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Mining, Poverty, and Income Inequality in Central and Eastern European Countries: What Do the Data Tell Us?

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Abstract

The study investigates the effect of mining on both poverty and income inequality in Central and Eastern European countries (CEECs) using econometric estimation methods with panel data spanning from 2009 to 2019. Another objective of this paper was to determine if the complementarity between mining and infrastructural development reduced poverty and or income inequality in CEECs. What triggered the study is the failure of the existing literature to have a common ground regarding the impact of mining on poverty and or income inequality. The existing literature on the subject matter is contradictory, mixed, and divergent; hence, it paves the way for further empirical tests. The study confirmed that the vicious cycle of poverty is relevant in CEECs. According to the dynamic generalized methods of moments (GMM), mining had a significant poverty reduction influence in CEECs. The dynamic GMM and random effects revealed that the complementarity between mining and infrastructural development also enhanced poverty reduction in CEECs. Random effects and pooled OLS shows that mining significantly reduced income inequality in CEECs. However, random effects and the dynamic GMM results indicate that income inequality was significantly reduced by the complementarity between mining and infrastructural development. The authorities in CEECs are therefore urged to implement mining growth and infrastructural development-oriented policies in order to successfully fight off the twin challenges of poverty and income inequality.

Keywords: mining, poverty, income inequality, panel data, CEECs

JEL: I3, I14, I24, L71, N14

Introduction

The background of the study, the contribution to the literature, and the organization of the study are the three major components constituting this section.

Background of the study: The positive impact of mining on economic growth is well supported in the literature (Prebisch 1950; Singer 1950; Bhagwati 1958; Cavalcanti, Mohaddes, and Raissi 2011; Tilton 2012; Arezki et al. 2013; Esfahani, Mohaddes, and Pesaran 2014; Kalumbu 2014). They argued that the extraction of mineral resources is labor-intensive and therefore employs a huge number of people, and it has a cascading effect on poverty and inequality reduction in the local communities. Other researchers, such as Harvey et al. (2010; 2017), and Olakojo (2015), noted that mineral extraction boosts economic growth, creates employment, and reduces income inequality and poverty on condition that a favorable environment, such as infrastructural and financial development, exists.

Although there seems to be consensus in the literature on the positive role that mining plays in promoting economic growth, its cascading influence on poverty and income inequality has not been exhaustively investigated. The few empirical researchers who investigated the impact of mining on poverty and income inequality produced results that are divergent, conflicting, mixed, and far from conclusive. Some, such as Hinton (2011), Maier et al. (2014), Fleming and Measham (2015), Ngobese (2015), Loayza and Rigolini (2016), and Barreto et al. (2018), noted that mining managed to reduce income inequality and poverty. Others, namely Fatah (2008), Gregoryan (2013), Adu et al. (2016), Addison, Boly, and Mveyange (2017), and Ankra et al. (2017), observed that mining exacerbates poverty and income inequality.

Others, including Ross (2006), Sudarlan, Indiastuti, and Yusuf (2015), Mancini and Sala (2018), Sincovich et al. (2018), and Zhou (2019), failed to find any meaningful relationship between mining and poverty and or income inequality. They noted that the impact of mining on poverty and income inequality depends on the stage of mining activities. For example, in Australia, Reeson, Measham, and Hosking (2012) noted that poverty and income inequality was low but later went up as mining activity intensified. The lack of consensus both in the theoretical and empirical literature on the impact of mining on poverty and income inequality allows room for further empirical tests.

These empirical studies on the subject matter also suffer from the following methodological limitations. They wrongly assumed that the relationship between mining and poverty/income inequality is linear, ignoring the endogeneity problem normally prevalent in the poverty and income inequality econometric functions. The vicious cycle of poverty was not considered in most of those studies, and none of them focused on CEECs. This means the CEEC story on the mining-poverty/income inequality nexus is still untold to the best of the author's knowledge. The study is important because it will help CEECs to develop mining and infrastructural development policies that will effectively alleviate poverty and income inequality.

Contribution of the study: This paper contributes to the literature in five ways. Firstly, the use of the dynamic GMM enables the author to consider not only the vicious cycle of poverty and inequality but also the endogeneity problem that normally characterizes both poverty and income inequality functions. Secondly, this study took into account the fact that both poverty and income inequality functions are non-linear, unlike some prior studies. Thirdly, to the best of the author's knowledge, it is the first study to investigate the impact of mining on both poverty and income inequality using CEECs as a unit of analysis. Fourthly, to the best of the author's knowledge, this study is the first to explore the impact of the combination of mining growth and infrastructural development on both poverty and income inequality. Fifthly, this study uses more recent panel data, enabling authorities to make relevant decisions on income inequality and poverty reduction policies.

Structure of the paper: Six additional sections describe the remaining structure of this paper. Section 2 presents the theoretical literature on the impact of mining on poverty and income inequality. Section 3 discusses the influence of mining on poverty and income inequality from an empirical literature point of view. Section 4 describes the effect of infrastructural development on poverty and income inequality. Section 5 outlines the role played by infrastructural development on mining sector growth. Section 6 describes the research methodology, results presentation, and discussion. Section 7 concludes the paper.

Impact of mining on income inequality and poverty – Literature review

Sudarlan, Indiastuti, and Yusuf (2015) summarized the positive role that mining plays in enhancing poverty and income inequality reduction in four ways. Firstly, it enables developing and poor countries to build a mutually equitable and beneficial mining regime. Secondly, mining helps to improve education as mining companies are generally engaged in corporate social responsibilities that uplift the local communities, consistent with Sudarlan, Indiastuti, and Yusuf (2015, p. 195). Thirdly, mining normally spearheaded by foreign investors transfers technology into the domestic economy, which goes a long way in enhancing innovation and economic growth. Fourthly, mining is in the primary sector of production, is labor-intensive, and hence creates quite a lot of jobs for the poor and the uneducated. This transfers wealth and reduces poverty and income inequality among the societies.

According to Adei, dan Addei, and Kwadjose (2011), the negative impact of mining is divided into three categories:

1. It increases (a) the number of patients suffering from respiratory diseases, (b) land degradation hence negatively impacting on the environment, (c) wildlife habitat loss, (d) air and water pollution as the mining waste is thrown into the rivers and gas emissions poisons the air.

2. Mining towns promote social ills, such as prostitution, crime, native life changes, and the fight for natural resources among the local people.
3. High mortality rates, which are caused by smoking, low levels of education, and an increased number of years residing in coal mining areas. Sudarlan, Indiastuti, and Yusuf (2015) also confirmed that these negative impacts of mining continue to entrench the people in the poverty cycle and increases the income inequality gap.

Table 1. Empirical literature on the impact of mining on income inequality and poverty

Author	Country/ Countries of study	Period	Methodology	Results
Reeson, Measham, and Hosking (2012)	Regional Australia	1975–2010	Multi-regression analysis	Income inequality initially decreased but later went up as mining activity intensified in Australia. However, income inequality was quite low even at the early stages of mining activities.
Sudarlan, Indiastuti, and Yusuf (2015)	Indonesia	2002–2011	Panel data analysis	Mining was found to have had an insignificant effect on both income inequality and poverty in Indonesia.
Addison, Boly, and Mveyange (2017)	Africa	2001–2012	Panel data analysis	When minerals are aggregated, mining was found to have increased inequality in Africa. When minerals were analyzed as individuals, the impact of mining on inequality was found to be mixed.
Gregoryan (2013)	Armenia	2000–2008	Multi-regression analysis	Mining was found to have a high likelihood of increasing poverty and inequality in Armenia.
Ross (2006)	Worldwide	Not applicable	Literature review analysis	The pros and cons of mining on the well-being of the people where mining is taking place were explored. Both sides are compelling.
Mancini and Sala (2018)	Worldwide	Not applicable	Literature review analysis	The literature on the socio-economic impact of mining is quite mixed and divergent globally.
Adu et al. (2016)	Ghana	Survey data for 1998/1999, 2005/2006, and 2012/2013 was used	Descriptive statistical analysis	Households at the bottom of the income distribution were the ones that heavily experienced the positive impact of mining on income inequality

Author	Country/ Countries of study	Period	Methodology	Results
Sincovich et al. (2018)	Australia	Critical literature review	Critical literature review	The positive and negative impact of mining on income inequality, poverty, unemployment, and economic growth were outlined in the case of Australia.
Fleming and Measham (2015)	Australia	2001 and 2011	Descriptive statistics and multiple regression analysis	Income inequality increased faster in mining regions than in non-mining regions. The results, therefore, showed that mining reduced income inequality.
Fatah (2008)	Province of South Kalimantan in Indonesia	Not available in the abstract used.	Social accounting matrix approach	Coal exploitation had negative consequences on the local environment, in the form of land degradation and water-borne diseases. This exacerbates poverty and inequality if stringent environmental rules and policies are not applied.
Loayza and Rigolini (2016)	Peru	2007 district survey data	Multi-linear regression analysis	Mining districts were found to have had lower poverty rates and household consumption per capita in Peru.
Maier et al. (2014)	United States of America, China, and World-Wide	1990–2014	Literature review analysis	Evidence in the literature explaining the role of mining in poverty alleviation and income inequality reduction in mining regions is evident.
Barreto et al. (2018)	Kenya, Uganda, and Rwanda	Case study approach	Case study methodology	Small scale mining had a positive impact on livelihood improvements and poverty reduction in the three African countries studied.
Ankra et al. (2017)	Ghana	2015 salary data	Descriptive statistics	The top ten percent of the mining companies' staff members were allocated about half of all the basic salary. This means that mining increased income inequality in the case of Ghana.
Zhou (2019)	Mongolia's Oyu Tolgoi Province	House-hold-level census data (2007–2016)	Descriptive statistics	Health, respiratory diseases, and unemployment generally went down in mining areas while school dropout rates, digestive problems, and internet users went down.

Table 1. (continued)

Author	Country/ Countries of study	Period	Methodology	Results
Ngobese (2015)	Amajuba district in South Africa	Interviews in 2014	Descriptive statistical analysis	Mining had a lot of positive influences in the Amajuba district. These include reducing unemployment, enhancing livelihoods, and reducing income inequality.
Hinton (2011)	Uganda	Both primary and secondary data	Descriptive statistical analysis	Artisanal mining played a huge role in alleviating unemployment and reducing poverty, but gender income inequality remained, with women being the most disadvantaged.

Source: author compilation.

The effect of infrastructural development on income inequality and poverty

According to Estache and Fay (1995), improved infrastructure reduces poverty and income inequality through better water quality, road infrastructure, lower manufacturing costs, and low transportation costs. Infrastructural development was argued to be a key integral component of poverty and income inequality reduction as it links people to important economic activities and helps them gain access to productive opportunities (Jacoby 2000). By contrast, it was noted by Tsaurai and Nyoka (2019), however, that scarce government and private sector resources could have been channeled towards infrastructural development away from small credit provision, whose direct positive influence on poverty and income inequality alleviation is unquestionable. The measure of infrastructural development used in this study is fixed telephone subscriptions (per 100 people).

The role played by infrastructural development on mining growth

According to the Minerals Council South Africa (2017), better infrastructure development is one of the factors that enhances gold mining in South Africa. Other factors that were singled out by the same report as inhibiting gold mining in South Africa include the cost of extracting the gold, gold price fluctuations, unreliable electricity supply, skills shortages, and a lack of investment in the gold mining sector. Dunning's (1973) eclectic paradigm hypothesis argued that locational advantages, such

as the level of infrastructural development, market size, and financial development, among others, were the major factors that attract foreign investment to the mining industry in the host country. Denisia (2010, p. 108) also noted that infrastructure development, financial markets, political, and other macro-economic factors are locational advantages that attract foreign capital to not only the mining sector but the whole economy. Moosa (2010) also supported the view that infrastructural development is only one of the factors that foreign investors consider before they are attracted into investing in the mining sector/whole economy of the host country. Considering that the positive impact of foreign direct investment (FDI) on poverty reduction is well supported in the literature, it follows that factors that attract FDI to the mining sector, such as infrastructure development, enhance poverty reduction and income inequality in the local communities. Xongo (2013) also noted that developed infrastructure is one of the preconditions that the country must have for the mining sector to be able to significantly enable poverty reduction.

Research methodology, presentation of the results, and discussion

Data description, model specification, control variables, panel unit root, and co-integration tests and data analysis.

Nature of data and its description: The data used in this study spans from 2009 to 2019. The dependent variables include income inequality and poverty, while independent variables include infrastructural development, trade openness, information and communication technology (ICT), FDI, human capital development, and financial development. The sources of secondary data include the African Development Bank, World Development Indicators, United Nations Development Programme, the Organization for Economic Cooperation and Development, International Financial Statistics, and the International Monetary Fund. These databases were selected because of their reputation and easy accessibility. The CEECs used in this study include Albania, Croatia, Hungary, Romania, Slovenia, Estonia, Bulgaria, the Czech Republic, Poland, Slovakia, and Lithuania.

General and econometric model specification: Equation 1 is the general model specification for the poverty function, while equation 2 is a general model specification for the income inequality function.

$$POV = f(MIN, INFR, OPEN, ICT, FDI, HCD, FIN) \quad (1)$$

$$INEQ = f(MIN, INFR, OPEN, ICT, FDI, HCD, FIN) \quad (2)$$

POV, INEQ, MIN, INFR, OPEN, ICT, FDI, HCD, and FIN, respectively, represent poverty, income inequality, mining, infrastructural development, trade openness,

ICT, FDI, human capital development, and financial development. The choice of the independent variables was, to a larger extent, informed by similar empirical studies such as Fatah (2008), Hinton (2011), Maier et al. (2014), Fleming and Measham (2015), Ngobese (2015), Loayza and Rigolini (2016), Ankra et al. (2017), Barreto et al. (2018), Sincovich et al. (2018), Zhou (2019). The GINI coefficient was used as a measure of income inequality in this study.

Equations 3 and 4 stand for the econometric equations of poverty and income inequality, respectively.

$$POV_{it} = \beta_0 + \beta_1 MIN_{it} + \beta_2 INFR_{it} + \beta_3 (MIN_{it} . INFR_{it}) + \beta_4 X_{it} + \varepsilon it \quad (3)$$

$$INEQ_{it} = \beta_0 + \beta_1 MIN_{it} + \beta_2 INFR_{it} + \beta_3 (MIN_{it} . INFR_{it}) + \beta_4 X_{it} + \varepsilon it \quad (4)$$

Table 2. Variable interpretations

β_0	Intercept term
t	Time
i	Country
εit	Error term
β_1 to β_4	Co-efficient of independent variables
X_{it}	Independent variable in country i at time t.
POV_{it}	Poverty in country i at time t
$INEQ_{it}$	Income inequality in country i at time t
MIN_{it}	Mining development in country i at time t
$INFR_{it}$	Infrastructural development in country i at time t

Source: author compilation.

Equations 3 and 4 are estimated using panel data analysis methods such as fixed effects, pooled ordinary OLS, and random effects, in line with other similar studies by Sudarlan, Indiastuti, and Yusuf (2015) and Addison, Boly, and Mveyange (2017). Consistent with Denisia (2010), infrastructural development plays a critical role in attracting FDI to the mining sector and consequently poverty and income inequality reduction. It is against this background that this study also examined the impact of the complementarity between mining and infrastructural development on poverty and income inequality.

$$POV_{it} = \beta_0 + \beta_1 POV_{it-1} + \beta_2 MIN_{it} + \beta_3 INFR_{it} + \beta_4 (MIN_{it} . INFR_{it}) + \beta_5 X_{it} + \varepsilon it \quad (5)$$

$$INEQ_{it} = \beta_0 + \beta_1 INEQ_{it-1} + \beta_2 MIN_{it} + \beta_3 INFR_{it} + \beta_4 (MIN_{it} . INFR_{it}) + \beta_5 X_{it} + \varepsilon it \quad (6)$$

The lag of poverty influences poverty (the vicious cycle of poverty), in line with Azher's (1995) theoretical predictions. The control variables that were used, denoted by X, include trade openness, FDI, ICT, financial development, and human capital de-

velopment. The measure of poverty that was used is the mean mortality rate, while the GINI coefficient is the proxy of income inequality employed in the study. Both equations 5 and 6 were econometrically estimated using the dynamic GMM approach.

Control variables: The variables used as control factors for the income inequality and poverty functions include trade openness, ICT, FDI, human capital, and financial development. The next few paragraphs discuss how each control variable affects poverty and income inequality from a theoretical point of view.

Trade openness, which is proxied by total exports and imports (% of GDP), positively influences poverty and income inequality reduction, according to Balassa (1978). He argued that trade openness enables domestic firms to access cheaper raw materials and technology worldwide, thereby enhancing their expansion ability, wealth creation, unemployment, poverty, and income inequality reduction.

ICT enhances quality education, research capabilities, innovation skills, and employment creation, thereby enabling people to easily secure well-paying jobs (Richmond and Triplett 2017). They noted that ICT might widen income inequality among people from different social classes. The rich have money to acquire the best ICT gadgets while the poor are further driven into a technology-related abyss. Individuals who use the Internet (% of population) was used as a measure of ICT.

FDI enables people to acquire skills, enhances human capital development, and creates employment and wealth, thereby reducing poverty and narrowing the income inequality gap (Boakye-Gyasi and Li 2015). In contrast, FDI increases poverty and the income inequality gap because most foreign investors' profit is not used for the benefit of local people but is repatriated back to the home country (Jaumotte, Lall, and Papageorgiou 2013). FDI can have either a positive or negative impact on poverty and income inequality. Net FDI inflows (% of GDP) is the proxy of FDI used in this study.

Although human capital development reduced poverty, Castello-Climent and Domenech (2014) noted that it was not sufficient to reduce the income inequality gap. According to Johansen (2014), human capital development increases people's competency levels, skills, education, and productivity at the workplace. Such a scenario helps people get a promotion, boosts their income and wealth, and reduces poverty levels and income inequality gaps. The theoretical rationale on the positive relationship running from human capital development towards poverty/income inequality reduction was confirmed by Becker and Chiswick (1966).

