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**ABSTRACT**

Today's political and economic framework is marked significantly by globalisation and AI automation exponential expansion. Their advancements ensure development and prosperity – which is often not equally distributed across nations. A study showed that U.S. citizens experienced a decrease in the medium household income although their productivity increased, making the problem of distribution visible. Why is this digital era disbalancing the key drivers that used to grow in union? A possible explanation is presented in this article through variables as total factor productivity and Globalisation Index. Investment in human capital, in the form of education, is discussed.

## 1. Introduction

Sharing technology knowledge, while ensuring free market system and high standard of living is crucial, but for that a new economic and political framework should be considered. Brynjolfsson and McAfee (2013) have displayed results in which U.S. citizen experienced a decrease in the medium household income although their productivity increases, defying law of microeconomics. How to avoid a phenomenon where productivity is increasing but salary does not follow the same trend? What is marking the digital era that disbalances the economic key drivers from growing in union?

It is known that technologies are playing a crucial role in enabling the globalisation of economic and social activities. The openness to new technologies for individual nations is significantly affecting their actual and potential economic development (Archibugi & Pietrobelli, 2003). The combined synergy of the effects of the new globalisation and new Industrial Revolution should be distributed in a beneficial way for the entire society.

Analysing structural changes, preliminary results theorised that both globalisation, represented by measures of openness, import penetration and export intensity at the sectoral level, and digitalisation, represented by ICT capital intensity at the sectoral level are all linked with higher wage divergence (Berlingieri et al., 2017).

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This article examines the disbalancing effect of AI-driven automation and globalisation on the economic growth, effects that influence this digital era. It is highlighted the inseparably connected effects of globalisation and AI-driven automation, with a special focus on human capital and education, which is fuelling them both.

## 2. Literature review

### 2.1. AI-automation and globalisation

Bergeaud et al. (2016), showed that there is an overall convergence process among developed countries relying significantly on total factor productivity. Basu et al. (2001) discussed that changes in technology helped explaining a constant growth in productivity throughout the 1990s. Diego (2006) gathered data that suggest that a large portion of total factor productivity growth is generated by endogenous innovation decisions. In his article, he positively linked innovation development with total factor productivity growth rate.

Such innovations boosted jobs creation that resulted in increased employments and economic development.

There were many theories debating on how will the new Industrial revolution influence the economic growth. One of the central propositions of New Growth theory is that, if we exclude land and capital, knowledge will not be subject to diminishing returns. The development of knowledge is a key driver of economic development. Government do have a crucial role, they should boost and invest in human capital, in the development of education and skills to ensure a sustainable growth with high standard of living (Bobanović, 2020).

Although knowledge has no diminishing returns, technological advancement which it is fuelled by it, might have different consequences.

A not very optimistic prediction was presented by Frey and Osborne (2017), stating that over the next two decades, 47% of U.S. workers will be at risk of automation. A report from McKinsey lowered that number to a 45%, while the World Bank published the estimation that 57% of jobs in the OECD could be automated over the next two decades (World Development Report, 2016).

Lately, the focus of the public has switched to the quality and the effect of the good public health system and education on the economic growth of countries around the globe (Alataş & Çakir, 2016). Such researches add value on the importance of the Globalisation Index that measures the economic, social and political dimensions of globalisation. Drivers of globalization are one of the most important drivers that lead towards closer economic integration (Bang & Markset, 2012).

Acemoglu et al. (2001) investigated the significant impact that human capital has in the long-run development of one economy. Important factors for economic integration seem to be institutions, education, innovation and technological progress, which are in turn linked to education and institutions (Acemoglu et al., 2014; Barro, 1991). Higher educational investments influenced national economic growth (Badea & Rogojanu, 2012). The weight of evidence suggests that a 1% increase in school enrolment rates had led to an increase in G.D.P. per capita growth of between 1 and 3% (Wilson & Briscoe, 2004).

Shopina et al. (2017) conducted an analysis of trends of the world economy in the period of 2000–2017. They indicated that there is an aggravation of economic problems and a decline in economic growth rates in all regions of the world, mostly in developed economies. They stated that the growing threat of terrorism, socio-economic instability, and geopolitical uncertainty are causing negative economic impacts on the global economy. Ying et al. (2014) established that the economic globalization has a positive influence on economic growth, but social and political globalization a negative impact on the growth of A.S.E.A.N. countries that Titalessy (2018) confirmed.

