Revista de Științe Politice. Revue des Sciences Politiques • No. 76 • 2022: 18 – 33

ORIGINAL PAPER

Impact of Education and Income Inequality on Per Capita Income Amid COVID-19 pandemic

Sumera Arshad[1)], Muhammad Zahid Naeem[2)], Cristi Spulbar[3)], Ramona Birau[4)], Petre Valeriu Ninulescu[5)]

Abstract:
The present research study is an attempt to analyse the effects of various levels of education and income inequality on real GDP per capita, in the COVID-19 pandemic era, including 70 countries. We found empirical evidence that the relationship of various levels of education with growth of real income per capita remained the same in 2020 as it was in 2010, except for the slight difference in the magnitudes of the coefficients. The primary school enrolment of the two decades earlier has revealed as the increasing factor to the income per person. However, when we took a decade early or so values the relationship became converse indicating primary school enrolment as the decreasing factor to the income per capita. The empirics indicated that the secondary school enrolment remained contributing factor to the growth of income per capita, and it is the most effective level of education to increase the real GDP per capita. Moreover, there is no empirical evidence in the favour of relationship between tertiary education and the income per person. The income inequality has also provided insignificant results in our analysis.

Keywords: *economic growth; income inequality; COVID-19 pandemic; social exclusion; poverty; education; income per capita; GDP per capita; human capital.*

[1)] Department of Economics, University of the Punjab, Lahore, Pakistan, Email: ecomaster68@yahoo.com.
[2)] School of Business and Economics, University of Brunei Darussalam, Brunei Darussalam, Email: drmznaeem@gmail.com.
[3)] University of Craiova, Faculty of Economics and Business Administration, Doctoral School of Economic Sciences, Craiova, Romania, Email: cristi_spulbar@yahoo.com.
[4)] University of Craiova, Doctoral School of Economic Sciences, Craiova, Romania, Email: ramona.f.birau@gmail.com.
[5)] Faculty of Economics and Business Administration, University of Craiova, Romania, Email: petre.pregi@yahoo.it

1. Introduction

Solow (1956) and Swan (1956) indicated the effectiveness of labour or the technology as the black box to increase the economic growth (Romer, 2012). These exogenous growth theories provided the foundation of the investment on the labour or the human capital to increase the productivity of the country for economic growth. Later, Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992) emphasised on the role of research and development in economic growth. These endogenous growth models takes the knowledge production as the engine of economic growth. However, most of these studies are based on past data and recently the role of technology is more highlighted with human capital. Both of these are considered education as a base and the ultimate goal is to enhance the incomes per person (as a measure of well-being). Hence, education has considered as a contributing factor to incomes per person (Barro, 1991).

Education can be taken as investment in humans and human capital consist of educated people. The increase in human capital has more implications for technological progress than physical capital (Nelson and Phelps, 1966). Increasing education was considered a major source of high productivity from 1960 to 1990. Over the long run social returns on education for 1990 were about 40% on average (education level of 5.3 years), which raised productivity level as well (Teulings and Van Rens, 2008). In order to investigate the impact of education on the economic growth various researches have introduced different levels of education like primary, secondary and university level education (Sylwester, 2000; Keller, 2006).

However, such division of education in different levels has created unclear decisions regarding personal incomes, the different levels of education may have positive or negative impact on the income per capita of the country (Kalaitzidakis et al., 2001; Keller, 2006; Gylfason and Zoega, 2003). The present study expands this work further by investigating the nature of relationship of various levels of education on the per capita income in 2020, during the period of COVID-19, by comparing the results with dataset of the same nature in 2010.

COVID-19 was a natural disaster, and evidently a negative shock, for all countries. The educational institutions were closed, due to lockdowns, leading to high enrolment and learning losses. In the period of 2019-2021, GDP of almost every country suffered. Later, after COVID-19 lockdowns were lifted the recovery period started in economies. However, the education would act as the latent variable which could affect the economies even in the long run, might be over decades.

Hence, there is a possibility that COVID-19 have changed the nature of relationship in education and real GDP per capita, at least for the period in which the crisis was continued, and the present study is an attempt to test this hypothesis using the empirical data. In general, the role of education has remained positive for economic growth; but the role of income inequality has remained ambiguous for economic growth. Some researchers found that income inequality is negatively related to the economic growth (Alesina and Rodrik, 1994; Persson and Tabellili, 1994); so the conclusion emerged that higher level of income inequality could hamper the growth process. However, it was not true in all studies. Many researchers have found higher income inequality, an increasing factor to growth(Li and Zou, 1998). Barro (2000) indicated the positive role of income inequality for growth in case of rich countries and negative in case of poor countries. Here arise a question, what takes them into different conclusion? It could be econometric technique, data set under study or the nature of relationship in

these variables that could be subject to change by time. Further, how the relationships among income per person, income inequality and levels of education has changed in COVID-19 era?

The present study explains the impact of both income inequality and various levels of education on per capita income including the comparative analysis for the COVID-19 pandemic era. It is a cross country analysis, including 70 countries, using data from the World Bank Database for three periods: 1990, 2010 and 2020. The ordinary least square (OLS) is used for the empirical analysis. This study proceeds in sections. Section 2 highlights literature review. Section 3 is based on economic and econometric analysis. Section 4 is based on empirical results of our study with a brief discussion. Section 5 consists of diagnostic tests for checking our estimated results. Section 6 concludes our whole study.