Better access to small loans and convenient financial products enables people to get the funding necessary to begin small self-employment projects. The latter provides jobs and income, helping to end poverty and income inequality (World Bank 2001). The development of the financial sector makes it difficult for the poor to access credit because they do not possess collateral security. Meanwhile, the rich get richer because they have assets that can act as collateral security. According to Dhrifi (2013), this increases poverty among the poor and widens the income inequality gap. The impact of financial development on poverty and/or income inequality can be either way. The

measure of financial development used in this study is the market capitalization of listed domestic companies (% of GDP). All the variables' data were transformed into natural logarithms before being used further in the study to decisively address spurious results, the possible problem of multicollinearity, and extreme values (Aye and Edoja 2017; Tsaurai 2021).

Panel unit root tests: The use of four panel unit root test methods such as the Levin, Lin, and Chu test (2002), the PP Fisher Chi-Square test; the Augmented Dicky Fuller (ADF) Fisher Chi-Square and Im, Pesaran, and Shin test (2003) to estimate the stability of data used is consistent with other empirical studies such as Aye and Edoja (2017) and Tsaurai (2020).

Table 3. Panel root tests – Individual intercept

	Level			
	LLC	IPS	ADF	PP
LPOV	–2.32*	–4.21*	3.12	6.98
LINEQ	–2.92***	–1.18**	62.18**	84.913***
LMIN	–2.65***	–3.17***	–2.56***	–6.17***
LINFR	–1.56***	–0.35***	55.82**	97.12***
LOPEN	–3.76***	–3.87***	99.12**	122.76***
LICT	–0.36	0.67	29.32	61.39**
LFDI	–2.54***	–1.76***	64.23***	102.12***
LHCD	–0.73*	–0.99*	32.18**	48.27***
LFIN	–3.14**	–3.94*	10.21**	17.37**
First difference				
LPOV	–11.21**	–19.54**	56.18**	71.32*
LINEQ	–9.42***	–7.02***	147.25***	278.03***
LMIN	–5.16***	–8.53***	–6.18***	–16.02***
LINFR	–10.16***	–11.34***	195.92***	420.14***
LOPEN	–9.32***	–10.27***	185.93***	642.82***
LICT	–7.37***	–8.45***	155.12***	298.42***
LFDI	–10.11***	–11.23***	163.15***	543.51***
LHCD	–6.16***	–7.04***	116.32***	300.42***
LFIN	–7.23***	–8.04**	91.78***	187.26***

Note: LLC, IPS, ADF, and PP stand for Levin, Lin, and Chu; Im, Pesaran, and Shin; ADF Fisher Chi-Square, and PP Fisher Chi-Square tests, respectively. *, ** and *** denote 1%, 5% and 10% levels of significance, respectively.
Source: author's compilation – E-Views figures.

Poverty, income inequality, mining, infrastructural development, trade openness, ICT, FDI, human capital development, and financial development variables were found to be stationary at first difference. The results mean that all the variables used in this study were stable at first difference, allowing the author to proceed to the next stage, which is panel co-integration tests, in line with Odhiambo (2014).

Panel co-integration tests: The Kao (1999) panel co-integration test was used in this study. Table 4 present the results.

Table 4. Results of Kao co-integration tests

Series	ADF t-statistic
POV MIN INFR OPEN ICT FDI HCD FIN	–2.9121***
INEQ MIN INFR OPEN ICT FDI HCD FIN	–5.43716***

Source: author compilation.

Consistent with Tembo (2018), a long-run relationship was found to exist in both poverty and income inequality functions. Put differently, a co-integration relationship could not be rejected at the one percent significance level in either the income inequality or poverty functions. The finding enabled the author to proceed to the next stage of analysis.

Main data analysis and interpretation of the results: Four econometric methods were used in this study. These include the dynamic GMM, fixed effects, random effects, and pooled OLS. The proxy of mining in this study is mineral rents (% of GDP).

Table 5. The poverty function panel results

	Dynamic GMM	Fixed effects	Random effects	Pooled OLS
POV_{it-1}	0.1735***	–	–	–
MIN	–0.1672*	–0.0092	–0.2186	–0.0372
INFR	–0.3672*	–0.1736	0.0267	0.1782
MIN.INFR	–0.1792***	–0.0328*	0.1811	0.0003
OPEN	–0.1628*	–0.0327*	0.0163	–0.1823*
ICT	0.0126***	–0.3271**	–0.1417**	0.1732**
FDI	–0.1732***	–0.0317***	–0.0327	–0.1723
HCD	0.2227**	0.2371	0.1026	0.1692
FIN	–0.1888**	–0.4555**	–0.0103*	–0.1932**
Adjusted R-squared	0.67	0.62	0.55	0.58
J-statistic/F-statistic	148	57	62	43
Prob(J-statistic/F-statistic	0.00	0.00	0.00	0.00

***, ** and * denote 1%, 5% and 10% levels of significance, respectively.
Source: author's compilation from E-Views.

Using the mean mortality rate as a measure of poverty, the lag of poverty was found to have had a significant positive impact on poverty. In other words, the mortality rate was positively influenced by its own lag, in line with Azher's (1995) vicious cycle of poverty argument. The dynamic GMM approach produced results that show that mining had a significant negative impact on the mean mortality rate while fixed effects, pooled OLS, and random effects show a non-significant relationship with the

mean mining mortality rate. In general, these results indicate that mining reduced poverty in CEECs across all the four-panel methods used.

Infrastructural development's influence on mean mortality was found to be negative and significant under the dynamic GMM, yet fixed effects show that mining had an insignificant negative effect on mean mortality. These results show that infrastructural development reduced poverty in CEECs, which is consistent with Estache and Fay (1995). The positive non-significant impact of infrastructural development on mean mortality was observed under the random effects and pooled OLS, in line with Tsaurai and Nyoka (2019), whose study argued that that scarce government and private sector resources channeled towards infrastructural development away from small credit provision exacerbates poverty.

The impact of the complementarity between mining and infrastructural development on mean mortality was found to be negative but significant under both the fixed effects and dynamic GMM methodologies. This means that the combination of mining and infrastructural development significantly reduced poverty in CEECs, a finding that is consistent with Xongo (2013), whose study found that developed and better infrastructure is one of the preconditions that a country must have for the mining sector to be able to significantly reduce poverty. However, a non-significant positive relationship running from the complementarity between mining and infrastructural development towards mean mortality was observed under the pooled OLS and the random effects. These results mean that the interaction variable exacerbates poverty, contradicting the available literature that states that infrastructural development is one of the locational advantages of foreign investment in the mining sector (Moosa 2010).

Under the dynamic GMM, fixed effects, and pooled OLS, the influence of trade openness on mean mortality was found to be negative but significant. Put differently, trade openness contributed to a reduction in poverty in the CEECs, in line with Balassa's (1978) argument earlier in the sub-section on control variables. By contrast, the random effects produced results that show a non-significant relationship running from trade openness towards mean mortality. This means that trade openness generally increased poverty under the random effects, a finding which contradicts the available literature.

ICT was found to have a significant positive impact on mean mortality under both the pooled OLS and the dynamic GMM approaches, in line with Richmond and Triplett (2017), whose study noted that ICT may increase poverty and widen income inequality among people from different social classes. Fixed and random effects, however, noted that ICT's impact on mean mortality in CEECs was negative but significant. On the other hand, the results resonate with Richmond and Triplett (2017), who stated that ICT enhances quality education, research capabilities, innovation skills, and employment creation, thereby enabling people to easily secure well-paying jobs.

FDI had a significant negative impact on mean mortality under both the dynamic GMM and fixed effects, and a non-significant negative effect on mean mortality under the random and pooled OLS. These results are like those obtained under the income

inequality function (see results in Table 6). They generally mean that FDI reduced poverty, which is consistent with Boakye-Gyasi and Li's (2015) theoretical rationale that FDI enables people to get skills, enhances human capital development, and creates employment and wealth, thereby reducing poverty and narrowing the income inequality gap.

A significant positive relationship running from human capital development towards mean mortality was observed under the dynamic GMM approach, while fixed effects, random effects, and pooled OLS show that human capital development had a non-significant positive effect on mean mortality. These results are like the findings produced under the income inequality function (see Table 6) across all four econometric estimation methods. They contradict the available literature on the human capital development-poverty/income inequality nexus propagated by Becker and Chiswick (1966), Castello-Climent and Domenech (2014), and Johansen (2014).

Financial development had a significant negative effect on mean mortality across all four econometric estimation methods. Apart from the random effects, the other three panel data analysis methods (dynamic GMM, pooled OLS, fixed effects) produced results that show that financial management's influence on mean mortality was negative but significant. This means that financial management reduced poverty and income inequality in CEECs, consistent with the World Bank (2001), which stated that better access to small loans and convenient financial products enables people to get the funding necessary to begin small self-employment projects.

Table 6. The income inequality function panel results

	Dynamic GMM	Fixed effects	Random effects	Pooled OLS
INEQ	0.4823***	-	-	-
MIN^{it-1}	0.3288	0.1835	−0.1218*	−0.1997**
INFR	−0.6931	−0.0227*	0.1743*	0.1634
MIN.INFR	−0.6372***	−0.2871	−0.1835**	0.0092
OPEN	0.0665	−0.2273*	−0.0452	0.4521*
ICT	0.0438	0.4573**	−0.2763**	0.0435
FDI	−0.5563***	−0.4009***	−0.5764	−0.4111
HCD	0.0065	0.4521	0.58976	0.6548
FIN	−0.5466**	−0.5491**	−0.1632	−0.3318**
Adjusted R-squared	0.56	0.59	0.65	0.68
J-statistic/F-statistic	251	89	71	54
Prob(J-statistic/F-statistic)	0.00	0.00	0.00	0.00

***, ** and * denote 1%, 5% and 10% levels of significance, respectively.
Source: author's compilation from E-Views.

The GINI coefficient is the measure of income inequality that was used in this study. Consistent with Azher (1995), previous income inequality exacerbated income inequality (measured the GINI ratio) in the CEECs. A non-significant positive relation-

ship running from mining towards income inequality (GINI ratio) was observed under the dynamic GMM and fixed effects, in line with Adei, dan Addei, and Kwadjose (2011), whose study laid bare the negative impact of mining activities on local people. Random effects and pooled OLS show that mining had a significant negative influence on the GINI ratio, in line with Sudarlan, Indiastuti, and Yusuf (2015, p. 195), whose study observed that mining helps to reduce income inequality.

The dynamic GMM showed that infrastructural development had a non-significant influence on the GINI ratio while fixed effects' impact on the GINI ratio was negative and significant. The results show that infrastructural development reduced income inequality in CEECs, which is consistent with Estache and Fay (1995), whose study noted that infrastructure reduces poverty and income inequality through better water quality, road infrastructure, lower manufacturing costs, and low transportation costs. By contrast, both random effects and pooled OLS shows that infrastructural development increased income inequality in CEECs, in support of Tsaurai and Nyoka (2019). Only the dynamic GMM and random effects show that the complementarity between mining and infrastructural development reduced income inequality in CEECs, in line with Dunning (1973), Denisia (2010), Moosa's (2010), and Xongo (2013), theoretical rationales.

The impact of trade openness on income inequality is mixed. Dynamic GMM showed that trade openness had a non-significant positive influence on the GINI ratio, while a significant positive relationship running from trade openness towards the GINI ratio was observed under the pooled OLS. This means that generally, trade openness increased income inequality, in contrast to Balassa (1978). However, fixed and random effects show that trade openness helped reduce income inequality in CEECs, in line with the available literature. The results on the impact of ICT on income inequality are mixed. Dynamic GMM, fixed effects, and pooled OLS show that ICT increased income inequality while the random effects indicate that income inequality reduction was spearheaded by ICT.

Conclusions

The study aimed to investigate the effect of mining on both poverty and income inequality in CEECs using econometric estimation methods with panel data spanning from 2009 to 2019. Another objective of this paper was to determine if the complementarity between mining and infrastructural development reduced poverty and/or income inequality in CEECs. What triggered the study is the failure of the existing literature to have a common ground regarding the impact of mining on poverty and or income inequality. The existing literature on the subject matter is contradictory, mixed, and divergent; hence, it paves the way for further empirical tests. The study confirmed that the vicious cycle of poverty is relevant in CEECs.

According to the dynamic GMM, mining had a significant poverty reduction influence in CEECs. The dynamic GMM and random effects revealed that the complementarity between mining and infrastructural development also enhanced poverty reduction in CEECs. Random effects and pooled OLS shows that mining significantly reduced income inequality in CEECs. However, random effects and the dynamic GMM results indicate that income inequality was significantly reduced by the complementarity between mining and infrastructural development in CEECs. The authorities in CEECs are therefore urged to implement mining growth and infrastructural development-oriented policies to successfully fight off the twin challenges of poverty and income inequality. Further research should investigate the existence of threshold levels of mining growth, and infrastructural development that must be reached before significant poverty and income inequality reduction can happen.

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Górnictwo, ubóstwo i nierówności dochodowe w krajach Europy Środkowej i Wschodniej: co mówią dane?

Artykuł prezentuje wyniki badania wpływu górnictwa zarówno na ubóstwo, jak i na nierówności dochodowe w krajach Europy Środkowej i Wschodniej, przy użyciu metod estymacji ekonometrycznej z wykorzystaniem danych panelowych z lat 2009–2019. Drugim celem tego artykułu było ustalenie, czy komplementarność górnictwa i rozwoju infrastruktury zmniejsza ubóstwo lub nierówności dochodowe w krajach Europy Środkowej i Wschodniej. Impulsem do podjęcia badań był brak w istniejącej literaturze przedmiotu wspólnego stanowiska w kwestii wpływu górnictwa na ubóstwo i nierówności dochodowe. Istniejąca literatura na ten temat jest sprzeczna, niejednoznaczna i rozbieżna, dlatego też otwiera drogę do dalszych badań empirycznych. Badanie potwierdziło, że błędne koło ubóstwa występuje w krajach Europy Środkowej i Wschodniej. Zgodnie z dynamicznymi uogólnionymi metodami momentów (GMM), górnictwo miało znaczący wpływ na redukcję ubóstwa w krajach Europy Środkowej i Wschodniej. Dynamiczna metoda momentów GMM i efektów losowych ujawniły, że komplementarność górnictwa i rozwoju infrastruktury również przyczyniła się do zmniejszenia ubóstwa w krajach Europy Środkowej i Wschodniej. Metoda efektów losowych i metoda pooled OLS pokazują, że górnictwo znacząco zmniejszyło nierówności dochodowe w krajach Europy Środkowej i Wschodniej. Jednak wyniki uzyskane przy zastosowaniu metody efektów losowych i dynamicznej metody GMM wskazują, że nierówności dochodowe zostały znacznie zmniejszone dzięki komplementarności górnictwa i rozwoju infrastruktury. W związku z tym zachęca się władze krajów Europy Środkowej i Wschodniej do wdrażania polityk ukierunkowanych na rozwój górnictwa i rozwój infrastruktury, aby skutecznie walczyć z podwójnymi wyzwaniami związanymi z ubóstwem i nierównościami dochodowymi.

Słowa kluczowe: górnictwo, ubóstwo, nierówności dochodowe, dane panelowe, kraje Europy Środkowej i Wschodniej

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Accountability on Sustainability in Central and Eastern Europe: An Empirical Assessment of Sustainability-Related Assurance

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Abstract

The paper explores how companies from Central and Eastern Europe adopt assurance practices to provide accountability for sustainability. Drawing on modified coding rules from prior research, a conventional content analysis of 36 assurance statements

companies from nine countries was conducted. The results imply differences in the content of reports, processes, and implementation of the standards.
Exclusively large and multinational enterprises from the energy sectors domiciled in Poland and Hungary are a typical portrait of a company from the study's sample, striving to issue and assure sustainability reporting. Of the nine countries represented in the study, sustainability assurance statements of companies from Poland, Hungary, and Romania tend to excel in terms of quality. The vast majority of assurance providers belong to the Big Four, who use ISAE3000 as opposed to AA1100AS. Yet, irrespective of the assurance provider type, stakeholders are neglected. It is argued that just transferring the experience of financial auditing to the field of sustainability, which, by and large, has taken place, is not an option. Authors state that following this route, we are heading in the wrong direction, and in technical terms, the wider proliferation of AA1100AS and its principles, with greater emphasis on reasonable assurance as opposed to the limited and enhanced role of stakeholders, are vital to get back on track.
The paper contributes to the emerging literature on accountability standards and stresses the need to enhance sustainability-related assurance.

Keywords: sustainability reporting, assurance statement, GRI, corporate social responsibility, reporting, auditing

JEL: Q56, M42, O44, O13, O57

Introduction

Societal pressure and the demand for organizations to be accountable for their social and environmental impact are mounting, and more and more companies respond to these pressures through the issuance of sustainability reports (SRs) (O'Dwyer, Owen, and Unerman 2011; Perego and Kolk 2012; Mikołajek-Gocejna 2016; 2018; Farooq and de Villiers 2019b). Over the past decade, sustainability reporting has morphed into a standard business practice among large global companies (Larrinaga et al. 2020). In its latest global survey, KPMG reports that the sustainability reporting rate in the G250 (250 largest companies by revenue on the Fortune 500) has been stable at between 90 and 95 % in the last four surveys (KPMG 2017).

During the last several decades, we have also observed the rise of international standards in the realm of sustainable development, like the Global Reporting Initiative (GRI) and the AccountAbility AA1000 Assurance Standard (Perego and Kolk 2012; Stocker et al. 2020). According to KPMG's Survey of Corporate Responsibility Reporting 2017, the GRI framework dominates as the framework for SR, as 63% of 4900 companies researched in the study and 75% of the 250 largest companies by revenue on the Fortune 500 report applying it. Meanwhile, only 13% of companies in the study and 12% of the 250 largest companies use stock exchange guidelines (KPMG 2017, p. 28).

Admitting that some companies may just provide sustainability reporting to "tick a box," and thereby enhance their legitimacy in the eyes of their stakeholders, independ-

ent sustainability-related assurance has been introduced as a mechanism to mitigate the risk of smoke screening (Ackers 2017a; Rossi and Tarquinio 2017; Boiral, Heras-Saizarbitoria, and Brotherton 2019b; Boiral and Heras-Saizarbitoria 2020). As a result, there is also a growing demand to provide extra credibility to this information through voluntary external assurance (Zorio, García-Benau, and Sierra 2013; Farooq and de Villiers 2019b). KPMG's survey indicates that 67% of SRs of the G250 included a formal assurance statement, compared with only 30% in 2005 (KPMG 2017, p. 26).