With unregulated outsourcing, workers in developed countries risk to lose their jobs, while those doing the work in poorer countries, get paid much less when working in poor conditions.

## 2.2. Human capital and economic growth

The significant impact of human capital on the economic growth was always indisputable. The study done by Wilson and Briscoe (2004) show that a 1% increase in school enrolment rates has led to an increase in G.D.P. per capita growth of between 1 and 3%. The effect of human capital on economic growth has been discussed since 1980 in the endogenous growth models developed by Romer, Lucas and Barro.

A quick summary (Alataş & Çakir, 2016) of empirical literature studies analysing quantitative relationship and interaction between human capital and economic growth is presented in Table 1.

The Human Capital Index is a new measure used to capture and follow the progress of the status of human capital development around the world. Human capital can have different meanings based on the perspectives: (1) in the business world, human capital is the economic value of an employee's set of skills; (2) to the policy-maker, it is the capacity of the population to drive economic growth; and (3) traditionally, human capital is perceived as a function of education and experience. Following the events in recent years, health (including physical capacities, cognitive function and mental health) came to be seen as a fundamental component of human capital. To sum up, the Index is based on four pillars: three core determinants of human capital (education, health and employment) in addition to those factors that

**Table 1.** Summary of empirical literature studies analysing quantitative relationship and interaction between human capital and economic growth (Alataş & Çakir, 2016).

| Author(s) | Country | Period | Period result(s) |
|---|---|---|---|
| Romer | 112 Countries | 1960–1985 | ↑ HC ≫GRO ↑ |
| Benhabib and Spiegel | 78 Countries | 1965–1985 | ↑ HC ≫GRO ↑ |
| Freire-Seren | 72, 65 and 22 Countries | 1960–1990 | ↑ HC ≫GRO ↑ |
| Ljunberg and Nilsson | Sweden | 1870–2000 | ↑ HC ≫GRO ↑ |
| Aka and Dumont | USA | 1929–1996 | ↑ HC ≫GRO ↑ |
| Ramos, Surinach and Artis | 229 and 190 Regions in EU | 1995–2000 2000–2005 | ↑ HC ≫GRO ↑ |
| Haldar and Mallik | India | 1960–2006 | ↑ HC ≫GRO ↑ |
| Yaylalı and Lebe | Turkey | 1938–2007 | ↑ HC ≫GRO ↑ |
| Koç | 27 EU Countries | 2012 | ↑ HC ≫GRO ↑ |

allow these three core determinants to translate into greater returns. It is important to highlight that the Index takes a long-term approach to human capital.

An interesting fact is that the W.H.O. outlines the importance to research the effects of the good public health system and education on the economic growth of countries around the globe (Alataş & Çakir, 2016; World Bank, 2018).

The Human Capital Index investigates the sources and effects to the development of a healthy, educated and productive labour force. The results display the quality of early childhood and captures the extent to which investments made in earlier years in health and education are being realised in the working age population through life-long learning and training World Bank (2018).

The Index includes the following three health measures: the probability of survival to age five, adult survival rate (a fraction of 15-year-olds that will survive to age 60) and the proportion of children who are not stunted. The three measures related to education are a child's expected years of schooling and harmonised test scores as a measure of quality of learning. It is recognizable that the higher investments in human capital are, the stronger the economy of the country is.

Investments in human capital are a strong driver of economic growth. Important factors for economic integration are institutions, education, innovation and technological progress, which are in turn linked to education and institutions (Aghion & Howitt, 2009; Acemoglu et al., 2014; Barro, 1991).

## 3. Methodology and data

This research analysed developed countries as the U.S., Japan and the U.K. and the eurozone (Bergeaud et al., 2016). The countries selected for the eurozone were narrowed to three countries that were affected by the Great Decoupling: Sweden, Finland and Germany, based on Bernstein and Raman (2015).

In the panel data analysis, six cross-sectional units are analysed. The cross-sectional units/countries are: Finland, Germany, Japan, Sweden, U.K., and U.S.A.