2. Literature Review

Education is the road by which the human capital journey is supposed to be attained. Although the structure of educational institutions and study plan differs, they all are trying to increase the productivity of the labour force that in turn could be translated into the economic growth of the countries. The relationship of education, income inequality and economic growth is well- established and has an extensive literature which could not be described into one section of this study alone, so we are discussing the most relevant analysis aligned with our study. Barro (1991) investigated the growth of real GDP per person in 98 economies over 1960 to 1985. His study found positive impact of school enrolment on incomes per person. The economies having large amount of human capital (proxy by education) were found to have large investment in physical capital. His study concluded that catch up for poor economies is possible only if their individuals possessed higher levels of human capital. Kalaitzidakis et al., (2001) investigated relation of human capital to growth of economy incorporating education. Their results revealed linear impact of enrolment to economy's growth, whereas such relationship is non-linear in case of mean years of education. They observed different implications of attainment and levels of education for growth. Their results revealed direct relationship of primary education to economic growth. Its impact is larger in case of low levels than for high levels of human capital countries. Castelló and Doménech (2002) found human capital inequality inversely impacting to economic growth while analysing 108 countries over 1960 to 2000. The inclusion of human capital inequality made the coefficient of income inequality positive indicating its direct relation to economic growth; this relation became even insignificant for explaining investment (physical capital). The study found economies that tend to decrease inequality in human capital over the period showed convergence.

Analysing panel of countries from 1960 to 2000, Keller (2006) had found the negative role of primary enrolment in increasing the GDP per capita globally. Secondary enrolment was found more effective among other education levels for contributing in GDP per capita. The increased primary and secondary enrolment lowered fertility and attract investment that indirectly increased GDP per capita. Gyimah-Brempong et al., (2006) analysed the effects of education on economy's growth for African countries over 1960 to 2000. They found education at every level to have positive relationship with growth in income per person. Higher education had revealed more elastic for growth than investments in assets. But, they could not separate higher education impact from other levels, which results in overestimation. They suggest considering various levels of

education for further researchers analysing growth of economies. In explaining impact of human capital on economic growth, Papageorgiou (2003) analysed 80 economies for the period of 1960 and 1987, for investigating the role of primary and post primary education. Human capital was introduced as the number of years of education and adjusted for mortality and drop outs. The study concluded that primary education remained helpful for the output. The post primary education revealed contributing for adopting innovations. Overall education was found necessary for growth process. In addition, Naeem et al. (2021) conducted an empirical study and suggested that income inequality highlights a direct influence on mortality.

Easterly and Rebelo (1993) found those increased education expenditures contributes in economic growth. The study analysed the impact of income inequality on education expenditures and growth rate from 1970 to 1985 (by cross-section analysis). They concluded that higher inequality increases education expenditures, which impacted negatively on growth. The expense of increasing human capital was an immediate decrease in economic growth. However, these expenses could become future increasing factor to economic growth. Sylwester (2000) had taken education to explain the interrelationship of income inequality and economic growth. The higher income inequality was found increasing education expenses. The immediate effect of education expenditures was negative on economic growth. In future such expenditures have found to be positively impacting economic growth. This was the reason that human resource development had sluggish effect on economic growth. Moreover, Spulbar et al. (2021) investigated the impact of sample taxes on the dynamics of GDP at EU-28 level.

Gylfason and Zoega (2003) made regional distinction through dummies for Asia, Africa Central and South America andanalysed data from 87 industrial and developing countries from 1965 to 1998. The study concluded education increases the effect of income inequality on economic growth. Asian countries found particularly more equitable and large education promoting (due to statistical significance) and so have rapid growth. The study concluded education enhanced economic growth directly through effectiveness of capital (both human and physical) that in turn decreased inequality. Li and Zou (1998) analysed the relationship of income inequality with the growth of economies. The estimated results showed positive relationship between them given the inclusion of consumption into utility analysis. They concluded that income inequality and growth relationship is complex. Therefore, causality could not be assigned for the presence either direct or inverse association empirically on the basis of its simple analysis. Later, Barro (2000) analysed economies over 1965 to 1995 for investigating relation of income inequality and growth. The high level of income inequality was found slowing economy's growth process for poor economies. Converse relationship existed for rich economies.He did not found such relationship helpful in explaining large differences across nations considering full sample.

Teulings and Van Rens (2008) concluded education explains well cross countries GDP growth and productivity differences from 1960 to 1990. They estimated 2.7% average annual increase in productivity growth due to rise in education from 1970 to 1990, whereas the actual growth rate was 2%. However, their results showed that economies which do not raise education level of labours were worsen over the time. Muysken and Nour (2005)analysed Gulf countries for making less dependence on oil exports and implications of their educational system. They pointed the inadequate educational facilities as a cause of less skilled labour, hindrance in research and development that in turn became a major problem in restructuring their economies. The

present infrastructure and enrolment in tertiary education were found fewer than required(by international standards). However, those results were based on the survey data (Nour, 2002b).

The Sustainable Development Goal (SDG) 4 require the, UN members, countries to ensure all the boys and girls to complete their secondary school with the meaningful learning level by 2030 (Azevedo et al. 2021). The school closure during COVID-19 pandemic has further exacerbated the situation as it has interrupted the students' attachment to schooling (Azevedo, 2020; Azevedo et al. 2021; World Bank, 2020). In amidst of the crisis the loss of students, Azevedo et al. (2020) has indicated that COVID-19 has resulted loss of 0.6 years of quality of schooling. The study highlighted that this gap in education has the potential of reducing $872 in yearly earnings on average that will accumulate to $16,000 over the working life students. Tarkar (2020) has indicated that the shutdown of universities has also affected the students' learning in universities. Ultimately, the education sector has hit hard by the pandemic. This research would try to escort the impact of various levels of enrolment in education on the real income per capita, and their nature of relationship by the COVID-19 era. Spulbar et al. (2022) argued that digital development and new technologies can contribute to poverty alleviation in the context of COVID-19 pandemic. The exiting literature indicates income inequality as the midway between the education and economic growth, so we have included the income inequality in the analysis as well.