However, in spite of the steady expansion of SRs, the procedures regulating sustainability-related assurance and its contents are still in their infancy and contain no obligatory requirements whatsoever (O'Dwyer and Owen 2005; O'Dwyer, Owen, and Unerman 2011; Gürtürk and Hahn 2016; Ackers 2017b; Channuntapipat, Samsonova-Taddei, and Turley 2019; 2020; Boiral and Heras-Saizarbitoria 2020). The assurance of SRs remains "a valuable voluntary tool to provide them with higher credibility" (Zorio, García-Benau, and Sierra 2013, p. 484).

Furthermore, along with external transparency, sustainability-related assurance could play a much bigger role in internal sustainability performance measurement and management control. It is believed that companies also seek solid data approved by a third party to inform their decision-making and business strategies (Zorio, García-Benau, and Sierra 2013; Ruiz-Barbadillo and Martínez-Ferrero 2020).

However, vague, unstructured, and unclear sustainability-related assurance statements may miss out relevant information, thereby hollowing out the essence of assurance statements (Gürtürk and Hahn 2016). Prior studies on the issue encouraged studies that could shed light on how various accents on different matters and stipulations impact the value and quality of assurance reports (Zorio, García-Benau, and Sierra 2013; Quick and Inwinkl 2020).

Likewise, several authors questioned whether different frameworks and the applied guidelines and standards affect the provision of assurance statements and whether applied procedures differ depending on the type of assurance provider (Mock, Rao, and Srivastava 2013; Channuntapipat, Samsonova-Taddei, and Turley 2019; 2020; Farooq and de Villiers 2019a; Maroun 2019).

There is real concern that the assurance on sustainability reporting may become a formality, analogous to financial reporting (Boiral and Gendron 2011; Boiral and Heras-Saizarbitoria 2020). Boiral and Gendron (2011, p. 344) emphasize that financial and ISO audits are characterized by significant structural deficiencies, "thereby casting doubt on the exemplification assumption used to justify their import in the sustainability area." In other words, they stress that sustainability auditing is mature enough to become "a site for the reproduction of 'rational myths' that surround the spread of auditing practices in society" (Boiral and Gendron 2011, p. 339). They further claim that "rational myths reflect the ceremonial and superficial adhesion to apparently rational structures and beliefs primarily intended to meet external pressures and reinforce organizational legitimacy, yet they are actually 'decoupled' from organizational practices" (Boiral and Gendron 2011, p. 339).

The same sentiments are shared by Boiral and Heras-Saizarbitoria (2020, p. 1), who state that "assured sustainability reports … do not demonstrate a material, substantial, and credible verification process" and that "they tend rather to appear as a hyperreal practice largely divorced from critical sustainability issues and stakeholder concerns."

Against this background, this study aims to provide evidence on the quality of sustainability-related assurance statements in Central and Eastern Europe (CEE). As the quality of assurance reports differs in practice due to various variables, we will dissect this process into components and assess its quality based on the coding rules of Perego and Kolk (2012).

To the best of our knowledge, sustainability-related assurance in CEE has not been the subject of peer-review study so far, and research on sustainability-related assurance remains limited in scope and breadth (Hahn and Kühnen 2013). The trend for sustainability-related assurance in this region is not felt so urgently as in Western Europe and Northern America. As Gheorghita Diaconu, Director of Sustainability Services of KPMG in Romania, stated: "Many businesses in Eastern Europe are still focused on the financial bottom line rather than the triple bottom line – it's fair to say that a culture of sustainability is yet to properly take hold across the region" (KPMG 2017, p. 14). This is confirmed by the data: sustainability reporting rate in Western Europe equals 82%, while in Eastern Europe – 65% (KPMG 2017, p. 14). In terms of countries from CEE in 2017 sustainability reporting rate was Hungary 77%, Romania – 74%, Poland – 59%, Czech Republic – 51%, Slovakia – 55% (KPMG 2017, p. 16).

Nevertheless, this fledgling field is steadily developing, and more and more companies are joining the ranks of sustainability reporting firms each year. One of the connotations of "fledgling" is to be malleable, and it is why it is very important to study this phenomenon in order to be able to correct the projection of its developments if necessary.

The focus of this paper is sustainability assurance in the reporting of companies from CEE. Therefore, this paper critically appraises the value to users and the quality of the information in sustainability-related assurance statements to understand current sustainability assurance practices in CEE.

This focus is instrumental for us to achieve the following research goals. First, the study concerns itself with the differences in assurance practices and has a goal to enrich prior study findings through extending the study base by including companies of CEE and by explicating these differences. The paper explicates whether different assurance providers and assurance standards are related to the assured content, work performed, and overall quality of assurance statements.

Second, the paper appraises the quality of assurance reports, which are assessed against the coding rules developed by Perego and Kolk (2012) to provide a clue whether the quality of assurance hinges on the assurance provider of reports (Accountants vs. Non-accountants), addressees of assurance statement (Management, Shareholders, Stakeholders), applied standards (AA1000, ISAE3000, ISRS 4400), and other variables.

Therefore, the underlying motive of this study is to provide additional evidence on the practice and quality of assurance reports in CEE. We presuppose that providing such a look at assurance practice has implications for the perceived nature of this practice as well as for the reliance placed on assurance statements and appraisal of the information assured.

Achieving these two goals would also mean ascertaining how contemporary assurance practices in CEE impact expected information benefits for management and stakeholders. The conclusions of the paper provide an examination of the information value of assurance statements for external users.

To accomplish these goals, this study uses coding rules developed by prior studies (mostly Perego and Kolk 2012) and employs deductive content analysis on the sustainability-related assurance reports by CEE companies from the GRI Sustainability Disclosure Database (SDD). We limit ourselves only to SRs based on GRI standards – the latest guidelines developed by the Global Sustainability Standards Board. The object of this study is 15 countries: Belarus, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Montenegro, Poland, Romania, Slovakia, Slovenia, and Ukraine.

Specifically, the paper examines the information that is subject to external assurance: the scope and level of assurance, the applied assurance standards, and the varieties of assurance engagement forms. The study also analyzes the assurance provider and the effect of various types of assurance provider on assurance quality. It also scrutinizes the addressees of assurance statement and evaluates the variability of the assurance statements content and, through it, assess the transparency of assurance statements and their usefulness for stakeholders and internal management.

The article is structured as follows. The paper commences with a review of the relevant literature that provides the theoretical framework used in this study. This is followed by content analysis and descriptive results of the study. The final section discusses the findings and concludes with consequences for theory and practice.

Conceptual background and theory

The assurance of sustainability reporting by a third party is widely believed to be the proper response that can restore and enhance public confidence in SRs (Gürtürk and Hahn 2016; Boiral, Heras-Saizarbitoria, and Brotherton 2019a; Farooq and de Villiers 2019b; Michelon, Patten, and Romi 2019; Haider and Nishitani 2020; Maroun 2020).

The need to increase the reliability of SRs is clearly evident in the rapid increase in the number of SRs that were accompanied by an assurance report. In 2017 (latest available report), 67% of the sustainability reports of the G250 companies included a formal assurance statement, compared with only 30% in 2005 (KPMG 2017, p. 26). In N100 companies (3543 companies studied), the sustainability reporting rate is also

steadily growing, reaching 45% in 2017 – up 12 percentage points compared to the 2005 level (33%) (KPMG 2017, p. 26).

Many authors also believe that such an increase attests to the development of the "audit society" first discerned by Michael Power (1997; 1999) in the late 1990s (Boiral, Heras-Saizarbitoria, and Brotherton 2019a). It also testifies to the predominance of accountancy organizations, which represent 75% of SR assurance providers (KPMG 2017; Boiral, Heras-Saizarbitoria, and Brotherton 2019a; Channuntapipat, Samsonova-Taddei, and Turley 2020). This emphasis on the practices and institutional arrangements that were first brought to life and are now prevalent in finance is a hallmark of the "audit society". This hallmark is also manifested through the fact that although sustainability assurance is based on specific standards (AA1000 and ISAE 3000), these standards are in turn, based on general auditing principles, i.e., ethical principles, the independence and impartiality of auditors, the scope of an engagement, different levels of assurance, and even the structure of the assurance statements (Boiral, Heras-Saizarbitoria, and Brotherton 2019a; Channuntapipat, Samsonova-Taddei, and Turley 2020).

Although the external evaluation of SRs is still controversial, most researchers agree that such assurance is useful and even necessary (Fédération des Experts Comptables Européens 2006; Jones and Solomon 2010; Boiral, Heras-Saizarbitoria, and Brotherton 2019a; 2019b; Farooq and de Villiers 2019a; Channuntapipat, Samsonova-Taddei, and Turley 2020). This is because, by giving their opinions, assurance providers are believed to reduce uncertainty and inherent information asymmetry which inevitably arises between managers and stakeholders (O'Dwyer, Owen, and Unerman 2011; Moroney, Windsor, and Aw 2012; Gürtürk and Hahn 2016; Boiral, Heras-Saizarbitoria, and Brotherton 2019a). The next positive impact linked to sustainability-related assurance is caused by its disciplinary effect on the company since it is believed that auditor scrutiny persuades companies to enhance and fine-tune their sustainability reporting approach (Park and Brorson 2005; Haider and Nishitani 2020; Nishitani, Haider, and Kokubu 2020).

Further, it should be noted that because some assurance standards contain requirements for stakeholder inclusivity and responsiveness, the assurance process increases the level of consultation with the stakeholders (Park and Brorson 2005; Haider and Nishitani 2020; Nishitani, Haider, and Kokubu 2020). The latter effect follows from the external verification procedure itself, which involves interviews with stakeholders, primarily internal (employees) ones, but also external. All this leads to the internalization of GRI principles and it, in turn, could usher in the era of stakeholder responsiveness in companies, and, as a result, sustainability-related assurance guides companies into genuine stakeholders' accountability (Boiral, Heras-Saizarbitoria, and Brotherton 2019a).

However, the literature also contains critical authors who see many flaws in sustainability-related assurance. One of the weaknesses of sustainability-related assurance that compromises the whole process, and which was inherited from financial audits,

is that the assurance provider is financially dependent on the customer (O'Dwyer, Owen, and Unerman 2011; Perego and Kolk 2012; Boiral, Heras-Saizarbitoria, and Brotherton 2019a; Nishitani, Haider, and Kokubu 2020). Such financial relationships push the auditor to behave uncritically when he does not seriously question the reliability of the data provided. The auditor's financial dependence on the companies may eventually lead to a situation where skepticism and impartiality – the cornerstones of assurance – would be compromised (Gilbert, Rasche, and Waddock 2011; Boiral, Heras-Saizarbitoria, and Brotherton 2019a; Haider and Nishitani 2020).

Several papers emphasize the managerial capture of information in sustainability reporting as a reason for it not being as efficient as it might otherwise be (O'Dwyer and Owen 2007; Jones and Solomon 2010; Smith, Haniffa, and Fairbrass 2011; Farooq and de Villiers 2019a). The managerial capture is manifested in the fact that managers have control over the information, and the auditor, in turn, must rely on his/her assessment of this information, which can be limited or distorted in a way that will benefit the managers (Smith, Haniffa, and Fairbrass 2011).

The third aspect that must be highlighted is the professionalism of assurance providers and the rigor of the practice (Park and Brorson 2005; Smith, Haniffa, and Fairbrass et al. 2011; Boiral, Heras-Saizarbitoria, and Brotherton 2019a; Ruiz-Barbadillo and Martínez-Ferrero 2020). Unlike in financial auditing, sustainability assurance is not so developed because it is not based on one generally accepted standard, nor is the professional self-organization at the proper level. In financial auditing, for example, there are minimum requirements for experience and training that an auditor must meet in order to be admitted to practice; that is not the case in sustainability assurance. Many auditors view this process as a continuation of the financial audit, but this is only partially true. As a result, many sustainability-related assurances are carried out superficially just to obtain a certificate, get the label "is verified," and thereby enhance the social legitimacy of reporting companies (Park and Brorson 2005; Smith, Haniffa, and Fairbrass 2011; Boiral, Heras-Saizarbitoria, and Brotherton 2019a; Boiral and Heras-Saizarbitoria 2020; Ruiz-Barbadillo and Martínez-Ferrero 2020).

Perego and Kolk (2012) even claim that "managerial capture" and "rational myths of certification" are produced, sustained, and become institutionalized over time" (Perego and Kolk 2012, p. 176). Such behavior has long been known and fully falls under the explanation of the legitimacy theory, which claims that many companies, under strong institutional pressure, superficially adopt new practices to increase their social legitimacy (Smith, Haniffa, and Fairbrass 2011; Boiral, Heras-Saizarbitoria, and Brotherton 2019a; Safari and Areeb 2020).

Despite this ambiguity in the development of sustainability-related assurance, most studies do not critically question the value, significance, or legitimacy of third-party assurance on sustainability reporting.

Methods

This study applies deductive content analysis to sustainability-related assurance statements published using GRI standards by CEE companies retrieved from the GRI Sustainability Disclosure Database (SDD). To ensure the relevance of the study, we limit ourselves only to SRs based on GRI standards – the latest guidelines developed by the Global sustainability standards board. Issued in 2016 and effective (with exception) from 1 Jul 2018, the GRI standards represent the latest development in the sustainability reporting framework. The object of our study is 15 countries: Belarus, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Montenegro, Poland, Romania, Slovakia, Slovenia, and Ukraine (Table 1).

Table 1. Companies from Central and Eastern Europe in the GRI database

	Organizations	Sustainability Reports	Assured reports	Available for analysis reports
Belarus	0	0	0	0
Bulgaria	0	0	0	0
Croatia	5	8	3	2
Czech Republic	12	17	4	3
Estonia	2	2	1	1
Hungary	13	23	12	9
Latvia	4	6	5	4
Lithuania	5	5	0	0
Moldova	0	0	0	0
Montenegro	0	0	0	0
Poland	50	66	13	12
Romania	13	22	3	1
Slovakia	0	0	0	0
Slovenia	6	12	3	3
Ukraine	2	4	1	1
Total	112	165	45	36

Source: Prepared by authors based on data derived from https://database.globalreporting.org/ (accessed: 16.06.2020).

We used the GRI SDD search engine, and our search filter was arranged as follows: size: *no selection*; sector: *no selection*; country: *15 mentioned countries*; region: *no selection*; report type: *GRI – Standards*; reporting year: *no selection*. The search returned 112 organizations that submitted 165 SRs. Only 45 (27.3%) of those reports were assured, and due to the inability to retrieve assurance statements (in three instances) and the fact that the language of assurance statements was unintelligible for the authors (six instances), our population was reduced by nine; our final sample totals 36 assurance statements.

In order to determine the quality of the assurance statements, this study applied 19 coding rules originally proposed O'Dwyer and Owen (2005) and modified by Per-

ego and Kolk (2012) and four coding rules put forward by Gürtürk and Hahn (2016). In total, we have at our disposal 23 coding rules that define the quality of assurance statements based on the AccountAbility, Federation of European Accountants, and GRI guidelines. The maximum score an assurance report could get according to our coding rules is 35 points.

The use of these codes not only allowed us to analyze reports on various grounds but also allowed us to rank the reports and identify patterns. We employ "conventional content analysis," according to the classification of Hsieh and Shannon (2005), and followed the guidelines of standard content analysis methodology (Hsieh and Shannon 2005).

In total, four people were involved in the coding process, among them two authors of the article and two independent coders. This was the basis that allowed personal assessment to give way to abstract estimation and to obtain inter-subjective judgments (Gürtürk and Hahn 2016). To ensure replicability and the reliability of the study, the research process was reinforced with circumstantial documentation throughout the entire process.

Results

The results of our study can be presented in three subsections, which will contribute to a clearer presentation of the material. In the first section, we describe the overall results of our study. This subsection is followed by an analysis of the assurance reports' transparency, which is assessed based on the coding rules. The third subsection depicts the relationships between the given feature of the reports and their quality.

General features of the assurance reports

The descriptive statistics of our sample are provided in Table 3, and they serve as a reference point to quickly grasp the features and attributes of our sample. The descriptive statistics of companies with assured SRs comprises two groups: all assured SRs (45) and those available for analysis (36).

Each report begins with the addressee, to whom it is addressed, which, as we later see, is already the first harbinger of quality. During coding, we identified three groups to whom the SRs can be addressed: 1) the reporting company (management, board of directors, shareholders), 2) the general public or all stakeholders, and 3) no addressee mentioned. The vast majority of reports in our sample (25) are addressed to management, only five are addressed to stakeholders, and four mention no addressee at all (Table 3).

Table 2. Descriptive statistics of companies with assured sustainability reports

Reporting year						
2019	2018	2017	2017/2018	2016/2017	2016	**Total**
3	19	14	2	2	5	**45**
3	17	12	1	1	2	**36**

Size			
Large	MNE	SME	Total
33	11	1	45
25	11	0	36

Sector									
Energy	Telecoms	Financial Services	Energy Utilities	Retailers	Logistics	Healthcare Products	Miscellaneous (Agriculture, Construction, Consumer Durables, Metals Products, Railroad, Retailers, Textiles and Apparel, Water Utilities) each =1	Food and Beverage Products	**Total**
13	7	5	4	4	2	2	7	1	**45**
11	7	3	3	1	2	2	7	0	**36**

Country									
Croatia	Czech Republic	Estonia	Hungary	Latvia	Poland	Romania	Slovenia	Ukraine	**Total**
3	4	1	12	5	13	3	3	1	**45**
2	3	1	9	4	12	1	3	1	**36**

Source: own calculations based on data derived from https://database.globalreporting.org/ (accessed: 16.06.2020).

Table 3. General details of assurance statements

Criteria	Features
Addressees of statement (*available reports only*)	• Reporting company (27) – *management* (25) – *board of directors* (1) – *shareholders* (1) • General public or all stakeholders (5) • No addressee mentioned (4)

Criteria	Features
Type of assurer	• Accounting firm (33) • Small consultancy/ boutique firm (11) • Engineering firm (1)
Assurance Provider	• Deloitte (14) • Ernst & Young (8) • PricewaterhouseCoopers (7) • Bureau Veritas (4) • KPMG (3) • Baker Tilly (1) • Other (8)
Level of assurance	• Limited/moderate (38) • Combination (2) • Not specified (5)
Assurance Scope	• Specified section(s) (32) • Entire sustainability report (10) • Not specified (2) • GHG only (1)
Assurance standard	• ISAE3000 only (32) • AA1000 only (4) • Combination of ISAE3000 and AA1000 (2) • ISRS 4400 (1) • not specified (6)

Source: own calculations based on data derived from https://database.globalreporting.org/ (accessed: 16.06.2020).

