic growth and education in the empirical literature. That is, these functional forms consider different proxy variables for education e.g. education index, gross enrollment ratio at primary or secondary level, which depends on availability of data. Therefore, to capture the effect of educational expansion at primary and secondary on economic growth, the following equations have been estimated

$$\boldsymbol{Y_t = \beta_0 + \beta_1 K_t + \beta_2 L_t + \beta_3 PRI_t + u_t} \quad (\mathbf{1})$$

$$\boldsymbol{Y_t = \delta_0 + \delta_1 K_t + \delta_2 L_t + \delta_3 SEC_t + e_t} \quad (\mathbf{2})$$

where,

Y is real GDP in million (constant 2010 US$) and it is a proxy variable for economic growth.

K represents real gross fixed capital formation in million (constant 2010 US$) and it is a proxy variable for physical capital.

L represents the total number of employed persons in million and it is a proxy variable for labor force.

PRI and ***SEC*** are the number of enrolled students in thousands at the primary and secondary levels, respectively. ***PRI*** and ***SEC*** are proxy variables for educational expansion.

All the variables are used in their logarithmic forms. Time series data for the period of 1973-2018 have been used. The main data sources are the Handbook of Statistics on Pakistan Economy by state

bank of Pakistan (2015), World Development Indicators (2018), and various issues of Economic Surveys of Pakistan.

Econometric Methods

We know theoretically that factors of production (e.g. L, K, or human capital) affect economic growth by production of goods and services. Economic growth in turn affects demand for these factors of production. That is, dependent and independent variables are determined jointly. Moreover, other variables also affect independent variables that are not included in the growth equations. Therefore, growth equations have a potential issue of endogeneity. The study utilized Two Stage Least Squares (2SLS hereafter) and Generalized Method of Moments (GMM) estimators to estimate the growth equations. In doing so, lags of variables are used to circumvent the problem of endogeneity in time series analysis e.g. first lag of dependent variable and lags of physical capital. Two important diagnostic tests are implied to evaluate the stability of the model. Durbin-Wu-Hausman (DWH) Test is utilized to test the endogeneity of independent variables. The test statistic has a Chi-square distribution with number of independent variables tested for endogeneity as degree of freedom. The null hypothesis is that independent variables are exogenous. The validity of instruments is tested using J-Statistic, it tests the null hypothesis that instruments are valid. J-Statistic has a Chi-square distribution with number of over-identifying restrictions as degree of freedom.

4. Results and Discussion

Table 1 presents the summary statistics of variables namely means, median, maximum, minimum, standard deviation, skewness, kurtosis, Jarque- Bera test, and their probability values. For most of the variables, the mean and median are approximately equal while the standard deviation ranges from 0.16 to 0.30 which is very small. Measure for skewness shows that distributions of variables are not skewed. Moreover, values of Jarque-Bera statistics and its probability values indicate that all the variables are normally distributed.

The 2SLS and GMM estimates of the first growth equation is presented in Table 2. This equation is based on primary education. All estimates are with expected signs and are highly significant. The physical capital, labor force, and primary education have a

significant positive impact on real GDP in Pakistan. The coefficients may be interpreted as elasticities of output with respect to inputs because dependent and independent variables are in log form. The findings are consistent with economic theory.

Table 1: Summary Statistics

	Y	*K*	*L*	*PRI*	*SEC*
Mean	4.970479	4.222921	1.576577	4.038895	3.089467
Median	5.010324	4.281983	1.548283	4.071067	3.171299
Maximum	5.405176	4.565559	1.864716	4.359570	3.585461
Minimum	4.473641	3.790229	1.314796	3.648360	2.591065
SD	0.273971	0.204470	0.164619	0.226351	0.308270
Skewness	-0.267478	-0.555938	0.161211	-0.316260	-0.058652
Kurtosis	1.937384	2.396938	1.828439	1.637889	1.660712
Jarque-Bera	2.712717	3.066571	2.829979	4.322904	3.464284
P-value	0.257597	0.215825	0.242928	0.115158	0.176905

GMM estimate shows that one percent increase in primary enrollment brings 0.25 % increase in real GDP whereas 2SLS estimate reports 0.30 % rise in real GDP. This result supports the idea of (Becker, et al., 1990; Barro, 1991). Similarly, this finding is in line with the findings of previous studies (for example Lin, 2006; Loening, 2005; Self & Grabowski, 2004; Pegkas, 2014; Mariana, 2015; Kotásková 2018).

The 2SLS estimates indicate that a 1 % increase in real gross fixed capital formation results in 0.52 percent increase in real GDP while GMM estimate is somewhat higher i.e. 0.56. Both 2SLS and GMM estimates indicate that a 1 % increase in the employed labor force increases real GDP by 0.63 percent. The lower panel of Table 2 reported two important diagnostic tests to evaluate the stability of the model. The DWH statistics for 2SLS and GMM show that null hypothesis that independent variables are exogenous is rejected. J-Statistic values show instruments are valid as we accept the null hypothesis.