3. Economic Theory and Econometric Methodology

Solow (1956) andSwan (1956) paved the way of explaining economic growth by introducing a black box which is named as the Solow's Residual.Although at that time the researchers were not very clear about what could define this residual in the better words, they were sure it is not the labour and capital.The earlier theories attached the name of effectiveness of labour or the progression in technology with the residual of growth model (Romer, 2012). Later, the research and development were used to explain the economic growth developed by Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992). These models have the distinguished perspective about the education and they discuss the knowledge production as the engine of economic growth. Grounded somewhere in these theories is the role of education on the economic growth as education provides the human capital which in turn creates knowledge and make labour effective. The empirical work of Barro(1991), Easterly and Rebelo (1993) and Teulings and Van Rens(2008) also supports the importance of education in determining the economic growth. Following the work, the present study attempts to check the effect of various levels of education on the economic growth. Education is treated as the human capital that explains the growth of countries. The same, human capital, has been given the name of the Solow residual or the productivity in the exogenous growth models.

Further studies expanded the work of earlier researchers, Romer (2012) elaborated various aspects of this growth model in which the savings are brought to light as the increasing factor to the steady growth path. The Engels' Law indicate that the poor spends more proportion of their income on necessary goods than the rich. Keynes consumption theories also indicate the similar fact that the large part of savings came from rich. These savings, in turn, lead toward the investment and hence results in economic growth. The income inequality is picked because it is a variable attached to the propensity to save and invest, and both of these variables are indicated as the crucial

for determining the economic growth from both the exogenous and endogenous growth theories (Romer, 2012). Therefore, it can be said that the relationship among national income, education and income inequality is evident from economic theory.However, the shocks, like economic recession and COVID-19, always create the diversion in the economic growth path. This study is exploring, this aspect of economic growth where, how the income per person has affected by the income inequality and various level of education- primary, secondary and tertiary- amid shock of COVID-19 pandemic.

The next step after identifying the variables is to take a good proxy for them. In order to select the appropriate measure of education, we take guideline from Gylfason and Zoega (2003). Theytook three measures of education namely: a) gross secondary school enrolment; b) government spending on education related to national income; and c) expectation of number of schooling years for females. However,secondary school enrolment is found to have higher impact on inequality and growth among other education indicators.Gyimah-Brempong et al., (2006) recommended inclusion of different education levels. Keller (2006) had used various enrolment ratios to population for explaining the economic growth. Using previous literature as a guide line for the selection of variables, the present study takes primary, secondary and tertiary enrolment to the percentage of population. Similarly, we used the gini coefficient, which is widely used, to measure the income inequality. Further, we use logarithm of real GDP per capita for identifying economic growth, which describes the percentage rise in the GDP per capita over time. However, there must be other factors that differentiate the growth of high countries. Accounting these facts, Papageorgiou (2003) divided the countries into high income, middle income and low income countries on the basis of per capita GDP for explaining economic growth. We also made this distribution based on Nielsen (2011), but we have just introduced the dummy variable for the high income countries. Adding this dummy variable would allow us to capture other factors that have been contributed to the progress of the high income countries. Hence, we made equation staking logarithm of real GDP per capita as dependent variable(the brief description of variables and data sources is in appendix A1; the list of countries included in analysis are in appendix A4). Briefly, the equations we are estimating are as follows:

$$LRGDPpc2010= \alpha_0+\alpha_1 PSE1990+\alpha_2 SSE1990+\alpha_3 TE1990+\alpha_4 Gini1990+\alpha_5 Dhigh+\varepsilon_1 \quad (1a)$$

$$LRGDPpc2010= \beta_0+\beta_1 PSE2010+\beta_2 SSE2010+\beta_3 TE2010+\beta_4 Gini2010+\beta_5 Dhigh+\varepsilon_2 \quad (1b)$$

$$LRGDPpc2020= \gamma_0+\gamma_1 PSE1990+\gamma_2 SSE1990+\gamma_3 TE1990+\gamma_4 Gini1990+\gamma_5 Dhigh+\varepsilon_3 (2a)$$

$$LRGDPpc2020= \mu_0+ \mu_1 PSE2010+ \mu_2 SSE2010+ \mu_3 TE2010+ \mu_4 Gini2010+ \mu_5 Dhigh +\varepsilon_4 (2b)$$

$$LRGDPpc2020= \eta_0+ \eta_1 PSE2020+ \eta_2 SSE2020+ \eta_3 TE2020+ \eta_4 Gini2020+ \eta_5 Dhigh +\varepsilon_5 (2c)$$

The education is taken as the enrolment to test the hypothesis that which level of education provides the far reaching impacts on the growth of income per capita. We have taken the year 2020 in order to test that the nature of per person growth has observed how much changes due to the COVID-19. If the equations 2a, 2b and 2c portray the same nature as the 1a and 1b then we could conclude that the role of education levels has remained same on growth of income per person in 2020. Similar position holds for the income inequality hypothesis as well. As far as the estimation

method is concerned, we are using cross section data so, OLS using robust standard deviations is employed.

4. Empirical Results and Discussions

The results of OLS with robust standard deviations are reported in table 1 (the coefficient and their robust standard deviations; t-statistic and p-value are reported in appendix A2).The primary school enrolment of 1990 turned out to have positive, and highly significant (at 1% level of significance), impact on growth of per person income in 2010 and 2020. The primary school children take some years to reach the market where they can earn and contribute in the growth of their economy. According to the estimates, an increase of enrolment by one percentage of population in 1990s primary school enrolment increases real GDP per capita by 1.9 percent. Further, the same, rise in primary enrolment effects remain significant in 2020 as well when they contribute by 1.6 percent in real GDP per capita growth. This result indicates the far reaching impacts of primary school enrolment in 1990 which could be seen even after 30 years in 2020. Kalaitzidakis et al., (2001) also found the primary school enrolment as an increasing factor to the per capita incomein low income economies.However, the primary school enrolment of 2010 tells the different story in both 2010 and 2020. Its contribution became negative and significant, at 5% level of significance, in regressions for both the periods. The one percent (of population) rise in primary school enrolment lowers real GDP per person by 1.5 percent (after rounding-off) in both 2010 and 2020. This result might indicate that the children reading in primary schools are not yet contributed significantly in the labour market even by 2020. Although, some of them would have joined the labour force, many of them would be still busy in continuing their studies and hence would not be earning at all.Keller (2006) found the similar relationship between primary enrolment and real GDP per capita in global analysis. The negative relationship exist even in the 2020 primary school enrolment and the same year real GDP per capita. Therefore, it can be concluded that the primary school enrolment pose the negative impact on the current real GDP per capita, and ittakes about twenty years to translate this negative relationship into the positive one. However, after the span of many years the primary school enrolment provides positive spill-over effects to real GDP per capita growth over decades.