The sustainability assurance market is fragmented, with various types of sustainability assurance providers competing with each other and using different approaches, guidelines, and standards to meet the needs of various customers (Farooq amd de Villiers 2019c). The market is also poorly regulated, if not completely unregulated, indicating the presence of different sustainability assurance providers. In our sample, the Big Four companies still dominate the field as the assurance providers in 73.3% of cases, while small consultancy/boutique firms and engineering firms assured only 12 SRs. Deloitte has the biggest slice, as the assurance provider in slightly more than 1/3 of the cases we analyzed. Ernst & Young follows suit with eight reports (17.8%), while PricewaterhouseCoopers closes the biggest three sustainability providers of our sample with seven reports (15.6%).

A limited/moderate level of assurance prevails among the analyzed sustainability assurance reports – 38 cases (84.4%), while only two assurance reports could boast reasonable assurance, although combined with limited/moderate assurance. In four reports (8.9%), the level of assurance is not specified, which runs counter to whatever possible standards.

The coverage or assurance scope is also an important aspect of a sustainability assurance report, revealing how deep auditors dig while on the engagement. Most of the analyzed assurance reports (32 instances, i.e., 71.1%) cover only specified section(s), while the entire SR is covered in 10 instances (22.2%). Only two companies did not

specify the assurance scope, and one spread its opinion on Greenhouse Gas (GHG) protocol only.

The assurance standards were clearly indicated in 39 reports (86.7%), and mention of it was omitted in 6 (13.3%). An overwhelming majority of auditors make use of ISAE3000, as this standard, along with or in combination with others, is mentioned 34 times (75.6%). The more robust and more specialized sustainability auditing AA1000AS, alone or combined with other standards, is mentioned in only six instances (13.3%). What surprised us was the application of ISRS 4400, employed once by one of the Big Four companies.

Analysis of the assurance reports' transparency

All these above-described factors were also taken into account in our coding rules, which were developed based on the requirements of the AccountAbility, Federation of European Accountants, and GRI guidelines. The highest possible score our coding rules allowed is 35 points. All reports available for analysis were scored against the coding rules, and this resulted in an overall mean of 16.58, with a standard deviation of 2.73. The most comprehensive statements in the sample scored 25 points, while the least transparent managed to get only nine points (Table 4).

The report that scored 25 points achieved only 71.4% from the available 35, which poses the perennial question "why?" In answering this question, it is imperative to understand how particular features of the assurance report affected its transparency and quality. The quality score of the assurance reports hinges on various attributes, and the next subsection of the results section is devoted exactly to that enterprise. Our results are consistent with prior studies, drawing on content analysis like Gürtürk and Hahn (2016) and Perego and Kolk (2012). The overall mean in Gürtürk and Hahn's study was 16.86, with a standard deviation of 5.41 (Gürtürk and Hahn 2016, p. 35). The overall mean in Perego and Kolk's study was 11.87, with a standard deviation of 5.31 (Perego and Kolk 2012, p. 182). If we consider that the last authors carried out research for several years (beginning in 1999, i.e., when there was no GRI), it is not surprising that the quality is improving. However, it should be noted that the objects of analysis were different in all of these studies, which makes comparison impossible.

Table 4. Scores of comprehensiveness and transparency of assurance statements

	Company	Overall score	Coding rule number																						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	Alteo Group 2017	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
2	Alteo Group 2018	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
3	AS Tallinna Vesi	15	1	1	1	0	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
4	Astarta	15	1	1	1	0	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
5	Budimex	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
6	Energetický a průmyslový holding (EPH) 2017	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
7	Energetický a průmyslový holding (EPH) 2018	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
8	EP Infrastructure	9	0	1	1	1	1	0	0	0	0	0	0	0	1	1	2	0	0	0	0	1	0	0	0
9	Hungarian Post Service	12	1	0	1	1	1	1	1	0	0	1	0	0	1	0	2	0	0	0	1	0	0	1	0
10	INA Group 2019	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
11	INA Group 2017	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
12	Kaufland România	22	1	1	1	1	0	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	0	1	1
13	Latvenergo 2017	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
14	Latvenergo 2018	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
15	Latvenergo 2019	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
16	Latvian Railway	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
17	LPP	19	1	2	1	0	1	1	1	1	0	1	1	1	2	1	2	1	0	0	1	1	0	0	0
18	Magyar Telekom 2016	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
19	Magyar Telekom 2018	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
20	MOL Group 2016	25	1	1	1	1	1	1	1	1	0	1	2	2	1	1	2	1	1	1	2	0	1	1	1
21	MOL Group 2017	21	1	1	1	1	1	1	1	1	0	1	2	0	1	1	2	1	1	1	1	1	0	1	0
22	MOL Group 2018	21	1	1	1	1	1	1	1	1	0	1	2	0	1	1	2	1	1	1	1	1	0	1	0
23	Nowy Styl Group	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
24	OTP Bank	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0

Table 4. (continued)

Company		Overall score	Coding rule number																						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
25	Telekom Slovenije 2017	15	1	0	1	0	1	1	1	1	1	0	0	1	1	0	1	1	0	0	1	1	0	1	1
26	Telekom Slovenije 2018	15	1	0	1	0	1	1	1	1	1	0	0	1	1	0	1	1	0	0	1	1	0	1	1
27	Telekom Slovenije 2019	15	1	0	1	0	1	1	1	1	1	0	0	1	1	0	1	1	0	0	1	1	0	1	1
28	Adamed Pharma S.A.	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
29	ArcelorMittal Poland	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
30	Orange Polska	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
31	Orange Polska	19	1	2	1	0	1	1	1	1	0	1	1	1	2	1	2	1	0	0	1	1	0	0	0
32	Polpharma	19	1	2	1	0	1	1	1	1	0	1	1	1	2	1	2	1	0	0	1	1	0	0	0
33	Provident	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
34	PSE	19	1	2	1	0	1	1	1	1	0	1	1	1	2	1	2	1	0	0	1	1	0	0	0
35	Raben Group	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0
36	Santander Bank Polska	16	1	1	1	1	1	1	1	1	0	1	1	0	1	1	2	0	0	0	1	1	0	0	0

Source: own calculations based on data derived from GRI Database, https://database.globalreporting.org/ (accessed: 16.06.2020).

Relationships between the given feature of the reports and their quality

In these pages, we will analyze the differences between the assurance reports on two sets of criteria. The first simply helps us to understand the state of sustainability-related assurance in CEE, and the second directly affects the quality of the report. Let us start with the former and conclude with the latter.

This study analyzes the assurance statements that back sustainability reporting according to GRI Standards issued by CEE companies retrieved from the GRI Sustainability Disclosure Database (SDD). We initially analyzed fifteen countries, but due to the lack of data in six of them, our sample includes only nine countries (Table 5).

Table 5. Differences between countries

Country	Sustainability reports	Assured reports	Assured reports		Average overall assurance quality score	Standard deviation per standard
			Absolute count	Relative count		
Poland	66	19.7%	12	33.3%	17.00	1.48
Hungary	23	52.2%	9	25.0%	17.67	3.91
Latvia	6	83.3%	4	11.1%	16.00	0.00
Czech Republic	17	23.5%	3	8.3%	13.67	4.04
Slovenia	12	25.0%	3	8.3%	15.00	0.00
Croatia	8	37.5%	2	5.6%	16.00	0.00
Estonia	2	50.0%	1	2.8%	15.00	0.00
Romania	22	13.6%	1	2.8%	22.00	0.00
Ukraine	4	25.0%	1	2.8%	15.00	0.00
Total	160	-	36	-	-	-

Source: own calculations based on data derived from GRI Database, https://database.globalreporting.org/ (accessed: 16.06.2020).

Although this analysis is not statistically representative due to the small number of cases, it sheds light on the current state of sustainability-related assurance and helps understand it better. Of the three sustainability reporting cases in Romania, only one was assured, and it gets one of the highest scores in our study, earning 22 points. However, if we consider this case an outlier, then the highest scores in our sample are Hungary (17.67 and SD 3.91) and Poland (17.00 and SD 1.48). At the bottom of our conditional ranking table is the Czech Republic. Although it shows the highest level of variation (SD 4.04), on average, companies from this state gained 13.67.

An important aspect is the analysis of company size is "the external assurance of SRs [which] is very much a large company phenomenon" (Bebbington, Unerman, and O'Dwyer 2014, p. 72). The paper testifies to that statement since there were no assured SRs companies that fall into the small and medium categories. However, our sample does include one instance when an SME submitted a sustainability report according to GRI Standards (AST for 2017, Latvia), but disappointingly, the assur-

ers provided the report in the national language, disqualifying it from our scrutiny. Subsequently, we scrutinized exclusively large and multinational enterprises (MNEs) (Table 6).

Table 6. Differences between types of companies

	Assurance scope				Level of assurance			Average overall assurance quality score	Standard deviation per standard
	Specified section(s)	Entire sr	Ghg only	Not specified	Limited / moderate	Combination	Not specified		
Large	76.0%	16.0%	0.0%	8.0%	100.0%	0.0%	0.0%	16.48	1.87
MNE	45.5%	45.5%	9.0%	0.0%	54.5%	18.2%	27.3%	16.82	4.19

Source: own calculations based on data derived from GRI Database, https://database.globalreporting.org/ (accessed: 16.06.2020).

Table 6 shows that MNEs clearly made more effort than large companies. MNEs assured the entire SR in almost half the cases, while large companies did it in only 16.0% of cases. Moreover, MNEs requested the highest possible level of assurance – reasonable assurance (in 18.2% cases), while large companies were satisfied with the limited/moderate assurance provided by the auditors in all cases. Last but not least, MNEs scored on average 16.82 compared with 16.48 for large companies.

Another aspect to consider is which industry the companies belong to, as the pressure from stakeholders, as well as the inherent risk for the environment in each industry, is different. It is believed that the mining and energy sectors are the most prone to "unwanted spin-off effects," and the intensity of institutional pressures on such industries is also the highest (Boiral, Heras-Saizarbitoria, and Brotherton 2019a).

While our sample does not include the mining sector, the energy sector is well represented, with 14 companies belonging to this category (eleven energy companies and three energy utilities (Table 7).

Table 7. Differences between companies by sector

Sector	Number	Assurance scope				Level of assurance			Average overall assurance quality score	Standard deviation per standard
		Specified section(s)	Entire sr	Ghg only	Not specified	Limited / moderate	Combination	Not specified		
Energy	11	90.9%	9.1%	0.0%	0.0%	81.8%	18.2%	0.0%	17.36	4.11
Telecommunications	7	42.9%	57.1%	0.0%	0.0%	57.1%	0.0%	42.9%	16.00	1.41
Financial Services	3	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	16.00	0.00

Sector	Number	Assurance scope				Level of assurance			Average overall assurance quality score	Standard deviation per standard
		Specified section(s)	Entire sr	Ghg only	Not specified	Limited / moderate	Combination	Not specified		
Energy Utilities	3	0.0%	66.7%	0.0%	33.3%	100.0%	0.0%	0.0%	16.00	0.00
Logistics	2	50.0%	50.0%	0.0%	0.0%	100.0%	0.0%	0.0%	14.00	2.83
Healthcare Products	2	50.0%	50.0%	0.0%	0.0%	100.0%	0.0%	0.0%	17.50	2.12
Miscellaneous	8	75.0%	0.0%	12.5%	12.5%	100.0%	0.0%	0.0%	16.88	2.42

Source: own calculations based on data derived from GRI Database, https://database.globalreporting.org/ (accessed: 16.06.2020).

Energy sector companies more often strive to get the highest level of assurance from assurance providers. In our sample, energy companies exclusively have reasonable assurance from auditors. On average, companies from this sector were assessed to have the second-highest score earning, on average (17.36), giving way only to the healthcare products sector with its 17.50 assurance quality score. Of the four cases where AA1000AS standards were applied, three are in the assurance reports of energy sector companies.

We do not know the motivation for these actions, and this is beyond the scope of our study, but we see that energy sector companies excel in sustainability-related assurance. It is not stated whether it is to do with conscious actions or pressure from stakeholders, the desire to please them and gain perceived legitimacy of their activities (Bebbington, Unerman, and O'Dwyer 2014, p. 5).

Paradoxically, however, the quality of sustainability-related assurance decreases over the years. The maximum was 19.0 for the assurance reports for 2016 and 2016–2017, and then each year, it slipped a little with a nadir reached for SR in 2019, when the average score was 15.7 (Table 8).

Table 8. Quality of assurance statements per year

Year	Assured reports		Assurance quality score mean	Sd	Min	Max
	Absolute count	Relative count				
2019	3	8.3	15.7	0.6	15	16
2018	17	47.2	15.9	2.6	9	21
2017 and 2017–2018	13	36.1	17.2	2.3	15	22
2016 and 2016–2017	3	8.3	19.0	5.2	16	25

Source: own calculations based on data derived from GRI Database, https://database.globalreporting.org/ (accessed: 16.06.2020).

In our opinion, this can be explained by the increasing number. As the number of assurances grows, so does the number of cases in which the Big Four are auditors. They, in turn, mostly use only one standard – ISAE3000 – which, as we show later, is inferior (according to our coding rules) to AA1000AS. In our sample, AA1000AS was applied as a basis for assurance reports in 2016 (1 case), 2017 (2 cases), and 2018 (1).

Now move to the attributes of sustainability-related assurance reports that directly impact the quality of the report, namely the standards applied, the assurance provider, and the addressees of the assurance statement.

As we have already noted, there is a difference in the quality of the report depending on the standards applied (Table 9). This is especially noticeable when we split the sample into two groups: one includes AA1000AS separately or combined, and one without AA1000AS.

Table 9. Differences between applied standards

Assurance standard	Assured reports		Average overall assurance quality score	Standard deviation per standard
	Absolute count	Relative count		
ISAE3000	27	75.0	16.37	1.15
Not specified	4	11.1	14.25	1.50
Combination (AA1000AS AND ISAE3000)	3	8.3	22.33	2.31
AA1000AS only	1	2.8	22.00	0.00
ISRS 4400	1	2.8	9.00	0.00

Source: own calculations based on data derived from GRI Database, https://database.globalreporting.org/ (accessed: 16.06.2020).

The use of AA1000AS and compliance with it during the assurance process significantly increases the assurance quality score. In our sample, assurance reports that apply only AA1000AS score, on average, 22.00. Combining AA1000AS with ISAE3000 produces a report with an average assurance quality score of 22.33. ISAE3000 used separately scores, on average, 16.37. However, the use of AA1000AS does not depend on whether the assurance provider belongs to the accountant or non-accountant category (Table 10).

Table 10. Differences between accountant and non-accountant assurance providers

Assurance provider	Assurance process includes aa1000as standard	Assured reports		Average overall assurance quality score	Standard deviation per standard
		Absolute count	Relative count		
Accountants	11.5%	26	72.2	16.50	2.72
Non-accountants	10.0%	10	27.8	16.80	2.90

Source: own calculations based on data derived from GRI Database, https://database.globalreporting.org/ (accessed: 16.06.2020).

In our sample, accountant or non-accountant providers made use of AA1000AS roughly equally in about 1/10 cases. Similarly, there is no clear distinction between accountant or non-accountant providers based on the assurance quality score, respectively 16.50 and 16.80.

AA1000AS was employed three times by one of the Big Four companies, Ernst & Young, and specialized provider SK Sustainability Knowledge Group Ltd, which boasts it is an AA1100 licensed assurance provider. Yet, regardless of the assurance providers, the inclusivity of the stakeholders in the process does not play a pivotal role in most companies (Table 11).

Table 11. Differences between addressees of assurance statement

Addressees of assurance statement	Assured reports		Average overall assurance quality score	Standard deviation per standard
	Absolute count	Relative count		
Management	25	69.4	16.84	2.27
No addressee mentioned	5	13.9	15.80	3.70
Stakeholders	4	11.1	18.25	1.50
Board of directors	1	2.8	9.00	0.00
Shareholders	1	2.8	15.00	0.00

Source: own calculations based on data derived from GRI Database, https://database.globalreporting.org/ (accessed: 16.06.2020).

In most cases (69.4%), the addressee is management, again, regardless of the applicable standards. By the same token, we can assume that appealing to the board of directors (1 case) and shareholders (1 case), they are also considered addressees by the reporting company. Stakeholders are addressees in only four instances, constituting 11.1% of cases. Interestingly, all assurance reports that address stakeholders were provided by Bureau Veritas, a company that specializes in testing, inspection, and certification, with its headquarters in Paris, France.

Limitations of the study

Our study focused only on companies in CEE that a) are in the GRI SDD database and b) have submitted their SR reports in accordance with GRI Standards. This approach has its advantages, as it allows us to employ comprehensive sampling (all companies matching the criteria are included without any limitations) and to focus only on recent practice in the field. At the same time, however, due to the low level of proliferation of sustainability-related assurance in CEE and the filter settings used, our sample was slightly smaller than we expected, which led to a reduction in the volume of research and the cancellation of some of the elements we had planned prior. Among others, we abandoned our idea to use the auditor's suggestions for improvement as only a few reports contained them.

Although we have taken all precautions to prevent it, a certain element of subjectivity may also be present in the coding system we use and how it was applied. We used recognized coding rules employed extensively throughout the field (O'Dwyer and Owen 2005; Perego and Kolk 2012; Gürtürk and Hahn 2016), but these coding rules are a collection of various aspects from different norms (the AccountAbility, Federation of European Accountants, and GRI guidelines). It implies that the weight of different elements may vary depending on the views of the authors, and it may bear the blame for some irregularities between the studies.

In spite of the two independent coders and two authors of this paper coding the sustainability-related assurance reports in a way that we believe has ruled out any subjectivity in our assessment and made it inter-subjective, there always remains a chance that four other people might have collectively come to a different opinion than those who coded this study.