Data for each country is available from 1957 to 2014 (Feenstra et al., 2015) with six cross-sectional units and 39 time periods and 234 observations (author's calculation).

In the model, we observe the following variables:

- Total factor productivity (T.F.P.)
- K.O.F. Index of globalisation (K.O.F.G.I.)
- G.D.P. per capita (G.D.P.pc)
- Crisis that occurred in 2009
- Crisis that occurred in 1991, 1992 and 1993

In the model, the abbreviation used for Total factor productivity is *T.F.P.* and are acting as regressors in the model. The dependent variable is G.D.P. per capita with abbreviation *G.D.P.pc*, that needed to be differentiated and one lag deducted to avoid autocorrelation and to interpret the influences of the variables on the rate of economic growth. For K.O.F. Globalisation Index, the abbreviation is *K.O.F.G.I.* If the

error term in the distributed lag serially correlated, statistical inference that rests on usual (heteroskedasticity-robust) standard errors can be strongly misleading.

Heteroskedasticity and autocorrelation-consistent (H.A.C.) estimators of the variance-covariance matrix circumvent this issue (Heiss, 2016).

As already mentioned, for the purpose of this research, panel data is used. Gujarati listed in his book *Basic of Economics* (2003) that phenomena such as economies of scale and technological change can be better handled by panel data than by pure cross-section or pure time series data. Both fixed and random effects model will be displayed.

A standard way to test which model is better to use, fixed or random, is using the Hausman test. Hausman test's null hypothesis is that the GLS estimates are consistent, meaning that the random effects are random. In case they are random, then they should not be correlated with any of the other regressors. If they are correlated with other regressors, then fixed effects (F.E.) model should be rather used to receive consistent parameter estimates of the slopes.

Data are computed and analysed using the Gretl software.

## 4. Results and discussion

Before proceeding with results, it is important to run the unit root test. The panel unit-root test is described by Levin et al. (2002). The null hypothesis is that all of the individual time series exhibit a unit root, while the alternative is that none of the series has a unit root. In Table 2, the unit root results are displayed for N = 6, T = 40 and 234 observations, at a 5% significant level. Results show that the times series for all countries for l_TFP and l_KOFGI are stationary, while in its first derivation, G.D.P.pc is stationary at a 5% significance level.

The panel data model is a model based on the opinion of the author of this research that is supported by an indicative literature review. The idea behind, suggests that there exists a positive impact on economic growth of technological advancement through AI-driven automation that can be represented with the variable total factor productivity. The negative impact of globalisation on economic growth can, on the other side, be represented through the K.O.F. Globalisation Index.

### 4.1. Fixed effects model

An F.E. model consists of levels values of independent variables that are assumed to be fixed (or constant) while the dependent variable changes as a reaction to the levels of independent variables.

The challenge with the F.E. model is that it hosts too many regressors which makes the model numerically not attractive and brings the problems of multicollinearity.

The estimates of the marginal effects l_TPF, l_KOFGI, dt_35 and crisis_l1 and the intercept are given as coefficients with the standard error and the corresponding t-ratio and p-value in Table 3. As displayed, the marginal effects of l_TFP, l_KOFGI, dt_35 and crisis_l1 are all statistically significant. The results show that an increase of

**Table 2.** Levin-Lin-Chu pooled ADF test for the variables TFP, KOFGI and GDPpc (Author's calculation).

| Variable | Levels | p-value | Log | p-value | 1st difference | p-value |
|---|---|---|---|---|---|---|
| TFP | 0.494075 | p < .05 | −0.089148 | p < .05 | −8.51852 | p < .05 |
| KOFGI | −2.51478 | p < .05 | −0.24092 | p < .05 | −12.6873 | p < .05 |
| GDPpc | 0.675206 | p < .05. | −0.094501 | p < .05. | −6.37587 | p < .05 |