On the other hand, the secondary school enrolment of 1990 do not play a significant role in determining real GDP per capita growth in both 2010 and 2020. It is because majority of the students at the secondary school age would enter the labour market sooner than a decade and start playing their positive role in the growth of their country. For the same reason, the secondary school enrolment of 2010 has revealed significant, at 1% level of significance, in both 2010 and 2020 regression for the real GDP per capita growth. The estimates reveal that the an increase of enrolment by one percentage of population in secondary school gives3.1 percent, approximately in both 2010 and 2020, increase in the real GDP per person growth. This estimate is showing that the impact of secondary education enrolment is the highest among the other education levels on the real GDP per capita growth. This impact also survives in case of 2020 secondary school enrolment, but with the decrease in magnitude. The estimate revealed that an increase of secondary enrolment of 2020 by one percentage of population increases the growth of GDP per person in 2020 by 2.5 percent approximately. This result also highlight the possibility of child labour in both the past

and the present periods. In other words, the secondary school students would have been contributing to the income of the country by earning as the part time employee or home workers. Certainly, the further research could be done to explore such possibilities, but the present study remained limited in this scope and does not explore this hypothesis. However, the researchers like Gylfason and Zoega (2003) also indicated that secondary enrolment has positive and significant impact on income per capita.Hence, we find that the relationship of secondary school enrolment to the real GDP per capita is positive, for nearly one decade, but it might not remain effective over two decades or so.

The estimation of 2010 real GDP growth per person revealed that the 1990 tertiary education enrolment had contributes positively in the income per person. The estimate indicate that one percent population more enrolled in the teriary education would lead to increase the real GDP growth by 1.3 percent; however, this coefficient is significant at the 10 percent level of significance. Although researches like Gyimah-Brempong et al., (2006) revealed that higher education affect significantly and positively to income per person, our analysis found no such evidence in estimating 2010 and 2020 income per person growth based on the tertiary enrolment of both 2010 and 2020. It seems unlikely when we consider the endogenous growth hypothesis because the tertiary education is the highest step toward the research and development. However, if we consider the access to the tertiary education then it would be clearly available to the limited population in the countries. Further, the enrolment in tertiary education might be attached to the study of traditional subjects that yield fewer job opportunities for the graduates. The income inequality has revealed positive and significant in only the equation 1b estimation. It indicates that a rise of one percent in the gini index would result in increasing the real GDP per capita by 2.9 percent. This result indicating positive relationship between income inequality and real GDP per capita is in accordance to Li and Zou (1998). However, this result is not consistent as no other equation reported in its approval. The gini index turned negative and insignificant while we took its 1990 value to explain the real GDP per capita growth of 2010 (equation 1a). The other equations reported insignificant and positive impact of income inequality on the real GDP per capita. Hence, we cannot declare the exact nature of relationship between the income inequality and the real GDP per capita based on our data analysis.

The equations 2a, 2b and 2c provided the impact of education levels and income inequality on the real GDP per capita growth in 2020 within the COVID-19 era. The estimated results indicated the similar patterns of primary school enrolment: the positive in case of 1990 enrolment and negative and significant in case of 2010 and 2020 enrolment. The secondary school enrolment remained positive in both 2b and 2c, with lower magnitude impact of 2020 secondary school enrolment. Tertiary education did not provide any significant results in all three equations (2a, 2b and 2c). Perhaps the study indicates that the secondary school education could be a key to lead the real GDP per capita growth to its higher levels. On the other hand, the primary school enrolment is a pre-requisite for the secondary enrolment; therefore, it is a necessary cost to bear for the future rising incomes. Moreover, tertiary education enrolment has failed to provide its trickle down effects on the real GDP per capita growth of the country. It might be possible that, using different proxy like, the quality of tertiary education or the completion of enrolled program could provide a different result. The gini index remained insignificant that indicate no statistical evidence in the favour of the hypothesis that widening the income gaps could help in rising the real GDP per capita of the country. Overall, the nature of relationship among the variables remained intact amid

the period of COVID-19 pandemic. The differences occurred briefly in magnitudes of the estimated variables.

Coefficient of dummy variable attached with higher income countries is positive and significant in all equations. It describes the role of other factors, not included exclusively in our study, in raising the income per person of the high income countries. The constant in each equation is large and significant that elaborates many other economic and social factors impact on altering the incomes per persons, those can be included in future analysis. The F-statistic is highly significant in all the models indicating that the models are good fit. The value of coefficient of determination (R-square) is over 0.81in all the equations that highlight education levels along with income inequality and a dummy variable for high income countries can explain at least 80 percent variation in incomes per person of the sample economies.