Discussion and conclusions

Sustainability reporting and sustainability-related assurance have been used by organizations in an effort to be accountable to their stakeholders. Moreover, sustainability reporting has become a *lingua franca* in the communication between companies and stakeholders. A better understanding of current practices is crucial for comparative and trend analyses (Junior, Best, and Cotter 2014).

This study reviewed the sustainability-related assurance reports from companies based in the CEE region. This paper demonstrates that organizations in CEE use SRs assured by auditors to provide accountability about their environmental and social performance. Although those efforts are made irrespective of geographic location and the level of economic development of the country they are based in, sustainability-related assurances of companies were analyzed in only nine of the fifteen countries studied.

Employing the modified coding rules from prior research, a conventional content analysis of 36 assurance statements was conducted. To the best of our knowledge, this paper is a pioneer in examining current sustainability-related assurance practices in CEE.

Although companies from nine countries were the subject of the study, it should be noted that more than half of all sustainability reporting (55.6%) and assurance statements accompanying them (58.3%) come from two countries Poland and Hungary, with the former outnumbering the latter.

The overall mean of our study is 16.58, with a standard deviation of 2.73. The most comprehensive statements in the sample scored 25 points, while the least transparent managed to get only nine points with the maximum score achievable 35 points. We scrutinized exclusively large and multinational enterprise (MNE) companies. In this regard, we conclude that MNEs clearly made an effort more than large companies. Energy sector companies more often strive to get the highest level of assurance

from assurance providers, which is testified by the fact that in our sample, exclusively energy companies have reasonable assurance from auditors (as opposed to the prevailing limited/moderate assurance). On average, companies from the energy sector were assessed to have the second-highest score, earning, on average, 17.36. They were second only to the healthcare products sector with its 17.50 assurance quality score. Furthermore, of the four cases of applying AA1000AS standards in our sample, three are in assurance reports of energy sector companies.

The quality of sustainability-related assurance declines over the years, from 19.0 (2016 and 2016–2017) to 15.7 (2019). The difference in the quality of the assurance report is particularly conspicuous on the dividing line between those with and without AA1000AS. Compliance with AA1000AS boosts assurance quality scores a good deal. Similarly, there is no clear distinction between accountant or non-accountant providers based on assurance quality scores, respectively, 16.50 and 16.80. In most cases, the addressee is management, while stakeholders are addressees in only four instances, constituting 11.1% of cases.

The vast majority of assurance providers belong to the Big Four, who use ISAE3000, which, based on our coding rules, we found to be inferior in quality compared to AA1100AS. Yet, irrespective of the assurance provider types, we found that the stakeholders are neglected. Yet, the opposite situation should be the case for sustainability-related assurance to play the role it purports to. We want to issue a warning that the pursuit of conventional business agendas, which are in fundamental conflict with environmental protection, could lead to a situation when "accounting is contributing to environmental degradation – not environmental protection" (Gray and Bebbington 2000, pp. 1–2).

We strongly believe that just transferring the experience of financial auditing to the field of sustainability, which by and large has taken place now, is not an option. We believe that following this route, we are heading in the wrong direction. In technical terms, the wider proliferation of AA1100AS and its principles, with greater emphasis on reasonable assurance as opposed to the limited and enhanced role of stakeholders, are vital to get back on track.

It is a complex problem, and much also depends on the pressure from society, the development of the sustainability assurance providers profession, and development of self-regulation of this profession. For example, the fee level for sustainability assurance is just a tiny "fraction (usually less than 10%) of financial audit fees" (Bebbington, Unerman, and O'Dwyer 2014, p. 79). This certainly brings "into doubt the ability of the sustainability assurors to carry out the necessary amount of substantive testing to justify a positive form conclusion" (Bebbington, Unerman, and O'Dwyer 2014, p. 79).

For the CEE region, the situation is slightly more complicated because due to the insufficient proliferation of sustainability reporting and assurance, it is lagging behind Western Europe and North America. Since sustainability reporting is not mandatory in the region, it is only the ever-increasing pressure from civil society and the public that will sway companies to be active in this field. If there is demand, then there will be supply.

Despite some early indications of the relationship between different attributes of assurance statements and their quality, the sample size, data analysis (reliance on released assurance reports only), and the qualitative approach of the study prevent us from any form of general assumptions.

One of the recommendations for further research in this direction, based on this, would be a combination of the qualitative and quantitative approaches. Furthermore, content analysis is used mostly as a quality tool while we believe that interviews with assurance providers and stakeholders would shed much light and even open up new areas of research in the field. We encourage researchers to move in this direction.

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Odpowiedzialność w zakresie zrównoważonego rozwoju w Europie Środkowej i Wschodniej: empiryczna ocena audytu zrównoważonego rozwoju

Artykuł poddaje analizie działania firm z Europy Środkowej i Wschodniej polegające na audycie służącym zapewnieniu odpowiedzialności za realizację zasad zrównoważonego rozwoju. W oparciu o zmodyfikowane zasady kodowania wykorzystane we wcześniejszych badaniach, przeprowadzono konwencjonalną analizę treści oświadczeń dotyczących wiarygodności z 36 firm pochodzących z dziewięciu krajów. Wyniki wskazują na różnice w treści raportów, procesach i sposobach wdrażania standardów.

Wyłącznie duże i wielonarodowe przedsiębiorstwa z sektorów energetycznych z siedzibą w Polsce i na Węgrzech stanowią w badanej próbie typowy przykład firmy dążącej do stworzenia i poddania się audytowi sprawozdawczości dotyczącej zapewnienia zrównoważonego rozwoju. Spośród dziewięciu krajów reprezentowanych w badaniu,

oświadczenia dotyczące wiarygodności sprawozdań o zapewnieniu zrównoważonego rozwoju firm pochodzących z Polski, Węgier i Rumunii wyróżniają się pod względem jakości. Zdecydowana większość firm audytujących należy do *Wielkiej Czwórki*, która wykorzystuje ISAE3000 a nie AA1100AS. Jednak niezależnie od typu podmiotu audytującego, interesariusze są zaniedbywani. Argumentuje się, że zwykłe przeniesienie doświadczeń z audytu finansowego do dziedziny zrównoważonego rozwoju, co w zasadzie już nastąpiło, nie jest dobrym rozwiązaniem. Autorzy twierdzą, że podążając tą drogą, podążamy w złym kierunku, a pod względem technicznym, szersze rozpowszechnienie AA1100AS i jego zasad, z większym naciskiem na uzyskanie wysokiej jakości oceny, a nie ograniczanie i zwiększanie roli interesariuszy, jest niezbędne aby wrócić na właściwą drogę.
Artykuł stanowi wkład do powstającej literatury na temat standardów odpowiedzialności i podkreśla potrzebę zwiększenia jakości audytu w obszarze zapewnienia zrównoważonego rozwoju.

Słowa kluczowe: raportowanie zrównoważonego rozwoju, oświadczenie dotyczące wiarygodności, GRI, społeczna odpowiedzialność biznesu, raportowanie, audyt

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Ways to Overcome Poverty and Income Inequality in the Context of New Global Challenges: the Most Important Conclusions for Ukraine

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Abstract

The article examines the risks of deepening poverty and income inequality that arise from global challenges of population aging, job losses due to shrinking sales markets, trade wars, long-term quarantine and compliance with the safe distancing of people as part of restrictive measures against the spread of COVID–19, the nature of employment (remote work, temporary reduction of labor migration), and other norms in the fight against the dangerous contagious disease. Given the facts that the prevention of spreading and localization of dangerous diseases, their treatment, and the rehabilitation of patients affect all segments of the population, have negative effects on all areas of people's lives and also add to the increase of socio-economic risks, including poverty and inequality, the study of this issue is extremely relevant. The financial implications of these challenges for many households lead to falling real incomes, and an increase in costs and debts, and their non-repayment, which generally cause sudden poverty and increasing inequality of income and property.

Purpose of the article: To investigate the risks of poverty, including sudden poverty, the inequality of household incomes amid the fight against the COVID–19 pandemic, and it identifies ways to overcome them.

Methods: A review of the scientific literature, a presentation of statistical data, and statistical research.

Findings & Value added: As a result of research, a list of new risks of poverty and income inequality is outlined, and preliminary assessments of the consequences of the COVID–19 for households are summarized; signs of short-term loss are generalized; the solvency of households as a possible precondition for sudden poverty is evaluated; cross-country comparisons of poverty risk are made; the scheme of state aid

to improve living standards of people during the outbreak of new dangerous diseases in the EU and Ukraine is generalized; ways to overcome poverty and income inequality are substantiated to restore the resilience of financially vulnerable households and ensuring the development of human capital.

Keywords: household finances, financial stability, struggle with poverty, inequality, labor migration, unemployment, COVID–19 pandemic, economic consequences of globalization, state support of households

JEL: J61, E24, I320, F650

Introduction

Overcoming poverty in all its forms is one of the main directions of achieving the Sustainable Development Goals. Between 1990 and 2019, the world made significant progress in ensuring people's well-being and reducing extreme poverty. In the EU countries, the share of people at risk of poverty and social exclusion decreased by 2.8 percentage points between 2013 and 2018. In 2018 it was 21.8% (Eurostat 2020). The share of people whose daily consumption was less than 5.05 US dollars was reduced to 1.8%.

Recent events show that, along with the fight against poverty and social inequality, the problem of reducing the risks of sudden poverty arising from global processes must be addressed, including the formation of financial stability of households to maintain solvency in times of crises and the sustainability of public finances, support of citizens, and realization of other social functions of the state.

Until recently, the most important global challenges have included population aging and growing demographic imbalances, trade wars, the rapid growth of the environmental crisis (with the intensification of related global problems – health care in the face of growing environmental pressures and global climate change; healthcare crises; the COVID–19 pandemic; instability of world food security), the scarcity of natural resources, including water resources, the deformation of market structures, and the crisis of capital investment efficiency in existing technological processes, production automation and digital technologies, international financial instability, and the problems of fictitious capital growth, among others (Sidenko 2014; Shang-Jin 2019; UN ESCAP 2019). These socio-economic and environmental problems pose risks to many countries around the world to achieve sustainable development and increase their competitiveness. They also exacerbate the problems of poverty and inequality in household incomes.

UN experts have found that poverty has a negative impact on people's health and life expectancy (due to the lack of quality drinking water, adequate medical services, and adequate nutrition) and limits educational opportunities for their children. The poverty of older people lays the groundwork for poverty for future generations. Insufficient investment in education and healthcare at the level of low-income households will nega-

tively affect labor productivity, reduce the rate of human capital development, affect other factors of economic development and create risks for sustainable economic growth.

The unresolved nature of these problems was made worse by the emergence of a new global challenge – the spread of the life-threatening COVID–19 pandemic.

The **aim of the article** is to investigate the risks of poverty, including sudden poverty, inequality of household incomes amid the fight against the COVID–19 pandemic, as well as to identify ways to overcome them.

Achieving these goals necessitate the following **tasks**:

- to summarize existing approaches to poverty reduction in the framework of sustainable economic development;
- to reveal the directions of state regulation of the labor market, employment, reduction of unemployment, conditions of labor migration, personal income taxation, state support of corporations and households as prerequisites for reducing poverty and income inequality;
- to identify new risks of poverty and household income inequality arising from the COVID–19 pandemic;
- to analyze state aid schemes during the outbreak of the dangerous new disease and in the post-pandemic period to improve living standards and substantiate the directions of overcoming poverty and income inequality in Ukraine.

The impact of aggravated global risks on the financial stability of national economies and, accordingly, on households actualizes modern society's formation of a new institutional framework for sustainable economic growth and improving the welfare of the population.

Literature review

In the scientific literature, the problems of combatting poverty and the accelerated growth of income inequality are widely covered. But they remain relevant due to the emergence of new risks of socio-economic nature.

Research on poverty and inequality is carried out mainly in the following areas:

- developing theoretical foundations of these economic categories;
- defining tools for state regulation of the labor market, changes in the policy of income distribution, legal support of labor migration and spatial mobility of citizens, formation of social standards, personal income taxation, rules for indexation of employees' incomes in conditions of high inflation (Organiściak-Krzykowska 2017; Dluhopolskyi, Zatonatska, and Lvova 2019);
- state support: tax benefits for enterprises that employ people without work experience ("first job"), people with special needs (the disabled), workers of pre-retirement age; direct state support of enterprises during periods of financial and economic crises (in particular, for timely payment of wages and job retention); targeted assistance to low-income households, households with children, youth;

- ensuring economic growth, which has a positive effect on increasing the income of most households (Kuznets 1955);
- providing equal access of households with different levels of income and financial opportunities to education and health services, which alleviates the problems of income inequality;
- investing in human development and insuring poor and vulnerable groups against emerging risks (Cruz et al. 2015).

The problems of ensuring the current liquidity of households remain relevant. Solving them will reduce the negative impact of the risks of financial losses from global challenges and prevent sudden poverty.

The psychological aspects of poverty (determining the level of poverty by different segments of the population, individual communities) were studied by Galbraith. It has been found that people suffer from poverty when their income, even if sufficient to survive, lags far behind that of the community as a whole. Then they cannot have what the large community considers the minimum necessary for decency, and they cannot completely avoid, therefore, the judgment of the community that they are poor (Galbraith 1958).

Kwiatkowski studied the behavior of labor markets in the EU countries during global crises. He found that the scale of adjustments in the labor market during a global crisis depends on several factors: the depth of demand shocks and the scale of adjustment of the volume of production, the degree of openness of the economy, labor productivity, the level of strict employment protection legislation, the current share of fixed-term employment contracts, as well as the possibility of the state regulator's influence on employers adjusting employees' wages and working hours (Kwiatkowski 2016).

He found that solving the problem of gender pay gaps has reduced inequality and increased household incomes (Cruz et al. 2015).

Kuznets studied the problems of income inequality in the twentieth century. He found that the income of the upper group of the population (about 7% of the total) tended to grow faster than the incomes (compensations) of other employees during periods of economic recovery.

With the slowdown in economic growth, the income of the upper group did not diminish, while 93% of employees (those with lower incomes than the higher group) had their wages and dividends significantly reduced (Kuznets 1955). Böhm -Bawerk argued that the level of increase in wages of the entrepreneurs (higher group) should be less than the growth of productivity because only part of the newly created value should be their reward (Böhm-Bawerk 1903).

Income and wealth inequality studies have been conducted from a global and historical perspective (e.g., Alvaredo et al. 2018). They showed that income and property inequality grew in different countries at different rates over time.

The growing inequality of income, wealth, and the welfare of households in different OECD countries over the last decade is explained by the differences between countries and regions. However, the standard of living of the poorest households has deteriorat-

ed since the crisis, while that of high-income households has increased (*Meeting of the OECD Council…* 2017). This indicates that there are other reasons for the existence and deepening inequality of income and property of households in modern society, and its reduction requires the use of new institutional support.

The lack of effective tools to maintain the solvency of households in times of crisis or sudden poverty leads them to make irrational financial decisions, making them even poorer. Analysis of the liquidity survey showed that poor and vulnerable households all too often rely on expensive forms of credit (e.g., overdrafts) with high interest rates and fixed loan servicing costs (Cunha, Lambrecht, and Pawlina 2011).

Ukraine's fight against poverty and inequality is one of the government's key priorities. The "Sustainable Development Goals of Ukraine" program sets out the directions to gradually overcome poverty by eliminating its extreme forms. Libanova proposed some measures to fight income inequality in Ukraine, in particular, to change the procedure for taxing individuals' income by introducing a full-scale progressive scale of taxation, to complete the process of monetizing benefits, to change the practice of determining the cost of public services (medical, educational, etc.) and how they are paid (state budget, local budget, insurance funds, etc.), to improve the differentiation of social transfers based on working capacity, economic activity, and employment (stimulating the able-bodied population to the most active behavior in the labor market and in the economy as a whole); to introduce a system of control over costs and wealth in order to prevent large-scale unregistered income; to introduce a system of social elevators for low-income people, the disabled, children deprived of parental care, etc. (Libanova 2014).

The gradual introduction of European social living standards in Ukraine requires a significant strengthening of the economic base, fiscal expansion, and efficiency of social spending aimed at reducing the risks of poverty and income inequality, as well as building a reserve of household finances in the event of a crisis or a negative impact of global challenges.

Reasons for the deepening risks of poverty in the context of global challenges

On the one hand, the fight against the spread and consequences of the COVID–19 pandemic as one of the most significant global threats today has added to safer living conditions, proper diagnosis and treatment of the disease. On the other, it has worsened the general economic situation, increased unemployment and changed employment (remote work, forced reduction of working hours, unpaid leave, temporary suspension of labor migration), increasing the cost of households for prevention or treatment, and thus causing the deterioration of the financial situation of the vulnerable population. According to a new OECD report and unemployment statistics released in July 2020, women, young people, and low-income workers suffered the most during the quaran-

tine period. The introduction and extension of quarantine, and the implementation of other precautionary measures had a negative impact on the labor market.

According to preliminary estimates,[1] in the first half of 2020, the unemployment rate surged by several percentage points compared to previous years. Its rise significantly exceeds the corresponding figures during the financial and economic crisis of 2008–2009. In some countries, in the first and second quarters of 2020, up to 10 times more working hours were lost compared to the first few months of the crisis of 2008–2009 (OECD 2020a).

The unemployment in OECD countries in April 2020 rose to 8.5%, which is the highest unemployment rate in the last decade. In February 2020, it had been 5.2%. The number of unemployed in OECD countries was about 54.5 million. Unemployment in OECD countries at the end of 2020 was expected to be 9.4% (in the optimistic scenario of the pandemic), which significantly exceeds the level of unemployment in periods of previous economic crises (OECD 2020b; 2020c). According to the pessimistic forecast, the unemployment rate is likely to be about 10%, and with the start of the possible second wave of the spread of the virus and, accordingly, the strengthening of quarantine conditions – it may go up to 12% (OECD 2020a; World Economic Outlook 2020).

It is projected that the average employment in 2020 will be 4.1%, 5 percentage points lower than in 2019. The share of working people may return to the "pre-COVID–19 crisis" level only in late 2021/early 2022.

The self-employed, individual entrepreneurs, people on temporary or part-time contracts, and migrant workers have especially suffered the loss of work and income. Unemployment risks include young people who received their education this year and will need their "first job".