**Table 3.** Fixed effects model (author's calculation).

Model: Fixed-effects, using 234 observations

Included 6 cross-sectional units
Time-series length = 39
Dependent variable: d_l_GDPpc
Robust (HAC) standard errors

| | Coefficient | std. error | t-ratio | p-value |
|---|---|---|---|---|
| const | 0.409404 | 0.0501644 | 8.161 | 0.0004 *** |
| l_TPF | 0.0430546 | 0.00896243 | 4.804 | 0.0049 *** |
| l_KOFGI | −0.0881389 | 0.0114949 | −7.668 | 0.0006 *** |
| crisis_l1 | −0.0266621 | 0.00853112 | −3.125 | 0.0261 ** |
| dt_35 | −0.0768644 | 0.00875976 | −8.775 | 0.0003 *** |

| | | | |
|---|---|---|---|
| Mean dependent var | 0.018009 | S.D. dependent var | 0.023210 |
| Sum squared resid | 0.070648 | S.E. of regression | 0.017759 |
| LSDV R-squared | 0.437139 | Within R-squared | 0.435271 |
| Log-likelihood | 616.2970 | Akaike criterion | −1212.594 |
| Schwarz criterion | −1178.041 | Hannan-Quinn | −1198.662 |
| rho | 0.387449 | Durbin-Watson | 1.189019 |

Joint test on named regressors -
    Test statistic: F (4, 5) = 264.475
    with p-value = P (F (4, 5) > 264.475) = 5.2942e-06
Robust test for differing group intercepts -
    Null hypothesis: The groups have a common intercept
    Test statistic: Welch F (5, 106.2) = 0.785924
    with p-value = P (F (5, 106.2) > 0.785924) = 0.562053
Distribution free Wald test for heteroskedasticity -
    Null hypothesis: the units have a common error variance
    Asymptotic test statistic: Chi-square (6) = 8.39712
    with p-value = 0.210428
Test for normality of residual -
    Null hypothesis: error is normally distributed
    Test statistic: Chi-square (2) = 6.38931
    with p-value = 0.0409807

1% in total factor productivity will result in an increase of 4.3% in the economic growth rate. The Globalisation Index, as well as the crises in the 2009 and the one from 1991–1993, had a significant negative impact on the rate of economic growth of 8.81%, 2.66% and 7.68%.

The R-square (R2) for the regression model represents the measure of goodness of fit or the coefficient of determination, and it explains about 43.71% of the variation in G.D.P. per capita, leaving the remaining 56.29% unexplained.

Results in the distribution free Wald test for heteroskedasticity present the p-value = 0.210428, meaning that we cannot reject that the units have a common error variance.

The Test for normality of residual shows that the p-value $= 0.0409807$, meaning we can reject the null hypothesis that the error is normally distributed.

## 4.2. Random effects model

In the F.E. model, the cross-section heterogeneity is assumed to be fixed. However, the main problem with the F.E. model is its specification with too many parameters, resulting in heavy dropping of degrees of freedom. Individual error components are not correlated with each other, as well as not autocorrelated across both cross-section and time series units.

The problem in question can be solved if the cross-section heterogeneity ($\mu_i$s) are taken to be random.

Table 4 shows the results that the Random effect model has generated. The marginal effects of l_KOFGI, l_TPF, dt_35 and crisis_l1 are presented as statistically significant. The results show that an increase of 1% in total factor productivity will result in an increase of 3.25% in the economic growth rate. The Globalisation Index,

**Table 4.** Random effects model (author's calculation).

| Model: Random-effects (GLS), using 234 observations | | | |
|---|---|---|---|
| Using Nerlove's transformation Included 6 cross-sectional units Time-series length = 39 Dependent variable: d_l_GDPpc Robust (HAC) standard errors | | | |
| | Coefficient std. | error | z | *p*-value |
| const | 0.338137 | 0.0506623 | 6.674 | 2.48e-11 *** |
| l_TPF | 0.0324650 | 0.0174579 | 1.860 | 0.0629 * |
| l_KOFGI | −0.0719924 | 0.0118985 | − 6.051 | 1.44e-09 *** |
| crisis_l1 | − 0.0266459 | 0.00368718 | − 7.227 | 4.95e-13 *** |
| dt_35 | − 0.0774163 | 0.00547093 | − 14.15 | 1.86e-45 *** |
| Mean dependent var | 0.018009 | S.D. dependent var | 0.023210 |
| Sum squared resid | 0.085647 | S.E. of regression | 0.019297 |
| Log-likelihood | 593.7704 | Akaike criterion | −1177.541 |
| Schwarz criterion | −1160.264 | Hannan-Quinn | −1170.575 |