Variables	Equation 1a LRGDPpc2010	Equation 1b LRGDPpc2010	Equation 2a LRGDPpc2020	Equation 2b LRGDPpc2020	Equation 2c LRGDPpc2020
Gini 1990	-0.0093 (0.0127)	--	-0.0128 (0.0127)	--	--
PSE 1990	0.01927*** (0.0050)	--	0.0160*** (0.0045)	--	--
SSE 1990	0.0067 (0.0062)	--	0.0084 (0.0058)	--	--
TE 1990	0.0133* (0.0078)	--	0.0114 (0.0074)	--	--
D high	1.8246*** (0.02003)	1.5139*** (0.2360)	1.5380*** (0.1927)	1.2193*** (0.2418)	1.4775*** (0.2181)
Gini 2010	--	0.0292** (0.0113)	--	0.0150 (0.0123)	--
PSE 2010	--	-0.0149** (0.0058)	--	-0.0148** (0.0070)	--
SSE 2010	--	0.0312*** (0.0056)	--	0.0323*** (0.0059)	--
TE 2010	--	0.0063 (0.0059)	--	0.0034 (0.0059)	--
Gini 2020	--	--	--	--	0.01775 (0.0108)
PSE 2020	--	--	--	--	-0.0150** (0.0061)
SSE 2020	--	--	--	--	0.0247*** (0.0045)
TE 2020	--	--	--	--	0.0045 (0.0051)
Constant	5.9629*** (.5826)	5.8359*** (0.6235)	6.5738*** (0.5678)	6.6406*** (0.6401)	6.7817*** (0.6815)
F-statistic (p-value)	117.81*** (0.0000)	138.25*** (0.0000)	100.69*** (0.0000)	128.98*** (0.0000)	99.41*** (0.0000)
R-square	0.8302	0.8826	0.8162	0.8684	0.8666
No. of Observation	70	70	70	70	70

Table 1: Results of estimated equations

Note: Robust standard errors are reported in parenthesis, and related t-statistics and p-values are shown in appendix A2. * indicates 10 percent significance level, ** indicates 5 percent significance level and *** indicates significance at 1 percent level respectively.

5. Diagnostic Testing

Diagnostic testing solely depends upon the type of data and the technique applied for the empirical analysis. Since we are dealing with cross sectional data, so heterogeneity is a rule. In order to correct the standard deviations, models are estimated using robust standard deviations. The estimation technique is OLS that demands diagnosing of multicollinearity and normality of residuals in order to make the inferences reliable. For checking multicollinearity among regressors we used variance inflation factor (VIF) and it's reciprocal (results are shown in appendix A3). The estimates show no signal of multicollinearity in our regressors. Hence, the interpretation of variables is acceptable. For analysing the normality in the residuals, we check histogram with the curve showing estimate of normality (the results are presented in appendixA5).The analysis diagnose no problem of multicollinearity and indicates that errors are normally distributed. In a nutshell, the estimates are reliable.

6. Conclusion

This study investigates the effects of various levels of education and income inequality on real GDP per capita, in the COVID-19 era by comparing its results with the similar equations from 2010. The empirical evidence highlighted that the relationship of various levels of education with growth of real income per capita remained the same in 2020 as it was in 2010, except for the slight difference in the magnitudes of the coefficients.We take data on 70 countries and did cross-sectional analysis, using the OLS with robust standard deviations. Multicollinearity is tested using variance inflation factor and residual plots are used for checking normality of the residuals. The results affirm normality, and no multicolinearity has detected among the regressors.The primary school enrolment of 1990 turned out to have positive impact on growth of per person income in 2010 and 2020 indicating that the primary school enrolment is beneficial for the growth of income per person even after decades. However, in the short span of time, about a decade or so, the contribution of primary school enrolment remained negative and significant in both 2010 and 2020 when we have considered the same period. Therefore, primary school enrolment can be considered as the latent variable which is a liability for the short period of time but provides fruits after a very long time, taking about twenty years. Besides, the primary school enrolment is crucial to proceed the children towards the secondary and tertiary enrolment. The results show that secondary school enrolment has become significant and increasing factor to the real income per person growth in the same year of analysis or a decade earlier from it (in equations 1b, 2b, 2c). The empirical estimate of secondary school enrolment has indicatedit as the most effective level of education to increase the real GDP per capita. The enrolment in tertiary education and the income inequality has not provided the significant and consistent results in our analysis; therefore, we cannot indicate the particular direction of relationship between these variables and the growth of real GDP per capita.

While real incomes per person remained high in developed countries far more than in developing countries due to other factors not included in our study. The models

are well fitted because estimated R-square is quite high for all of them, which elaborate at least 81 percent of variations inreal GDP per person growth, are explained by the variables included in the models of our study. Constant terms in all regression equations remained large and significant which emphasis the role of various other factors in explaining income per capita across countries that should be included in further researches. The study emphasise to focus on education particularly primary and secondary levels by enhancing the enrolment.

Authors' Contributions:

The authors contributed equally to this work.

References:

Aghion, Philippe, and Howitt, Peter. (1992). A Model of Growth through Creative Destruction.*Econometrica* 60 (March): 323–351.

Alesina, A. and Rodrik, D.(1994). "Distributive Politics and Economic Growth," *Quarterly Journal ofEconomics* 109, 465–490.

Azevedo, João Pedro. (2020). Learning Poverty: Measures and Simulations. Policy Research Working Paper No. 9446. World Bank, Washington, DC. http://hdl.handle.net/10986/34654

Azevedo, J. P., Hasan, A., Goldemberg, D., Geven, K., and Iqbal, S. A. (2021). Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes: A Set of Global Estimates. The World Bank Research Observer, 36(1), 1-40.

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics*, *106*(2), 407-443.

Barro, R. J. (2000). Inequality and Growth in a Panel of Countries. *Journal of Economic Growth*, *5*(1), 5-32.

Castelló, A., and Doménech, R. (2002). Human Capital Inequality and Economic Growth: Some New Evidence. *The Economic Journal*, *112*(478), C187-C200.

Easterly, W., and Rebelo, S., (1993). Fiscal Policy and Economic Growth: An Empirical Investigation. *Journal of Monetary Economics* 32, 417–455.

Grossman, Gene M., and Helpman, Elhanan. (1991). Innovation and Growth in the Global Economy. Cambridge, MA: MIT Press.

Gujarati, D. N. (2003). *Basic Econometrices.* New York: Mc Graw Hill.

Gyimah-Brempong, K., Paddison, O., and Mitiku, W. (2006). Higher Education and Economic Growth in Africa. *The Journal of Development Studies*, *42*(3), 509-529.