Table 2: 2SLS and GMM Estimates of Growth Equation 1
Dependent Variable: LnY (log of GDP)

Variable	2SLS	GMM
Constant	0.54**	0.57*
	(4.14)	(2.55)
K	0.52**	0.56**
	(6.65)	(4.59)
L	0.63**	0.63**
	(8.43)	(6.74)
PRI	0.30**	0.25*
	(3.42)	(2.23)
R-square	0.9952	0.9951
Adj-R-square	0.9949	0.9947
F-Stat	2750	
p-value	[0.000]	
J-Stat	3.23	3.16
p-value	[0.72]	[0.75]
DWH Test	26.27	24.22
p-value	[0.000]	[0.000]

Notes: t-statistics are in parentheses and p-values are in brackets;
*significant at 5%, **significant at 1%

To find out the effect of educational expansion at the secondary level on economic growth, the study estimates the same model by replacing primary education with secondary education as in equation 2. The 2SLS and GMM estimates of growth equation 2 are presented in Table 3. The estimated relationship reveals that educational expansion does not alter its long-run elasticity if secondary education is used as an explanatory variable instead of primary education in the case of 2SLS estimate i.e 0.30. Whereas, GMM estimate is somewhat higher that is one percent increase in secondary enrollment results in 0.31 percent increase in real GDP. This finding follows (Mankiw et al., 1992; Petrakis & Stamatakis, 2002; Gylfason & Zoega, 2003; Leoning, 2005; Lin, 2006; Mariana, 2015; Ali, 2017; Kotásková, 2018; Marquez-Ramos & Mourelle, 2019).

Both 2SLS and GMM coefficients on physical capital are positive and highly significant if secondary education is used as an

explanatory variable. Moreover, the effect of labor force on real GDP is lower, both 2SLS and GMM estimates show that the employed labor force has a similar effect on real GDP i.e. 0.42 percent. The results support the findings of previous studies by (Self & Grabowski, 2004; Chaudhary et al., 2009). The lower panel of Table 3 reported DWH statistics and J-Statistic for 2SLS and GMM models. They show that null hypothesis that independent variables are exogenous is rejected and instruments are valid.

Table 3: 2SLS and GMM Estimates of Growth Equation 2
Dependent Variable: LnY (log of GDP)

Variable	2SLS	GMM
Constant	1.01**	1.05**
	(4.02)	(3.71)
K	0.56**	0.54**
	(5.55)	(4.80)
L	0.42**	0.42*
	(2.71)	(2.10)
SEC	0.30*	0.31*
	(2.54)	(2.23)
R-square	0.9926	0.9927
Adj-R-square	0.9921	0.9921
F-Stat	1728	
p-value	[0.000]	
J-Stat	0.17	0.49
p-value	[0.89]	[0.82]
DWH Test	33.73	6.65
p-value	[0.000]	[0.084]

Notes: t-statistics are in parentheses and p-values are in brackets;
*significant at 5%, **significant at 1%

5. Conclusion

The study estimated the relationship between economic growth and educational expansion at the primary and secondary levels. The analysis shows that educational expansion has a positive effect on economic growth. This tends to support the notion that human capital accumulation leads to a higher rate of economic

growth. However, its effect on economic growth is low. The possible reason for this is that the quality of education is so low that year of schooling creates low human capital and it does not raise cognitive skills or productivity. In addition, Pakistan's fragmented educational system is the main reason for low educational status, which has formed some intractable problems in the optimal utilization of human resources. Moreover, the possible reason for the low impact of physical capital on economic growth is the complementarity of physical capital with education which is of low quality.

Educational expansion can promote the economic growth of Pakistan. Expenditure on education will improve the quality of education and will boost efficiency and productivity. Moreover, the education system requires a thorough review and particularly, the amendment of the current curriculum to improve the quality of education at all levels. The curriculum should be reviewed to make it more relevant to the needs of the job market.

It is well understood that all type of education raises cognitive skills. So, the implication of low or poor past returns from education in a perverse policy environment is not "do not educate your people" but rather reform your system of education so that investment in education will pay off better in the future. Moreover, future empirical studies should estimate a measure of quality of education and investigate its impact on economic growth. This direction should be of interest in future research on education and economic growth nexus.

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References

Abbas, Q., & Foreman-Peck, J. S. (2008). Human capital and economic growth: Pakistan 1960-2003. *Lahore Journal of Economics*, *13*(1), 1−27. http://orca.cf.ac.uk/id/eprint/40496

Afzal, M., Malik, M. E., Begum, I., Sarwar, K., & Fatima, H. (2012). Relationship among education, poverty and economic growth in Pakistan: An econometric analysis. *Journal of Elementary Education*, *22*(1), 23−45.