'Between' variance = 0.000120576
'Within' variance = 0.000301913
theta used for quasi-demeaning = 0.754379
corr (y,yhat)∘2 = 0.342527

Joint test on named regressors -
    Asymptotic test statistic: Chi-square (4) = 833.289
    with p-value = 4.72545e-179
Breusch-Pagan test -
    Null hypothesis: Variance of the unit-specific error = 0
    Asymptotic test statistic: Chi-square (1) = 0.505269
    with p-value = 0.477194
Hausman test -
    Null hypothesis: GLS estimates are consistent
    Asymptotic test statistic: Chi-square (2) = 4.73846
    with p-value = 0.0935527
Test for normality of residual -
    Null hypothesis: error is normally distributed
    Test statistic: Chi-square (2) = 3.72028
    with p-value = 0.155651

as well as the crises in the 2009 and the one from 1991–1993, had a significant negative impact on the rate of economic growth of 7.20%, 2.66% and 7.74%.

In order to determine which model, F.E. or Random effects model, is better to use, the Hausman test is run:

$H_0$: random effects would be consistent and efficient, versus

$H_1$: random effects would be inconsistent.

The results display that the p-value is 0.0935, which is greater than 5% and we cannot reject the $H_0$ that the random effects would be consistent. Hence, we select the R.E. model. The tests suggest that the countries effects in the data set are not correlated with the explanatory variables. They can be taken as random; meaning the R.E. estimators will be consistent.

Although the Hausman test results prefer the R.E. model as a better model to use, based on Judge (1988) and the simple rule that "if T is large and N small, there is little difference in the parameter estimates of F.E. and R.E. models. Hence computational convenience prefers F.E. model". It can be concluded that both models are a good fit for the estimation. It is important to highlight that both models imply that the selected variables are significant to the model.

The Test for normality of residual, with p-value = 0.1556 confirms that the error is normally distributed for the R.E. model.

## 5. Conclusion

The educational and learning systems of today have helped to empower the expansion of the middle class across a number of developed and developing economies, especially in this globalised world. But they lack the tools to achieve the scale at a speed needed in the new world of labour that globalisation and technology changes are marking. The hub of the fourth industrial revolution is defined by unexpected change across economies and labour markets, a new common demand for talent is needed in order to ensure current and future social mobility.

In creating a strategy, it is crucial for policymakers to include improved and more modernised education systems and investment in human capital as fundamentals for economic growth and more equal distribution of its benefits. Wilson and Briscoe (2004) show that a 1% increase in school enrolment rates has led to an increase in G.D.P. per capita growth of between 1 and 3%. Such results have a significant impact on the next generation of workers, it is now an imperative to learn how to shape them and prepare for future trends. Technology and globalisation are changing the skills that employers seek. It is changing how people work and the terms on which they work.

The idea behind this research, suggests that there exists a positive impact on economic growth of technological advancement through AI-driven automation that can be represented with the variable Total factor productivity. The negative impact of globalisation on economic growth can, on the other side, be represented through the K.O.F. Globalisation Index.

The results of the Random Effects panel data demonstrate that an increase of 1% in total factor productivity will result in an increase of 3.24% on the economic growth rate. The K.O.F. Globalisation Index will have a negative impact of a decrease of 7.1% on the economic growth rate.

From the displayed results, a revised model should be followed in order to adapt new mechanisms and ensure distribution of wealth in a non-discriminating way. Companies and other institutions can today improve in an easier way their productivity mostly because of the benefits that digital transformation and digital era we live in provides – simpler access to knowledge and information than was ever before. On the other side, such unregulated expansion of globalisation can re-shape the boundaries of competition, that might lead to bankruptcy of local or smaller firms with significantly smaller economies of scale. AI driven automation boosts productivity and innovation, creating new jobs and work places, generating positive trends in an economy. The instability arises when innovation is growing at a slower pace than automation, resulting in a disbalance: more jobs being replaced by automation than created. It is paramount for governments of all countries to engage in building new strategies following the newest trends, to intervene and safeguard current and future social mobility by insuring fair and equal distribution of wealth and knowledge.

## Disclosure statement

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