Gylfason, T., and Zoega, G. (2003). Education, Social Equality and Economic Growth: A View of the Landscape. *CESifo Economic Studies*, *49*(4), 557-579.

Kalaitzidakis, P., Mamuneas, T. P., Savvides, A., and Stengos, T. (2001). Measures of Human Capital and Nonlinearities in Economic Growth. *Journal of Economic Growth*, *6*(3), 229-254.

Keller, K. R. (2006). Investment in Primary, Secondary, and Higher Education and the Effects on Economic Growth. *Contemporary Economic Policy*, *24*(1), 18-34.

Li, H., and Zou, H. F. (1998). Income Inequality is not Harmful for Growth: Theory and Evidence. *Review of Development Economics*, *2*(3), 318-334.

Maddala, G. S. (2001). *Introduction to Econometrics.* Chichester: Jhon Wiley and Sons.

Muysken, J., and Nour, S. (2006). Deficiencies in Education and Poor Prospects for Economic Growth in the Gulf Countries: The Case of the UAE. *The Journal of Development Studies*, *42*(6), 957-980.

Naeem, M.Z., Arshad, S., Birau, R., Spulbar, C., Ejaz, A., Hayat, M.A., Popescu, J. (2021) Investigating the impact of CO2 emission and economic factors on infants health: a case study for Pakistan. *Industria Textila*, 72, 1, 39–49, http://doi.org/10.35530/IT.072.01. 1784.

Nielsen, L. (2011). *Classifications of Countries Based on Their Level of Development: How it is Done and How it Could be Done [Electronic resource]*. IMF Working Paper.– 2011.–Mode of access: http://www. relooney. fatcow. com/0_ NS4053_1504. pdf.

Nelson, R. R., and Phelps, E. S. (1966). Investment in Humans, Technological Diffusion, and Economic Growth. *The American Economic Review*, *56*(1/2), 69-75.

Papageorgiou, C. (2003). Distinguishing Between the Effects of Primary and Post-Primary Education on Economic Growth. *Review of Development Economics*, *7*(4), 622-635.

Persson, T. and Tabellini, G. (1994).“Is Inequality Harmful for Growth? Theory and Evidence,” *AmericanEconomic Review* 84, 600–621.

Pregibon, D. (1979).Data Analytic Methods for Generalized Linear Models.Unpublished Ph.D thesis: University of Toronto.

Romer, D. (2012). Advanced Macroeconomics Fourth Edition. Irwin: McGraw Hill.

Romer, Paul M. (1990). Endogenous Technological Change.*Journal of Political Economy* 98 (October, Part 2): S71–S102.

Solow, R. M.(1956). A Contribution to the Theory of Economic Growth. *Quarterly Journalof Economics* 70 (1), 65–94.

Spulbar, C., Anghel, L.C., Birau, R., Ermiș, S.I., Treapăt, L.-M., Mitroi, A.T. (2022) Digitalization as a Factor in Reducing Poverty and Its Implications in the Context of the COVID-19 Pandemic. Sustainability. 2022; 14(17):10667. https://doi.org/10.3390/ su141710667.

Spulbar, C., Ehsanifar, M., Birau, R., Babaie, A., & Doagă, D. I. (2021). Advanced empirical research based on structural equation modeling (SEM) regarding the impact of tax revenue on GDP dynamics at EU-28 level. Scientific Annals of Economics and Business, 68(3), 285–307. https://doi.org/10.47743/saeb-2021-0017.

Swan, T. W.(1956). Economic Growth and Capital Accumulation. *Economic Record* 32 (63), 334–361.

Sylwester, K. (2000). Income Inequality, Education Expenditures, and Growth. *Journal of Development Economics*, *63*(2), 379-398.

Tarkar, P. (2020). Impact of COVID-19 Pandemic on Education System. *International Journal of Advanced Science and Technology*, *29*(9), 3812-3814.

Teulings, C., and Van Rens, T. (2008). Education, Growth, and Income Inequality. *The Review of Economics and Statistics*, *90*(1), 89-104.

World Bank (2020). The COVID-19 Pandemic: Shocks to Education and Policy Responses.

Appendix

A 1: Variables and Data Description:

LRGDPpc2010=Logarithm ofGDP per capita 2010 (constant 2010 US$)
LRGDPpc2020= Logarithm of GDP per capita 2020 (constant 2015 US$)
PSE1990=School enrollment, primary 1990 (% gross)
PSE2010=School enrollment, primary 2010 (% gross)
PSE2020= School enrollment, primary 2020 (% gross)
SSE1990=School enrollment, secondary 1990 (% gross)

SSE2010=School enrolment, secondary 2010 (% gross)
SSE2020= School enrolment, secondary 2020 (% gross)
TE1990=School enrolment, tertiary 1990 (% gross)
TE2010=School enrolment, tertiary 2010 (% gross)
TE2020= School enrolment, tertiary 2020 (% gross)
Gini1990=GINI index 1990
Gini2010=GINI index 2010
Gini2020= GINI index 2020
Dhigh= 1, for high income countries
Dhigh= 0, otherwise.
Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Dhigh is a dummy variable identifying that countries are high income that distribution of countries is based on Nielsen (2011).Data on all the variables is taken from the World Bank database (World Development Indicator website). For the missing values near most value is taken as proxy.