Aghion, P., & Howitt, P. (1992). A model of growth through creative destruction. *Econometrica, 60*(2), 323−351.

Ali, A. (2017). Relationship between female secondary education and economic growth of Pakistan. *Sarhad Journal of Management Sciences*, *3*(1), 22−35. http://journal.suit.edu.pk/index.php/sjms/article/view/55

Barro, R. J., & Sala-i-Martin, X. (1995). *Economic Growth.* McGraw-Hill.

Barro, R. J. (1991). Economic growth in a cross section of countries. *The Quarterly Journal of Economics*, *106*(2), 407−443. https://doi.org/10.2307/2937943

Barro, R. J., & Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, *104*, 184−198. https://doi.org/10.1016/j.jdeveco.2012.10.001

Becker, G. S., Murphy, K. M., & Tamura, R. (1990). Human capital, fertility, and economic growth. *Journal of Political Economy*, *98*(5), S12−S37.

Benhabib, J., & Spiegel, M. M. (1994). The role of human capital in economic development evidence from aggregate cross-country data. *Journal of Monetary Economics*, *34*(2), 143−173. https://doi.org/10.1016/0304-3932(94)90047-7

Benos, N., & Zotou, S. (2014). Education and economic growth: A meta-regression analysis. *World Development*, *64*, 669−689. https://doi.org/10.1016/j.worlddev.2014.06.034

Bils, M., & Klenow, P. J. (2000). Does schooling cause growth? *American Economic Review*, *90*(5), 1160−1183.

Chaudhary, A. R., Iqbal, A., & Gillani, S. Y. M. (2009). The nexus between higher education and economic growth: An empirical investigation for Pakistan. *Pakistan Journal of Commerce and Social Sciences*, *3*, 1−9.

Cohen, D., & Soto, M. (2007). Growth and human capital: Good data, good results. *Journal of Economic Growth*, *12*(1), 51−76.

Dauda, R. O. S. (2010). Investment in education and economic growth in Nigeria: An empirical evidence. *International Research Journal of Finance and Economics*, *55*(10), 158−169.

De Meulemeester, J. L., & Rochat, D. (1995). A causality analysis of the link between higher education and economic development. *Economics of Education Review*, *14*(4), 351−361. https://doi.org/10.1016/0272-7757(95)00015-C

Ganegodage, K. R., & Rambaldi, A. N. (2011). The impact of education investment on Sri Lankan economic growth. *Economics of Education Review*, *30*(6), 1491−1502. https://doi.org/10.1016/ j.econedurev.2011.08.001

Gylfason, T., & Zoega, G. (2003). Education, social equality and economic growth: a view of the landscape. *CESifo Economic Studies*, *49*(4), 557−579. https://doi.org/10.1093/cesifo/49.4.557

Hassan, G., & Cooray, A. (2015). Effects of male and female education on economic growth: Some evidence from Asia. *Journal of Asian Economics*, *36*, 97−109. https://doi.org/10.1016/j.asieco.2014.09.001

Islam, T. S., Wadud, M. A., & Islam, Q. B. T. (2007). Relationship between education and GDP growth: A multivariate causality analysis for Bangladesh. *Economics Bulletin*, *3*(35), 1−7.

Jones, C. I. (1995). Time series tests of endogenous growth models. *The Quarterly Journal of Economics*, *110*(2), 495−525. https://doi.org/10.2307/2118448

Kobzev Kotásková, S., Procházka, P., Smutka, L., Maitah, M., Kuzmenko, E., Kopecká, M., & Hönig, V. (2018). The impact of education on economic growth: The case of

India. *Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis*, *66*(1), 253−262. https://doi.org/10.11118/actaun201866010253

Krueger, A. B., & Lindahl, M. (2001). Education for growth: Why and for whom?. *Journal of Economic Literature*, *39*(4), 1101−1136.

Liao, L., Du, M., Wang, B., & Yu, Y. (2019). The impact of educational investment on sustainable economic growth in Guangdong, China: a cointegration and causality analysis. *Sustainability*, *11*(3), 766. https://doi.org/10.3390/su11030766

Lin, T. C. (2003). Education, technical progress, and economic growth: the case of Taiwan. *Economics of Education Review*, *22*(2), 213−220. https://doi.org/10.1016/S0272-7757(02)00030-4

Lin, T. C. (2006). Alternative measure for education variable in an empirical economic growth model: Is primary education less important. *Economics Bulletin*, *15*(15), 1−6.

Loening, J. L. (2005). *Effects Of Primary, Secondary, And Tertiary Education On Economic Growth: Evidence From Guatemala, Volume 1 Of 2*. The World Bank.