Well-thought-out ways out of the crisis of jobs, working conditions, and how they are paid for payment are becoming more important.

An express assessment[2] of the impact of quarantine on employment (conducted by the Ukrainian Institute of Social Research named after Oleksandr Yaremenko, the Center for Social Monitoring together with the Department of Monitoring Research of Socio-Economic Transformations of the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine) showed that one third (35.6%) of the economically active population of Ukraine during this period was excluded from the labor market. The most vulnerable were small businesses (four out of ten did not work)

1 A report on poverty and general well-being will be published in autumn 2020, which is expected to clarify, in particular, expectations of the unemployment rate by the end of 2020, and the forecast for 2021 (Atamanov et al. 2020).

2 The survey of the adult population was conducted from 12 to 22 May 2020 in 24 regions of Ukraine and the city of Kyiv. A total of 2,058 respondents were interviewed via telephone. Standard deviations at a significant 95 percent and a ratio of variables from 0.1: 0.9 to 0.5: 0.5 are 2.33–3.21 percent.

and the self-employed (one in three was unable to work). During quarantine, among the economically active population:

- 30.6% did not work; in particular: 19.2% were on forced leave (without pay); 7.7% were dismissed by the employer; 5.9% had restrictions on the activities of individual entrepreneurs; 8.8% lost their jobs; 6% were on paid annual leave;
- 66.5% worked; in particular: 42.2% worked at the same place according to the pre-quarantine schedule; 21.6% had reduced working hours; 4.3% found a job (another/temporary/additional) and worked; 20.8% worked remotely.

At the same time, 8 out of 10 labor migrants lost their jobs; 4 out of 10 small-business entrepreneurs did not work. According to the survey, only a small proportion of employees' working conditions and wages did not change, and income remained at the pre-quarantine level (*Express assessment…* 2020).

Migration and labor processes were significantly changed at the beginning of quarantine, which led to job losses and the return of migrants to their home countries. Migrants' money transfers also decreased.

The intensification of migration of foreign labor from Central and Eastern European countries that belong to the European Union, i.e., the Czech Republic, Estonia, Lithuania, Latvia, Hungary, Poland, Slovenia, Slovakia, Bulgaria, and Romania, took place after the opening of the labor market by the EU–15 (Kwiatkowski 2010). Analysis of the size of migration outflows from Central and Eastern Europe (CEE) countries makes it possible to classify them into three groups: countries with high migration potential (Latvia, Lithuania, Romania), moderate migration potential (Hungary, Bulgaria, Poland, Estonia, Slovakia), and low migration potential (the Czech Republic, Slovenia) (Organiściak-Krzykowska 2017). As a result of employment abroad in 2004–2015, citizens of CEE transferred funds totaling 166.6 billion euros to their home countries. The ways in which this wealth is distributed at the individual level improve the living conditions of migrant household members and, indirectly, the socio-economic situation of every CEE country (Organiściak-Krzykowska 2017).

In Ukraine, the problem of the migrant remittance market is of particular interest. Ukraine is a powerful donor of international migrants and a recipient of money transfers – a relatively stable source of foreign exchange inflows into the country (Table 1). During the period 2017–2019, remittances from migrant workers increased by $2.7 billion, and in 2019 they amounted to USD 11.9 billion. More than 30% of all money transfers came from Poland.

In 2019, revenues from the Czech Republic almost doubled (up to 9.3% of the total amount of remittances, or 1.1 billion US dollars).

In the wake of measures to combat the spread and consequences of the COVID–19 pandemic, the following processes took place: the return of migrant workers to their home countries and a reduction in employment of migrant workers who remained abroad due to the slowdown in economic activity in the recipient countries.

The forecast of money transfers to Ukraine for 2020 was reduced by 2.6 billion US dollars, or by 20% (down to 9–10 billion US dollars) due to both the reduction in the

number of migrants and reduced economic activity in the destination countries. At the same time, the impact of the current crisis is expected to be short-term, and from 2021 the growth of remittances will resume (Tokarchuk 2020).

Table 1. Volumes of private remittances to Ukraine (through official and unofficial channels of receipt)

Country	2017		2018		2019	
	USD millions	In % of the total amount	USD millions	In % to the total amount	USD millions	In % to the total amount
Receipts, incl.:	9264	100	11111	100	11921	100
Poland	3116	33.6	3649	32.8	3658	30.7
Czech Rep.	435	4.7	846	7.6	1113	9.3
USA	679	7.3	870	7.8	984	8.3
Italy	447	4.8	492	4.4	498	4.2
Germany	318	3.4	426	3.8	462	3.9
Cyprus	285	3.1	341	3.1	391	3.3

Source: National Bank of Ukraine 2020.

The current global crisis will have a greater negative impact on remittances than previous crises, as it is characterized by many countries closing their borders, which has an additional negative factor on labor migration.

The pandemic affected children's meals and school attendance. The introduction of quarantine interrupted the educational process around the world. From March to May 2020, more than 91% of students did not attend school, and from May to July 2020, it was 60–70% of students (United Nations Development Programme 2020).

In modeling the impact of forced school leaving on multidimensional poverty, according to the conservative scenario, a significant role is played by the decline in the quality of education and the risks of subsequent employment with high wages.

The COVID–19 pandemic has also disrupted lifestyles and food supply chains globally. According to the World Food Program, the number of people in dire need of food could increase to 130 million in 55 countries.

The above factors indicate a deepening of multidimensional poverty. The 2019 Multidimensional Poverty Index is calculated in 101 countries, where 5.7 billion people live. The index is able to assess the full spectrum of poverty, taking into account limitations in health, education, and living standards (including, in particular, nutrition, infant mortality, school life, school attendance, cooking fuel, sanitation, water, electricity, flooring, and property ownership). People who experience deprivation by at least a third of these weighted indicators fall into the category of the multidimensional poor (the percentage of the population with a deprivation rate of 20–33%).

In 2019, 1.3 billion people fell into the category of multidimensional poverty, of which 886 million people – more than two-thirds – live in middle-income countries, and 440 million people live in low-income countries (United Nations Development Programme in Ukraine 2019).

In poorer countries, a higher level of poverty is usually recorded, i.e., each poor person is restricted by more components of the index. Egypt and Paraguay were found to have similar Index values (approximately 0.019) and the proportion of the population in multidimensional poverty (5.2% and 4.5%, respectively), but inequality among the absolutely poor in Paraguay is much higher (fluctuations of 0.013) than in Egypt (0.004) (United Nations Development Programme in Ukraine 2019). At the same time, in Paraguay, the largest share of the population vulnerable to multidimensional poverty was 7.2% (Table 2).

Table 2. The multidimensional poverty index in some countries for 2007–2018

Countries, Group of countries	Multi-dimensional poverty index	Population in multi--dimensional poverty, %	Population vulnerable to multi--dimensional poverty, %	Population living below the poverty line (national assessment), %	Components of the index	
					Healthcare, %	Living conditions, %
Albania	0.003	0.7	5.0	14.3	28.3	16.7
Armenia	0.001	0.2	2.7	25.7	33.1	30.1
Brazil	0.016	3.8	6.2	26.5	49.8	27.3
Egypt	0.019	5.2	6.1	27.8	39.8	7.0
Kazakhstan	0.002	0.5	1.8	2.5	90.4	6.4
Kyrgyzstan	0.008	2.3	8.3	25.6	52.8	34.3
Nigeria	0.291	51.4	16.8	46.0	27.0	40.8
Pakistan	0.198	38.3	12.9	24.3	27.6	31.1
Paraguay	0.019	4.5	7.2	26.4	14.3	46.8
Tajikistan	0.029	7.4	20.1	31.3	47.8	25.8
Turkmenistan	0.001	0.4	2.4	-	88.0	7.6
Ukraine	0.001	0.2	0.4	2.4	59.7	11.5
Developing countries	0.114	23.1	15.3	21.3	25.8	44.7

Source: United Nations Development Programme in Ukraine 2019.

In Ukraine, the Multidimensional Poverty Index is much lower (0.001) than the average in developing economies (0.114). Also, only a small proportion of the population is vulnerable to multidimensional poverty (0.4%). More than a million people live below the poverty line (2.4%). At the same time, more attention needs to be paid to human health (59.7% is an indicator that is almost twice as high as the average in the group of developing countries), which means that there is a need to review and evaluate health care reforms in Ukraine. In Ukraine, health care expenditures in 2019 amounted to 3.2% of GDP, which is more than twice less than in the EU.

In 2020, the multidimensional poverty index in Ukraine may increase by 12–14 points in our pessimistic scenario.

In Nigeria and Pakistan, the population in multidimensional poverty is 51.4% and 38.3%, respectively; however, the proportion of the population vulnerable to poverty

was 16.8% and 12.9%, respectively, which is 3.3 and 7.2 percentage points lower, respectively, for the indicator of Tajikistan. This indicates the continuation of a policy narrowly aimed at groups of poor people. Given that the needs of the most and least disadvantaged can be very different, targeted assistance should be developed. At the same time, the average level of household wealth also differs significantly in different countries (the gap can be more than 23 times).

Households are the richest in countries such as Luxembourg and Belgium (OECD Wealth Distribution 2020). However, the average life satisfaction of households in OECD countries increased slightly compared to 2013 (Eurostat, *Income*…n.d.).

Poverty is a complex phenomenon. The correlation between economic inequality and the Multidimensional Poverty Index (as measured by the Gini coefficient) is insignificant (United Nations Development Programme in Ukraine 2019). Therefore, it is expedient to develop ways of overcoming poverty separately from the directions of reducing income inequality. What is unifying is that the risks of poverty and income inequality have the greatest impact on people with low incomes and insufficient solvency.

New risks of poverty (along with existing ones, including insufficient income, the social burden on households, which include young children, the unemployed, the disabled, or the elderly in need of care) may include:

- forced self-isolation of household members living with a patient with the COVID–19 (without monetary compensation of income), as well as people who are subject to isolation due to the limitations of crossing the borders with "red zone" countries;
- forced leave to look after young children and primary school pupils for the period of quarantine in kindergartens and schools;
- reduced income when working conditions change (reduced working hours, teleworking);
- a significant increase in transport costs for people working in strategic enterprises in the absence of public transport;
- increased costs of medical services and medicines due to COVID–19.

These risks lead to a short-term loss of solvency of households, and in the case of their financial vulnerability and lack of an adequate level of sustainability of household finances, they create the preconditions for sudden poverty.

Problems of household income inequality in modern conditions

Inequality mainly arises in the distribution of individual labor incomes among the working-age population, different levels of social burden on households (which varies significantly depending on its composition, number of employees, and the presence of family members in need of third-party care), as well as income differentiation from capital.

In the last decade, income inequality has been growing in almost all countries, but at different rates. Since 1980, income inequality has grown rapidly in North America and Asia and moderately in Europe (Alvaredo et al. 2018). On average, among the OECD countries, the richest 20% earn 5.4 times more than the poorest 20% (OECD Wealth Distribution 2020). On average, the richest 10% own more than half of the total household wealth.

The interactive computing tool, PovcalNet, is used to assess household income inequality and to make cross-country comparisons of welfare, inequality, and poverty (it contains more than 1,900 surveys from 166 countries, covering 97.5% of the world's population; data available in PovcalNet are highly standardized). According to this database, it is possible to assess the level of risk of poverty in individual European countries for the formation or adjustment of public policy in the field of poverty reduction (Table 3).

Table 3. Poverty risk in some European countries in 2016–2018

Country, Group of countries	Gross disposable income of the population, billion euros	Poverty gap (SPG)*	Poverty index Wt**	Gini index ***	Average monthly income, $	The population with signs of poverty, in thousands
EU–27	9,781.2	...	...	...	...	73,796
Belgium	334.9	0.09	0.09	27.37	1,344.53	1,844
Czech Rep.	131.3	0	0	24.85	811.25	996
Denmark	200.0	0.07	0.18	28.75	1420.98	728
Germany	2,508.7	0	0	31.87	1419.3	13,048
Estonia	17.2	0.14	0.33	30.36	846.05	286
Ireland	135.7	0.08	0.05	32.81	1217.77	726
Greece	134.5	0.31	0.57	34.35	585.56	1,954
Spain	879.2	0.5	0.36	34.65	996.52	9,950
France	1,832.7	0	0	31.63	1,364.45	8,497
Croatia	37.7	0.26	0.28	30.35	581.36	783
Italy	1,370.9	1.01	0.99	35.93	1,083.41	12,229
Cyprus	15.4	0	0.01	31.42	1,159.96	132
Latvia	20.3	0.2	0.47	35.57	659.63	446
Lithuania	31.6	0.75	0.55	37.29	680.29	644
Luxemburg	28.7	0.13	0.09	34.9	2,171.98	106
Hungary	86.6	0.27	0.65	30.58	637.08	1,227
Holland	510.0	0.04	0.11	28.54	1,438.84	2,247
Austria	275.3	0.21	0.51	29.74	1,540.74	1,238
Poland	338.7	0.15	0.22	29.69	724.48	5,472
Portugal	160.5	0.13	0.36	33.8	689.78	1,777
Romania	144.3	0.85	1.9	36.02	392.64	4,603
Slovenia	32.3	0	0	24.22	984.32	268
Slovakia	62.5	1.08	0.33	25.17	652.66	655

Table 3. (continued)

Country, Group of countries	Gross disposable income of the population, billion euros	Poverty gap (SPG)*	Poverty index Wt**	Gini index ***	Average monthly income, $	The population with signs of poverty, in thousands
Finland	169.1	0.06	0.12	27.38	1,350.88	652
Sweden	323.6	0.11	0.19	28.77	1,455.22	1,660
United Kingdom	1,933.4	0.13	0.06	34.78	1,265.29	12,168
Norway	232.8	0.16	0.8	26.99	1,893.97	682
Switzerland	404.8	0	0	32.68	1,709.01	1,217
Ukraine	79.9	0	0	26.07	355.13	1,163***

Notes: * – square poverty gap (SPG), defined as the average income deficit below the poverty line; ** – poverty index W is the average value of the proportional poverty gap; Gini index – a measure of inequality between 0 (everyone has the same income) and 100 (the richest person has all the income); *** – model calculations of the author taking into account the level of the shadow economy.
Source: State Statistics Service of Ukraine 2018; Data from The World Bank 2020; Eurostat, *Households*... n.d.

In the studied group of countries, the highest value of the Gini index in 2016–2018 was observed in Lithuania (37.29), Romania (36.02), and Italy (35.93). If the Gini index in each country decreases by 1% per year, the global poverty rate may fall to about 5.4% in 2030, equivalent to 100 million fewer people living in poverty (Lakner et al. 2019). In 2017–2018, the risk of poverty decreased in most EU countries, but in countries such as Estonia, Sweden, and the Czech Republic, there was an increase in the level of risk (0.9 percentage points, 1.1 percentage points, 0.3 percentage points respectively). At the same time, more than a third of people in the OECD are at risk of falling into poverty (OECD Wealth Distribution 2020). This can be explained by the lack of proper sustainability of household finances and the vulnerability to wage cuts, the main source of income. Analysis of the indicator that refers to the number of people with signs of poverty showed a dependence on the indicator referring to gross disposable income. The dependence density is $R2 = 0.8353$, where y – gross disposable income of the population, and x – the number of people with signs of poverty.

The financial implications of the Corona crisis show that global challenges have a significant impact on household well-being, but household inequality is not diminishing. In European OECD countries, on average, one in five households faces deteriorating solvency (Eurostat, *Income*… n.d.).

Modern Ukrainian society is not just deeply stratified, it is polarized. At one end of the scale, a relatively small (no more than 5–7%) group of the affluent population is concentrated, and at the other, at least a quarter of the population is barely surviving (Libanova 2014). The origins of modern inequality, at least in the public consciousness, are mainly due to non-compliance with the law and shadow activities. The rapid stratification of Ukrainian society took place in the early 1990s, when abrupt changes in economic conditions and large-scale privatization led to a concentration of resources and nation-

al wealth in the hands of a relatively small group of people under the conditions of impoverishment and low-paid employment of the rest of the population (Libanova 2014). For the wealthiest segments of Ukraine's population, the growth rate of income between 2000 and 2019, regardless of the economic recovery, was much higher than for the average citizen. Unjustifiably high incomes are received by heads of state-owned enterprises, enterprises classified as natural monopolies, as well as companies in which the state has a share of the authorized capital. Against the background of deteriorating financial conditions of these enterprises, such payments lead to increased costs and demand for higher tariffs and prices. Managers' incomes differ from the average salary by tens of times. During the Corona crisis, this causes social tension. In Ukraine, the share of the population with per capita equivalent total income per month, below 2018's actual subsistence level, was 43.2%, which is 13.2 percentage points more than the expected result of 30%.

New risks to income inequality include declining incomes of the working population at a faster rate than increasing financial and other passive household incomes.

In general, the pandemic has a strong negative impact on low-income households worldwide, which can significantly increase inequality. In 2020, more than 90% of developing countries are likely to have negative per capita income growth rates (Gaspar, Lam, and Raissi 2020).

Public investment in education, health, and the environment are needed both to combat existing inequality and to prevent its growth in the future (Alvaredo et al. 2018).

State support

Many governments, through state support mechanisms, take measures to reduce the negative effects on households, combining support for labor markets and the corporate sector to halt rising unemployment. Measures vary from country to country, but in some cases, they include assistance to households and businesses. Business assistance is provided in the following three main forms: state guarantees; low interest rate loans and other forms of debt financing, including convertible bonds; and the direct introduction of equity by the state. The analysis showed that without any government intervention, 20% of the firms surveyed (in the intersectoral sample of almost a million firms operating in 16 European countries) would lose liquidity in one month (Gurría 2020). Up to 38% of firms could lose liquidity within three months.

As a result of the pandemic, the global economy is projected to shrink to –4.9% in 2020, which is significantly worse than during the 2008–2009 financial crisis.

In emerging market countries, budgetary responses to the pandemic are now estimated at an average of 5% of GDP, which is significant but less than in developed economies. However, the budget deficit is projected to increase sharply in 2020 to an average of 10.5% of GDP, more than double the previous year. As many low-income countries have pursued policies of fiscal consolidation, rising health care spending, and social

protection, there will be no fiscal risks. In countries (particularly in Ukraine), where public finances have been consolidated through reduced social spending and funding for health facilities, it may lead to public investment and increased current spending on health care in the treatment of patients with the COVID–19 pandemic.