A 2:

Variables	Equation 1a LRGDPpc2010 t-statistic (p-value)	Equation 1b LRGDPpc2010 t-statistic (p-value)	Equation 2a LRGDPpc2020 t-statistic (p-value)	Equation 2b LRGDPpc2020 t-statistic (p-value)	Equation 2c LRGDPpc2020 t-statistic (p-value)
Gini 1990	-0.73 (0.470)	--	-1.01 (0.318)	--	--
PSE 1990	3.89 (0.000)	--	3.54 (0.001)	--	--
SSE 1990	1.09 (0.280)	--	1.45 (0.153)	--	--
TE 1990	1.72 (0.090)	--	1.53 (0.131)	--	--
D high	9.11 (0.000)	6.42 (0.000)	7.98 (0.000)	5.04 (0.000)	6.78 (0.000)
Gini 2010	--	2.59 (0.012)	--	1.23 (0.225)	--
PSE 2010	--	-2.56 (0.013)	--	-2.12 (0.038)	--
SSE 2010	--	5.52 (0.000)	--	5.49 (0.000)	--
TE 2010	--	1.07 (0.290)	--	0.58 (0.562)	--
Gini 2020	--	--	--	--	1.65 (0.105)
PSE 2020	--	--	--	--	-2.44 (0.017)
SSE 2020	--	--	--	--	5.53 (0.000)
TE 2020	--	--			0.89 (0.375)
Constant	10.24(0.000)	9.36 (0.000)	11.58 (0.000)	10.37 (0.000)	9.95 (0.000)

A 3: Test Results for Multicollinearity

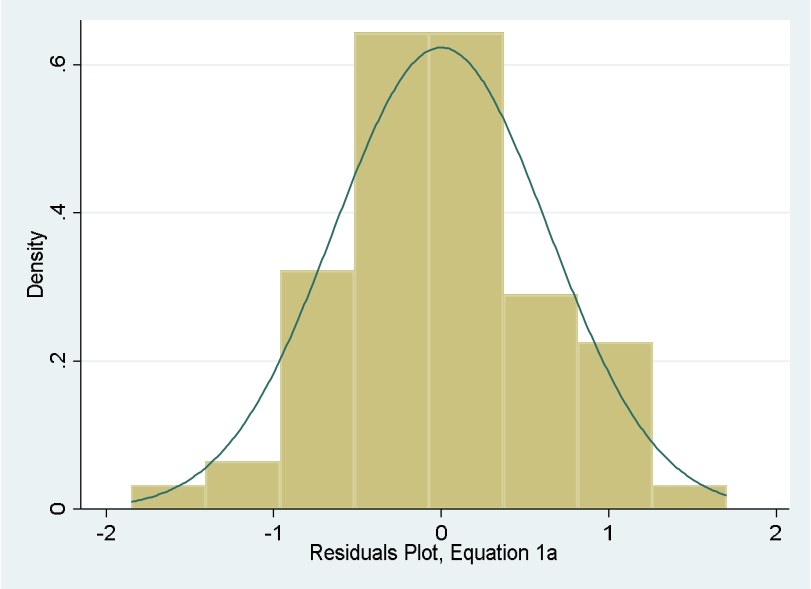
Variables	Equation 1a VIF(1/VIF)	Equation 1b VIF(1/VIF)	Equation 2a VIF(1/VIF)	Equation 2b VIF(1/VIF)	Equation 2c VIF(1/VIF)
Gini 1990	1.94 (0.515)	--	1.94 (0.515)	--	
PSE 1990	1.75 (0.571)	--	1.75 (0.571)	--	
SSE 1990	4.55 (0.220)	--	4.55 (0.220)	--	
TE 1990	2.60 (0.384)	--	2.60 (0.384)	--	
D high	1.88 (0.532)	2.29 (0.437)	1.88 (0.532)	2.29 (0.437)	1.86 (0.537)
Gini 2010	--	1.80 (0.556)	--	1.80 (0.556)	
PSE 2010	--	1.48 (0.677)	--	1.48 (0.677)	
SSE 2010	--	4.23 (0.236)	--	4.23 (0.236)	

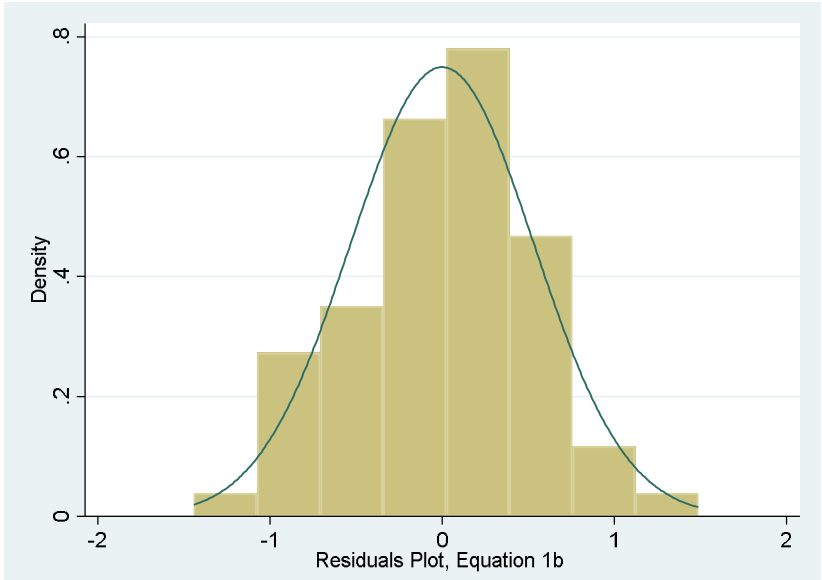
TE 2010	--	3.52 (0.284)	--	3.52 (0.284)	
Gini 2020	--	--	--	--	1.45 (0.687)
PSE 2020	--	--	--	--	1.15 (0.873)
SSE 2020	--	--	--	--	3.04 (0.329)
TE 2020	--	--	--	--	2.79 (0.358)
Mean VIF	2.54	2.66	2.54	2.66	2.06