Lucas Jr, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, *22*(1), 3−42. https://doi.org/10.1016/0304-3932(88)90168-7

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The Quarterly Journal of Economics*, *107*(2), 407−437. https://doi.org/10.2307/2118477

Mariana, D. R. (2015). Education as a determinant of the economic growth. The case of Romania. *Procedia-Social and Behavioral Sciences*, *197*, 404−412. https://doi.org/10.1016/j.sbspro.2015.07.156

Marquez-Ramos, L., & Mourelle, E. (2019). Education and economic growth: An empirical analysis of nonlinearities. *Applied Economic Analysis*, *27*(79), 21−45. https://doi.org/10.1108/AEA-06-2019-0005

Mercan, M., & Sezer, S. (2014). The effect of education expenditure on economic growth: The case of Turkey. *Procedia-Social and Behavioral Sciences*, *109*, 925−930. https://doi.org/10.1016/j.sbspro.2013.12.565

Pegkas, P. (2014). The link between educational levels and economic growth: A neoclassical approach for the case of Greece. *International Journal of Applied Economics*, *11*(2), 38−54.

Petrakis, P. E., & Stamatakis, D. (2002). Growth and educational levels: A comparative analysis. *Economics of Education Review*, *21*(5), 513−521. https://doi.org/10.1016/S0272-7757(01)00050-4

Pink-Harper, S. A. (2015). Educational attainment: An examination of its impact on regional economic growth. *Economic Development Quarterly*, *29*(2), 167−179. https://doi.org/10.1177/0891242414561495

Pradhan, R. P. (2009). Education and economic growth in India: Using error correction modelling. *International Research Journal of Finance and Economics*, *25*(1), 139−147.

Pritchett, L. (2001). Where has all the education gone? *World Bank Economic Review*, *15*(3), 367–391.

Qazi, W., Raza, S. A., & Jawaid, S. T. (2014). Higher education and growth performance of Pakistan: evidence from multivariate framework. *Quality & Quantity*, *48*(3), 1651−1665.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, *94*(5), 1002−1037. https://www.journals.uchicago.edu/doi/abs/10.1086/261420

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, *98*(5, Part 2), S71−S102.

Sarwar, G. (2013). *Education, economic growth and earnings: An econometric analysis for Pakistan* (Unpublished Doctoral Dissertation). Department of Economics, University of Sargodha, Sargodha.

Schultz, T. W. (1961). Investment in Human Capital. *American Economic Review*, *51*(1), 1−17.

Self, S., & Grabowski, R. (2004). Does education at all levels cause growth? India, a case study. *Economics of Education*

Review, *23*(1), 47−55. https://doi.org/10.1016/S0272-7757(03)00045-1

Sial, M. H., Sarwar, G., & Akram, W. (2018). Education and within groups earning inequality in Pakistan. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, *12*(1), 183−197.

Siddique, H., Usman, S., & Ishaq, J. (2018). Financial development and economic growth: The role of energy consumption. *Journal of Quantitative Methods*, *2*(2), 43−55. https://doi.org/10.29145/2018/jqm/020204

Stengos, T., & Aurangzeb, A. (2008). An empirical investigation of the relationship between education and growth in Pakistan. *International Economic Journal*, *22*(3), 345−359. https://doi.org/10.1080/10168730802294677

Sterling, S. (2016). A commentary on education and Sustainable Development Goals. *Journal of Education for Sustainable Development*, *10*(2), 208−213. https://doi.org/ 10.1177/0973408216661886

Teixeira, A. A., & Queirós, A. S. (2016). Economic growth, human capital and structural change: A dynamic panel data analysis. *Research Policy*, *45*(8), 1636−1648. https://doi.org/10.1016/ j.respol.2016.04.006

Temple, J. R. (1998). Robustness tests of the augmented Solow model. *Journal of Applied Econometrics*, *13*(4), 361−375.

Temple, J. (1999). A positive effect of human capital on growth. *Economics Letters*, *65*(1), 131−134. https://doi.org/10.1016/S0165-1765(99)00120-2

Temple, J. R. (2001). Generalizations that aren't? Evidence on education and growth. *European Economic Review*, *45*(4-6), 905−918. https://doi.org/10.1016/S0014-2921(01)00116-7

Lee, M., & Kim, H. (2017). Exploring the organizational culture's moderating role of effects of Corporate Social Responsibility (CSR) on firm performance: Focused on corporate contributions in Korea. *Sustainability*, *9*(10), 1883. https://doi.org/10.3390/su9101883

Yu, H., Lee, H., & Jeon, H. (2017). What is 5G? Emerging 5G mobile services and network

requirements. *Sustainability*, *9*(10), 1848. https://doi.org/10.3390/su9101848

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