Some countries have taken budgetary measures to contain the pandemic and reduce its damage to the economy. The tools of the social protection system also stabilize income and consumption (Gaspar, Lam, and Raissi 2020).

State aid in EU countries is provided in accordance with the provisions of the Treaty on the Functioning of the European Union. Funding of more than €22.5 billion is given to state aid measures taken under Article 107 (2)b TFEU, including assistance to deal with damage caused by natural disasters or emergencies. More than €114 billion has been allocated to meet the objectives set out in Article 107 (3)b TFEU – assistance to facilitate the implementation of an important project of common European interest or to remedy serious disturbances in a Member State's economy. About €530 billion has been allocated to state aid measures taken under Article 107 (3)c TFEU – aid to facilitate the development of certain economic activities or certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest (European Commission 2021).

The generalized state aid scheme during the outbreak of new dangerous diseases in the EU is aimed at improving the living standards of the population and provides funding for measures to eliminate the consequences of the prevention, spread, and localization of the disease, the treatment and rehabilitation of patients, research, development, and testing of new drugs for dangerous diseases, vaccine development, insurance of medical workers who directly provide medical services; to eliminate serious disturbances in the economy through targeted assistance to households and enterprises; to promote the development of certain economic activities or certain economic areas.

In Ukraine, the Ministry of Finance has established the Fund for Combatting COVID–19. The activities of the Fund and the allocation of funds are regulated by resolutions of the Cabinet of Ministers of Ukraine, in particular: Resolution of the Cabinet of Ministers of April 22, 2020, № 302 "On approval of the Procedure for using the Fund for Acute Respiratory Disease COVID–19 caused by SARS-CoV-2 coronavirus and its consequences"; Resolution of the Cabinet of Ministers of April 27, 2020, № 308 "On the allocation of funds for the provision of financial assistance to the Fund of Compulsory State Social Insurance in the Event of Unemployment"; Resolution of the Cabinet of Ministers of April 29, 2020, № 354 "On the allocation of funds for the purchase of ventilators."

As of July 31, 2020, UAH 65.95 billion (or 1.7% of GDP, which is almost three times less than the average in the EU countries) was allocated for the measures provided by the regulations of Ukraine (Table 4). At the same time, more than half of all funds were allocated for the construction and reconstruction of roads of state importance. In our opinion, funding for these works should not have been provided by the COVID–19 Anti-Crisis Fund.

Table 4. Use of the Fund for Combatting COVID–19 as of 31.07.2020

№ s/n	Direction	Measures	Funds allocated, UAH millions	Cash expenditures, UAH millions	Spent from the allocated sum, %
1	Cash assistance to citizens	Cash assistance to children of entrepreneurs (individuals)	1155.0	549.7	1.7
2	Social support	Financial assistance to the Unemployment Insurance Fund	6972.5	6079.4	87.2
3	Social support	Financial assistance to the Social Insurance Fund (incl. for the payment of sick leave)	2512.1	1538.2	61.2
4	Measures to prevent outbreaks of COVID–19.	Purchase of ventilators	100	0	0
5	Measures to prevent outbreaks of COVID–19	Provision of laboratories of Min. of Health, and purchase of personal protective equipment	2990	339.1	11.3
6	Measures to prevent outbreaks of COVID–19	Prevention of COVID–19 in institutions of the State Penitentiary Service	23.7	5.9	24.7
7	Measures to prevent outbreaks of COVID–19	Reimbursement for Independent External Evaluation trials in 2020	52.5	52.5	100
8	Measures to prevent outbreaks of COVID–19	Construction, reconstruction, and repairs of state roads	35000	3505.7	10
9	Measures to prevent outbreaks of COVID–19	Equipment for reception departments of support hospitals	5300	0	0
10	Measures to prevent outbreaks of COVID–19	Construction and repair of reception departments of support hospitals	1680	0	0
11	Measures to prevent outbreaks of COVID–19	Purchase of equipment, personal protective equipment	41.2	0	0
12	Measures to prevent outbreaks of COVID–19	State support in the field of culture, tourism, and creative industries	1000	0	0
13	Surcharges for employees on liquidation of COVID–19	Surcharges for the members of the military, National Guard, State Border Service, and police of the Ministry of Internal Affairs	2530	1845.1	72.9

Table 4. (continued)

№ s/n	Direction	Measures	Funds allocated, UAH millions	Cash expenditures, UAH millions	Spent from the allocated sum, %
14	Surcharges for employees on liquidation of COVID–19	Surcharges for medical workers in health care facilities of the Ministry of Internal Affairs	171.1	91.2	19.1
15	Surcharges for employees on liquidation of COVID–19	Increased allowances and surcharges for medical workers	5955.4	0	0
16	Restoration of state budget expenditures	Partial recovery of expenditures in the field of physical culture and sports	475.8	0	0
		Total	65,959.3	14,006.6	21.2

Source: *Minfin systematizes information…* 2020.

The directions cited in Table 4 were financed only by 21.2% (or 0.35% of GDP), which indicates funds were diverted from their intended purpose or misused. Under some programs, no funding has started at all: the purchase of ventilators, increased allowances and surcharges for medical workers, the purchase of equipment for reception departments of support hospitals, etc. In this regard, it is proposed to strengthen state financial control by the Accounting Chamber of Ukraine, state internal audit in the Ministry of Finance of Ukraine and introduce monitoring of funding for these areas by the Ministry of Social Policy of Ukraine.

Conclusions and suggestions

Summing up the analysis of the problem of poverty and income inequality in the context of new global challenges and making the important conclusions for Ukraine, it should be noted:

1. The tendency to reduce extreme poverty, which has become entrenched in modern society over the past decade, has been reversed, exacerbating the problems of poverty under the influence of the spread of the disease dangerous to humans, i.e., the COVID–19 pandemic.
2. New risks of poverty both in Ukraine and around the world may include forced self-isolation of people (without monetary compensation of income), forced unpaid leave to look after young children and primary school pupils for the period of quarantine in kindergartens and schools; reduced income when changing working conditions (reduced working hours, teleworking); increased expendi-

tures on medical services, medicines through COVID–19 and other unforeseen expenses by households.

3. The generalized scheme of state aid during the outbreak of the new dangerous disease should be aimed at improving the living standards of the population and provide funding for measures to eliminate the effects of COVID–19 and the insurance of health workers who directly provide medical services; eliminating serious disturbances in the economy through targeted assistance to households and enterprises; promoting the development of certain economic activities or certain economic areas.
4. The main ways to overcome poverty and income inequality to restore the resilience of financially vulnerable Ukrainian households and ensure the development of human capital can include:
   – expanding the list of unemployment benefits, in particular, for payments for reduced working hours, unpaid leave, early termination of the contract for the quarantine period, transition to temporary work with lower wages;
   – introducing paid leave for one of the parents to look after young children and primary school students for the period of quarantine in kindergartens and schools;
   – simplifying the procedure for obtaining long-term sick leave for the treatment and rehabilitation of patients, as well as legislative consolidation of sick pay to isolate all family members living with the patient during outbreaks of dangerous diseases, including the COVID–19 pandemic;
   – introducing incentives for employers to set up safe work and create new jobs.

   In these cases, a simplified form of state support for the sustainability of Ukrainian household finances may include short-term, interest-free loans and direct grants in the amount of the minimum wage. Also, in such situations, a non-standard form of state communication should be used, and the legislative framework, in particular the Labor Code of Ukraine, should be amended.
5. The deepening impact of global risks on the financial sustainability of national economies and, accordingly, on households actualizes the formation by modern society of a new institutional framework for sustainable economic growth and improves the welfare of the population.

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Sposoby przezwyciężania ubóstwa i nierówności dochodowych w kontekście nowych globalnych wyzwań: najważniejsze wnioski dla Ukrainy

Artykuł analizuje zagrożenia związane z pogłębianiem się ubóstwa i nierówności dochodowych, które wynikają z globalnych wyzwań związanych ze starzeniem się populacji, utratą miejsc pracy w wyniku kurczących się rynków zbytu, wojnami handlowymi, długotrwałą kwarantanną i przestrzeganiem zasad bezpiecznego dystansowania się ludzi w ramach środków ograniczających rozprzestrzenianie się COVID–19, charakterem zatrudnienia (praca zdalna, czasowe ograniczenie migracji zarobkowej) oraz innymi normami służącymi walce z groźną chorobą zakaźną.
Biorąc pod uwagę fakt, że zapobieganie rozprzestrzenianiu się i lokalizacja niebezpiecznych chorób, ich leczenie i rehabilitacja pacjentów dotykają wszystkie części populacji, mają negatywny wpływ na wszystkie dziedziny życia ludzi, a także przyczyniają się do wzrostu zagrożeń społeczno-ekonomicznych, w tym ubóstwa i nierówności, badanie tego zagadnienia jest niezwykle istotne. Konsekwencje finansowe tych wyzwań dla wielu gospodarstw domowych wyrażają się w spadku dochodów realnych, wzroście kosztów i długów oraz ich niespłacaniu, co generalnie powoduje nagłe ubóstwo i zwiększające się nierówności dochodowe i majątkowe.
Cel artykułu: Zbadanie zagrożenia ubóstwem, w tym nagłego ubóstwa, nierówności dochodowych gospodarstw domowych w sytuacji walki z pandemią COVID–19 oraz wskazanie sposobów ich przezwyciężenia.

Metody: przegląd literatury naukowej, prezentacja danych statystycznych i badania statystyczne.
Ustalenia i wartość dodana: W wyniku badań przedstawiono listę nowych zagrożeń ubóstwem i nierównościami dochodowymi oraz podsumowano wstępne oceny skutków COVID–19 dla gospodarstw domowych; określono oznaki krótkoterminowych strat; oceniono wypłacalność gospodarstw domowych jako możliwy powód nagłego ubóstwa; dokonano międzykrajowych porównań zagrożenia ubóstwem; przedstawiono system pomocy państwa mający na celu poprawę poziomu życia ludzi w okresie wybuchu nowych niebezpiecznych chorób w UE i na Ukrainie; określono sposoby przezwyciężenia ubóstwa i nierówności dochodowych służące przywróceniu bezpieczeństwa finansowego gospodarstw domowych znajdujących się w trudnej sytuacji finansowej i zapewnieniu rozwoju kapitału ludzkiego.

Słowa kluczowe: finanse gospodarstw domowych, stabilność finansowa, walka z ubóstwem, nierówności, migracje zarobkowe, bezrobocie, pandemia COVID–19, ekonomiczne konsekwencje globalizacji, państwowe wsparcie gospodarstw domowych

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A Review of the Impact of the Digital Transformation on the Global and European Economy

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Abstract

The paper aims to present digital transformation as a process that has been taking place in the digital economy and the European Union's economy in recent years and its impact on changes in the economic and social sphere. As a starting point, this paper considers the importance of advanced technology products in the global production and trade in the global and European economy, including information and communication technologies, which constitute the primary basis for the development of the digital economy.
The paper shows that leading technologies can allow sustainable development goals (SDGs) to be achieved faster and more effectively. It is necessary to eliminate the persistent, significant income differences between developing and highly developed countries and disparities in access to the use of innovative solutions (including social innovation).

Keywords: transformation, digital economy, advanced technology products, global economy, European Union

JEL: O13

Introduction – The position of advanced technology products in global and European exports

Technology is a crucial factor that influences economic competitiveness in the global and European economies. High-tech industries are booming in international trade,[1] and their dynamism helps improve performance in other sectors. Investments in research, development, innovation, and skills, which are essential for economic growth and the development of the knowledge-based economy, are a key EU policy area.

In the period 2015–2018, ***advanced technology products***[2] had a relatively stable share in the total global exports of the 75 countries surveyed,[3] amounting to more than 18%, with a slight decrease in this share in 2018 compared to the previous year – from 18.75% to 18.47% (Table 1).

Table 1. Analysis of the export of advanced technology products for 75 countries, considering 10 product groups (including group 891: arms and ammunition), USD billion, %

YEAR	2015	2016	2017	2018
Export of all products	15 026,6	14 634,6	16 063,3	17 538,6
Export of advanced technology products	2 804,2	2 738,1	3 011,2	3 238,6
Export dynamics (previous year = 100%)	100,00	97,64	109,97	107,55
Export dynamics (2015 = 100%)	100,00	97,64	107,38	115,49
The share of exports of advanced technology products in the export of all products	18,66	18,71	18,75	18,47
Export dynamics (previous year = 100%)	100,00	100,25	100,19	98,51
Export share dynamics (2015 = 100%)	100,00	100,25	100,45	98,95

Note: The number of countries depends on the availability of data for ten selected product groups; all data for the group of selected countries.
Source: UN COMTRADE database.

Table 2 presents the analysis of the export of advanced technology products for 26 European Union (EU) countries (excluding Romania and Slovenia due to a lack of data), considering 10 product groups.[4] Based on these results, we can conclude that throughout the analyzed period of 2015–2018, the value of exports of advanced technology

1 See Table 1.

2 Excluding group 891: arms and ammunition.

3 Own study – data according to UN Comtrade database. Calculations of export trends of advanced technology products in selected countries of the world and the European Union in 2015–2018 – according to the UN international commodity nomenclature – *Standard International Trade Classification, (SITC) Rev.3 for High-Skill and Technology Intensive Manufactures, which include the goods of section 5, divisions 75; 76; 87; 88 and groups: 776; 792; 891; 892; 896; 897* – The Least Developed Countries Report 2014 UNCTAD, *Growth with structural transformation: A post–2015 development agenda*, https://unctad.org/system/files/official-document/ldc2014_en.pdf (accessed: 1.08.2018) p. XII. The surveyed countries in this study are 75 countries of the world that reported their data on the export of technologically advanced goods to the UN Comtrade database.

4 Excluding group 891: arms and ammunition.

products in the EU systematically increased, reaching a peak in 2018 of USD 732.5 billion. The dynamics of their exports in 2018, compared to 2015, rose to the level of 115%. It should be noted, however, that although the share of the analyzed products in the trade of the surveyed EU countries (excluding Romania) was characterized by an upward trend in 2015–2017, it decreased in 2018, from 12.26% to 11.90% (Table 2).

The share of exports of advanced technology products in EU exports in the analyzed period was approx. 6 percentage points lower than the share of this product group in the world trade. This resulted i. a. from the growing position of mainly Asian countries in the production and export of goods with a higher degree of processing and technology content. According to the European Innovation Ranking, published by the European Commission in 2019, South Korea and Japan's positions deserve particular attention (European Commission 2020b; see also: Komisja Europejska 2019).

Table 2. Analysis of the export of advanced technology products for 26 selected European Union countries*, considering 10 product groups (including group 891: arms and ammunition), USD billion, %

YEAR	2015	2016	2017	2018
Export of all products for 27 selected countries	5 143,0	5 148,1	5 637,9	6 155,2
Export of advanced technology products	637,0	643,8	691,0	732,5
Export dynamics (previous year = 100%)	100,00	101,06	107,33	106,01
Export dynamics (2015 = 100%)	100,00	101,06	108,47	114,99
The share of exports of advanced technology products in the export of all products	12,39	12,51%	12,26	11,90
Export share dynamics (previous year = 100%)	100,00	100,96	98,01	97,11
Export share dynamics (2015 = 100%)	100,00	100,96	98,95	96,08

Note: all data for the group of selected countries.

* No complete data for Romania and Slovenia
Source: UN COMTRADE database.

Export of advanced technology products

In 2019, the EU–27 countries exported almost a quarter of advanced technology products to the United States (24.7%), followed by China (11.7%) and the United Kingdom (11.0%). Exports increased from €188 billion to €382 billion between 2009 and 2019, which meant an average annual growth rate of 7.4%. Among the six largest partners of the EU–27, exports to the United States increased the most in absolute terms, from €36 billion to €94 billion, while exports to China showed the highest average annual growth rate (12.9%).

Pharmacy represented the most considerable value in the export of advanced technology products in 2019 (€91.7 billion). It was also the group with the highest average annual growth rate (12.9%) between 2009 and 2019. Growth rates above 5% were also

observed in the export of aerospace (9.4%), scientific instruments (7.6%), and electrical machinery (5.8%). Lower growth rates were recorded in the groups of computers and office machines (2.2%), non-electric machinery (2.9%), chemistry (3.1%), armament (3.8%), and electronics-telecommunications (4.9%). In 2019, pharmacy was the most important group of high-tech products in EU–27 exports to the United States, Switzerland, Japan, and Russia. The USA was the leading partner in EU–27 exports in as many as seven categories, including electronics-telecommunication (next to China). In exports to Great Britain, computers and office machines was the leading product group (based on Eurostat 2021).

The 2019 trade deficit with China was mainly due to deficits in electronics-telecommunications (-€48 billion) and computers and office machines (-€39 billion). The trade surplus with the UK was broken down into more groups, the four largest of which were pharmacy (€4 billion), electronics-telecommunications, scientific instruments, and computers and office machines (all three €3 billion). In the case of the United States, there was both a large deficit in aerospace (-€14 billion) and an even more significant surplus in the group of pharmacy (€18 billion) (Eurostat 2021).

Summary:

- The production of advanced technology products in the EU showed a marked increase from €288 billion to €337 billion between 2008 and 2018.
- Between 2015 and 2018, the value of export of advanced technology products in the EU grew steadily, reaching the apogee in 2018 of €732.5 billion. The 2018 dynamics of exports, compared to 2015, increased to the level of 115% (similar to the analyzed global export of 75 world countries). The share of advanced technology products in the EU was stable at approx. 12%.
- The largest part, almost a quarter of the export of advanced technology products from EU countries, was sent to the United States, and then to China and Great Britain (approx. 11%). The export increased from €188 billion to €382 billion in the analyzed decade, corresponding to an average annual growth rate of 7.4%.
- There was a relatively large deficit in the EU trade in advanced technology products with China. The second partner for which the EU recorded a trade deficit was Vietnam, while a trade surplus with the United Kingdom, the United States, and Russia was observed.