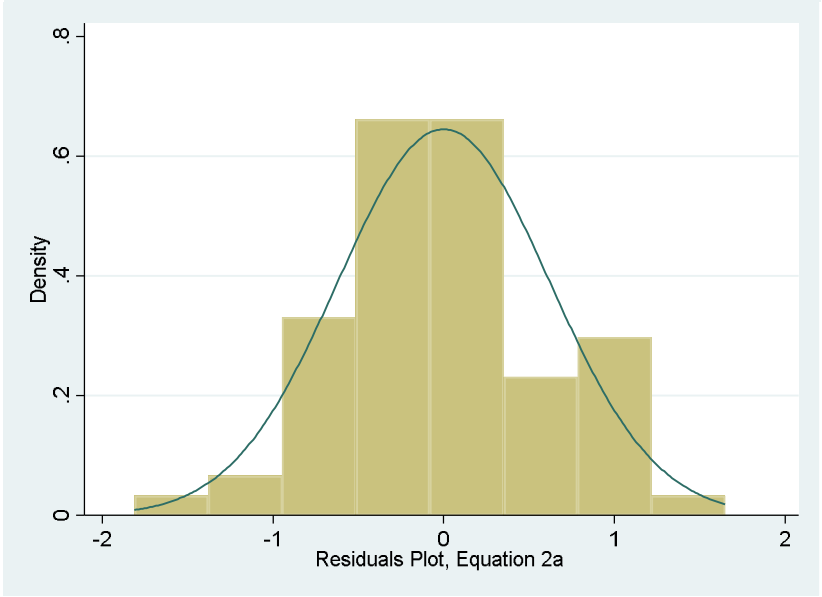
A4: Countries included in Analysis

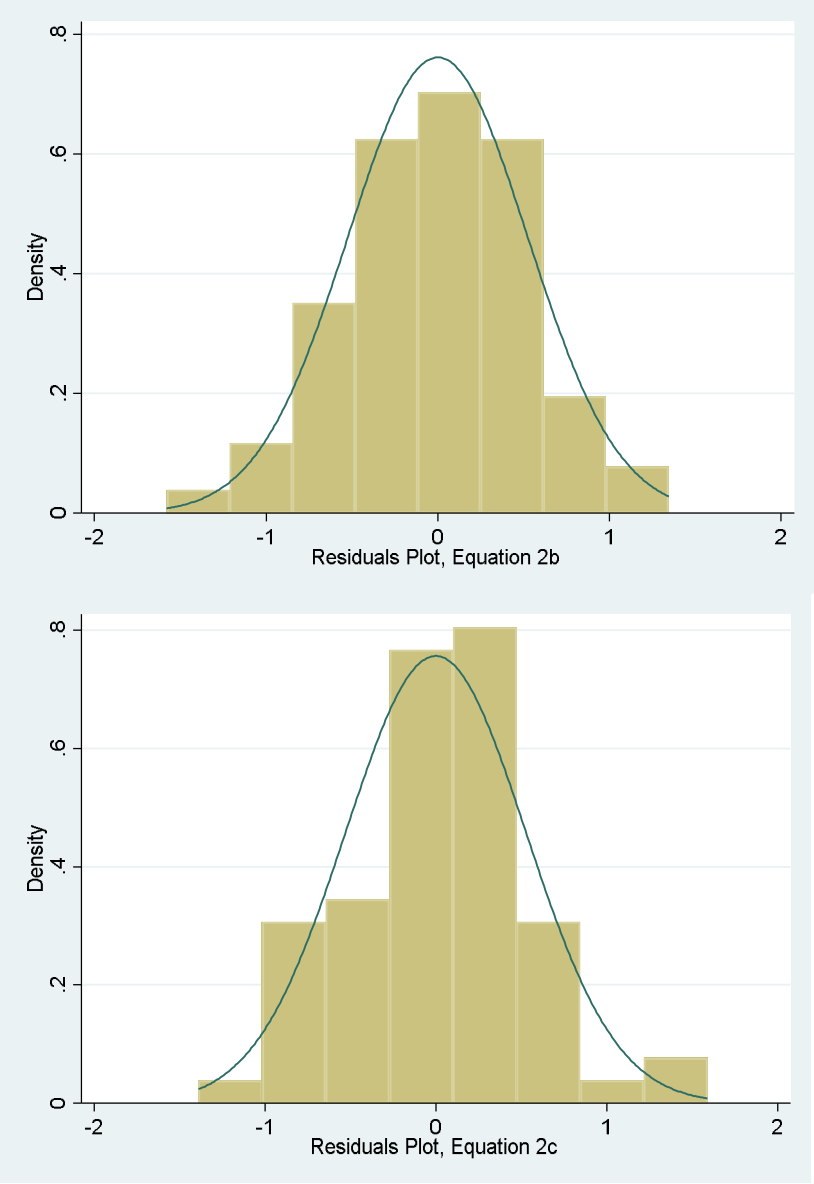
Argentina, Armenia, Australia, Austria, Belarus, Belgium, Bhutan, Bulgaria, Burkina Faso, Chad, Chile, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt(Arab Republic), Estonia, Ethiopia, Fiji, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, India, Indonesia, Iran, Ireland, Italy, Kazakhstan, Kyrgyz Republic, Lao PDR, Lesotho, Lithuania, Luxembourg, Malawi, Malta, Mauritius, Mexico, Moldova, Mongolia, Netherlands, Niger, Nigeria, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Romania,Russian Federation, Senegal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Tanzania, Togo, Turkey, United Kingdom, United States, Uruguay

A 5: Residual plots of Equations




Density
0
.2
.4
.6
.8
-2
-1
0
1
2
Residuals Plot, Equation 1b


Density
0
.2
.4
.6
.8
-2
-1
0
1
2
Residuals Plot, Equation 2a



Corresponding author: Ramona Birau, University of Craiova, Doctoral School of Economic Sciences, Craiova, Romania, Email: ramona.f.birau@gmail.com.

Article Info

Received: October 14 2022
Accepted: October 22 2022

How to cite this article:
Arshad, S., Naeem, M. Z., Spulbar, C., Birau, R., Ninulescu, P. V. (2022). Impact of Education and Income Inequality on Per Capita Income Amid COVID-19 pandemic. *Revista de Științe Politice. Revue des Sciences Politiques*, no. 76, pp. 18 – 33.