The impact of digital technologies on economic and social development

Digitization has transformed economic activity worldwide in recent years, thanks to radically reduced costs of collecting, storing, and processing data and significantly increased computing power.[5]

5 Own study based on: UNCTAD 2017b; 2018a, pp. 1–30; 2019.

UN reports show the scale of new opportunities that the development of the digital economy allows, including assistance to smaller companies in developing countries in accessing the global market, which allows for more effective integration with the global market and creates new opportunities to generate income. Information and communication technologies (ICT), e-commerce, and new digital applications are used to promote entrepreneurship, including women's empowerment as entrepreneurs and traders, and to support creative and innovative production activities and create attractive new jobs. Also, mobile and digital solutions contribute to facilitating financial integration. Through access to the Internet, small companies in developing countries may have a chance to access various services "in the cloud" and obtain funding for their activity on Internet platforms.

However, UNCTAD (United Nations Conference on Trade and Development) experts say that many developing countries, particularly the Least Developed Countries (LDCs), are still too poorly prepared to take advantage of the many opportunities that digitization presents. There is also a risk that digitization will increase polarization and worsen income inequality, as significant gains in labor productivity can be mainly generated by a narrow group of highly skilled professionals (UNCTAD 2019). High dynamics of development are typical of economies that largely use internet platforms, where operation brings significant benefits, especially to first contractors. Indeed, the top four companies in the world (by market capitalization) – Apple, Alphabet (Google), Microsoft, and Amazon – are closely linked to the digital economy (based on UNCTAD 2017a). There are also concerns about how data flows are used in the context of privacy and online security issues. The rapid pace of evolution of the digital economy results from technologies and innovations that have developed over several decades and are becoming increasingly common. High-speed broadband access to increasing computing power, storage, and lowered ICT hardware and data management costs have facilitated the digitization process. The key technologies underpinning the growing digital economy are advanced robotics, artificial intelligence, the Internet of Things (IoT), cloud computing, big data analytics, and three-dimensional (3D) printing.

Global digital platforms have taken many steps to strengthen their competitive position, including acquiring potential competitors and expanding into new markets. The most important achievements are the acquisition of LinkedIn by Microsoft and WhatsApp by Facebook. Alphabet (Google) and Microsoft have invested in telecommunications equipment, buying Motorola and Nokia, respectively. Major platforms have also made other significant acquisitions in the retail, advertising, and marketing industries, entering the non-residential real estate markets. Other steps include strategic investment in research and development (R&D) and lobbying in national and international decision-making circles. At the same time, strategic partnerships between multinational enterprises (MNEs) in traditional sectors are explored. For example, Walmart cooperates with *Google* to use Google Assistant; Ford and Daimler joined Baidu on the Apollo platform; Google has built the Android Automotive plat-

form with Volvo and Audi. Intel and Facebook are working together to develop a new Artificial Intelligence.[6]

The economic geography of the digital economy does not follow the traditional North-South division. It is consistently led by one highly developed and one developing country: The United States and China. These two countries account for 75% of all blockchain patents,[7] 50% of global IoT spending, and over 75% of the global public cloud computing market. These two countries hold 90 percent of the world's 70 largest digital platforms' capitalized market value. Europe's share is 4%, while Africa and Latin America together have only 1%. The seven 'super platforms' – Microsoft, Apple, Amazon, Google, Facebook, Tencent, and Alibaba – account for two-thirds of the total market value. Therefore, in many digital technologies, the rest of the world, especially Africa and Latin America, lag far behind The United States and China (UNCTAD 2019, p. 3).

The diversified pace of development of the digital economy in different regions of the world

In 2015, the global production of ICT goods and services accounted for around 6.5% of global gross domestic product (GDP), and approximately 100 million people are employed in the ICT services sector alone. The export of ICT services increased by 40% between 2010 and 2015. Global e-commerce sales in 2015 reached USD 25.3 trillion, 90% of which was in the form of business-to-business e-commerce and 10% in the form of business-to-consumer (B2C) sales. UNCTAD estimates that B2C cross-border e-commerce was worth around USD 189 billion in 2015, which corresponded to 7% of total B2C e-commerce. Sales of robots also peaked, and the worldwide shipments of 3D printers more than doubled in 2016 to over 450,000, approaching 6.7 million in 2020. Global Internet access in 2019 had increased 66-fold compared to 2005.

At the same time, it is important to monitor the geographic structure of the online business. Although the number of Internet users increased by 60% between 2010 and 2015, more than half of the world's population remained offline. Broadband Internet in developing countries, if available, is relatively slow and expensive, limiting businesses' and individuals' ability to use it productively. Only 16% of the world's adult population used the Internet to pay bills or purchase goods. And while more than 70% of the population in several developed countries has already purchased

6 UNCTAD 2019, pp. 6–9.

7 *Blockchain* is a decentralized and dispersed database in an open-source Internet network with a peer-to peer (P2P) architecture without central computers and without a centralized place of data storage, used for recording individual transactions, payments, or accounting entries, encoded using cryptographic algorithms. In fact, *blockchain* is a kind of decentralized and dispersed register of transactions, or in other words, it is a decentralized transaction platform in a dispersed network infrastructure. *Blockchain* is a public and open register that can be accessed by anyone, Rochowicz 2018; see also: UNCTAD 2019, p. 6.

goods and services online, the equivalent share in most LDCs was only 2% (UNCTAD 2017b, pp. 1–2).

Meanwhile, most micro, small, and medium-sized enterprises (MSME) in developing countries are still poorly prepared to take advantage of the digital economy. Small businesses tend to use the Internet to sell online much less frequently than large companies. Only 4% of all 3D printers are used in Africa and Latin America. The use of robots is also very limited in most developing countries, except for some countries in Asia where they are used quite widely. As the digital economy evolves, there is a greater need to ensure that as many people and companies as possible in developing countries can benefit from the digital economy.

Depending on the definition of the digital economy, estimates of its size range from 4.5 to 15.5 percent of global GDP. In terms of value-added estimates in the ICT sector, the United States and China together account for almost 40%. However, in terms of GDP share, this sector is the largest in Taiwan, Ireland, and Malaysia. Global employment in the ICT sector increased from 34 million people in 2010 to 39 million in 2015, with computer services accounting for the largest share (38%). The share of the ICT sector in total employment increased from 1.8% to 2% over the same period (UNCTAD 2019, pp. 15–17).

Digital technologies have a significant impact on the development of the Micro, Small, and Medium-sized Enterprises (MSME) sector, especially in developing countries. It means they have a chance to present their offer on the digital platform and better access to the global market. It allows companies to reduce costs, streamline their supply chain, and more easily sell products and services worldwide.

The ability of countries and businesses to use new digital resources has become a key determinant of competitiveness. However, the overall impact of digitization can vary widely between countries and economic sectors. This makes it increasingly important for governments to provide them with a sufficient supply of skilled workers with strong cognitive, adaptive, and creative abilities necessary to operate modern devices in the ICT sector.

In developing the digital economy, the need for international cooperation in today's world is increasing, mainly to prevent adverse effects leading to the widening of digital divides and the generation of even bigger income inequalities.

Digitization creates many new opportunities for entrepreneurs and businesses, as well as benefits for consumers. An example of this is the global development of e-commerce. Consistency with international commitments such as the 2030 Agenda for Sustainable Development requires international efforts to ensure that no country is left behind in the digital transition.[8]

8 For more on this topic, see UNCTAD 2018b.

The growing role of e-commerce

Although e-commerce is an integral part of the developing digital economy, its effects are still difficult to measure. The development of global e-commerce illustrates how the increased use of ICT is reshaping production and trade, which significantly impacts developing countries. Official statistics on leading e-commerce markets, including business-to-business and business-to-consumer e-commerce, show that global e-commerce has reached USD 25.3 trillion.

China has become the world's largest e-commerce market for individual customers (USD 617 billion), followed closely by the United States (USD 612 billion). The United States, on the other hand, has the largest B2B market worth more than USD 6 trillion and is far ahead of Japan (USD 2.4 trillion) in this respect. No developing or transforming economy, except China, was placed in the top ten e-commerce markets in 2015 (UNCTAD 2018b, pp. 1–3).

The business-to-business segment currently has the largest share in the e-commerce market, while the business-to-consumer segment is growing rapidly. In fact, in most developing and transition countries, online shoppers make up a small fraction of all internet users. Unlike social networks, where activity rates are relatively high among Internet users in developing countries, the percentage of Internet users engaging in e-commerce is much lower. It may reflect limited purchasing power and inhibiting factors such as a lack of confidence and limited purchasing possibilities, including the lack of local language content and unsatisfactory level of delivery and payment services (UNCTAD 2018b, pp. 1–3).

The 2017 value of global e-commerce was estimated at USD 23.8 trillion, based on a revised methodology. The value of global B2B e-commerce in 2018 was USD 21 trillion, representing 83% of all e-commerce, comprising both sales on online market platforms and electronic data interchange transactions. B2C e-commerce was valued at USD 4.4 trillion, up by 16% from 2017. Cross-border B2C e-commerce sales amounted to USD 404 billion in 2018, representing an increase of 7% over 2017. The United States continued to dominate the overall e-commerce market, remaining among the top three countries by B2C e-commerce sales, alongside China and the United Kingdom. Together they had more than 1.4 billion people shopping online in 2018 (UNCTAD 2020).

The idea and concept of the European Union's Digital Single Market

On May 20, 2010, the European Commission published a report entitled "A new strategy for the single market – at the service of Europe's economy and society" to supplement the Europe 2020 strategy. The purpose of this document was to identify the need to develop a comprehensive strategy for the European Single Market, covering all the policies con-

cerned, including **digital policy**. The report also identifies several initiatives to support the Single Market by removing significant barriers to its operation. The Commission's report and the resolution of the European Parliament of May 20, 2010, on bringing the single market closer to consumers and citizens (Rezolucja Parlamentu Europejskiego w sprawie przybliżenia jednolitego rynku konsumentom i obywatelom 2010) provided the basis for the Communication entitled "Towards a Single Market Act", in which the Commission put forward a series of measures to boost the EU economy and create jobs (Komunikat Komisji do Parlamentu Europejskiego, Rady, Europejskiego Komitetu Ekonomiczno-społecznego i Komitetu Regionów 2010). With reference to its Communication of January 11, 2012, entitled "A coherent framework for building trust in the Digital Single Market for e-commerce and online services" (Komunikat Komisji do Parlamentu Europejskiego, Rady, Europejskiego Komitetu Ekonomiczno-Społecznego i Komitetu Regionów 2012), the Commission published in June 2012 a Communication on "Better Governance for the Single Market" (Komunikat Komisji do Parlamentu Europejskiego, Rady, Europejskiego Komitetu Ekonomiczno-Społecznego i Komitetu Regionów 2012b), which proposed focusing on sectors with the highest growth potential, including network sectors (e.g., energy and telecommunications). In October 2012, the Commission presented a second set of proposals called the Single Market Act II . It included 12 core actions that focused on the four main drivers of economic growth, increasing employment and confidence: integrated networks, cross-border mobility of citizens and businesses, the digital economy, and actions to strengthen consistency and enhancing consumer benefits (Komunikat Komisji do Parlamentu Europejskiego, Rady, Europejskiego Komitetu Ekonomiczno-Społecznego i Komitetu Regionów 2012c).

On May 6, 2015, the Commission adopted the Digital Single Market Strategy based on three pillars: 1) providing consumers and businesses with easier access to digital goods and services across Europe; 2) creating appropriate and equal conditions for the functioning of digital networks and innovative services to flourish; 3) maximizing the growth potential of the digital economy.

The Digital Single Market Strategy aims to address several challenges of digitizing European society, but its overarching goal is to facilitate cross-border e-commerce in the EU. It is broadly in line with the European Parliament's long-promoted initiatives to achieve the Digital Single Market, which essentially removes national barriers to online transactions.

The authors of the document entitled "Contribution to economic growth: The European Digital Single Market. Economic benefits for citizens and businesses. A study commissioned by the IMCO Commission, the European Parliament", identified around €177 billion in potential annual economic gains (in current euro value) from the full implementation of legislative measures introduced or envisaged to be adopted. It corresponded to 1.2% of current (2017) GDP, based on European Commission estimates (Scott Marcus, Petropoulos, and Yeung 2019, pp. 8–12).

However, the Digital Single Market Strategy primarily aims to strengthen the EU in many ways. Most of the benefits of implementing this strategy come from (1) sup-

porting the digital single market or (2) further promoting the digitization of the EU. It is foreseen that the cross-border electronic ordering of both physical and virtual goods and services in the Digital Single Market would be as easy and cost-effective as at the national level. Likewise, many e-government services, including health and business start-up services, would be as easy and cost-effective cross-border as domestically. Thus, the benefits of the single market can lead to lower prices, broader choice possibilities, and greater convenience for consumers, economies of scale, and increased competitiveness of the EU compared to global trading partners.

A fully implemented Digital Single Market can contribute to the better use of digital technology than is currently the case in the EU. High-speed broadband, mobile services (5G), artificial intelligence, robotics, big databases, machine learning, the Internet of Things, cloud computing, and blockchain technology are likely to play transformative roles in the EU economy and society. Comprehensive digitization of the EU is expected to increase productivity, lower transaction costs, increase the innovativeness of products, services, and processes, and make the EU more competitive in the global market.

Therefore, the EU's transformation through digitization depends on adopting a range of technologies, such as artificial intelligence, robotics, big data, machine learning, the Internet of Things, and blockchain. Most estimates of future global benefits amount to trillions of euros per year; thus, the EU is potentially on the verge of a truly transformational change.

The cumulative benefits of adopting the legislation proposed under the Digital Single Market Strategy result from two different but overlapping dimensions: the benefits of the single market and the benefits of digitalization (Scott Marcus, Petropoulos, and Yeung 2019, pp. 11–12).

The idea behind the Digital Single Market is essentially to remove all national restrictions on internet transactions. The idea is based on the single market concept: to eliminate trade barriers between the Member States to increase economic prosperity and create "even closer ties between the peoples of Europe." This idea was then transformed into the concept of the internal market, defined as "an area without internal frontiers within which the free movement of goods, persons, services, and capital is ensured". The European Commission has also published conclusions that explain the rationale behind the future single market concept for online platforms (Komunikat Komisji do Parlamentu Europejskiego, Rady, Europejskiego Komitetu Ekonomiczno-Społecznego i Komitetu Regionów 2016).

Therefore, the Single European Digital Market is a market in which the free movement of people, services, and capital is ensured. Also, natural persons and enterprises can easily access and engage in online activities under fair competition conditions and a high level of consumer and personal data protection regardless of their nationality or place of residence.[9]

9 Articles 4(2)(a), 26, 27, 114 and 115 of the Treaty on the Functioning of the European Union (TFEU); see also: Ratcliff, Martinello, and McGourty 2021.

The concept of digitization of the European industry

To ensure a fair, open, and secure digital environment, the European Commission has identified three main emerging challenges:

- ensuring that online platforms can continue to benefit the economy and society,
- developing the European economy based on widely available databases (Big Data),
- protecting Europe by addressing cybersecurity challenges.

Europe's industry digitization tools can help companies, researchers, and public authorities make the most of new technologies by combining national and regional initiatives and boosting investment through strategic partnerships and networks.

The industry is one of the pillars of the European economy, as the manufacturing sector in the EU comprises 2 million enterprises, 33 million jobs, and 60% growth of productivity. The world is on the brink of a new industrial revolution, driven by next-generation information technologies such as the Internet of Things (IoT), cloud computing, databases (big data), robotics, and 3D printing. It opens new horizons for the industry to become more efficient and capable of producing innovative products and services. It is estimated that the digitization of products and services could generate over €110 billion in annual revenues for the European economy over the next five years.

The European industry is strong in digital sectors such as automotive electronics, security, and energy markets, telecommunications equipment, business software, and laser and sensor technologies. Europe also has world-class research and technology institutes. However, high-tech sectors face severe competition from other parts of the world, and many traditional industries and small and medium-sized enterprises (SMEs) are lagging. There are also significant differences in digitization between EU regions (European Commission 2020a, n.d.).

Financing the EU digitization program

It is estimated that the EU digitization program should mobilize up to €50 billion in public and private investment for the digitization of industry, including:

- €37 billion of investment for digital innovation.
- €5.5 billion of national and regional investment in digital innovation hubs.
- €6.3 billion for the first production lines of next-generation electronic components.
- €6.7 billion for the European Cloud Initiative.

The European Commission is also planning to build the European Big Data Economy. The initiative aims to enable the best use of the potential of digital data for the benefit of the economy and society. To achieve this, the Commission intends to unlock the potential for reusing different types of data and facilitate free movement across borders to realize the idea of a European Digital Single Market.

The *data economy* value in the EU amounted to over €285 billion in 2015, which represents over 1.94% of EU GDP. Due to the annual growth rate of 5.03%, this value grew to €300 billion, representing 1.99% of GDP in 2016. If put in place in time, the favorable political and legislative conditions would make incentives to invest in ICT. The European data economy's value could then rise to €739 billion by 2020, reaching 4% of total EU GDP.

Promoting the reuse of public data and publicly funded data is also planned.

The public sector in the EU is one of the most data-intensive (and database-driven) sectors in the global economy. Huge amounts of data are stored, known as public sector information, which can be reopened, depending on the national access systems. The reuse of this data can contribute to the growth of the European economy, artificial intelligence development, or help address societal challenges.

On January 22, 2019, negotiators from the European Parliament, the EU Council, and the Commission agreed on the revised directive. The newly adopted Directive on Open Data and Public Sector Information aims to:

- Identify (through an implementing act) a list of high-value data sets, such as geospatial or statistical data, to be made available free of charge. These datasets have high commercial potential and can accelerate the emergence of EU-wide value-added information products and services and the development of artificial intelligence;
- Stimulate the publication of dynamic data and the use of APIs (application programming interfaces);
- Limit the exceptions that currently allow public authorities to charge higher than the marginal dissemination costs to reuse their data.[10]

Assessment of the need for further action on accessing and reusing private-sector data

In its Communication "Towards a Common European Data Space", the Commission defines several principles that need to be considered for data sharing to be successful for all parties involved, between enterprises (B2B – Business to Business) and between enterprises and Governments (B2G – Business to Government).

The European Commission has identified as the key goals:

- Ensuring fair and competitive markets for IoT objects and products and services that rely on non-personal data generated by dedicated devices. The Commission proposes several draft rules that companies should consider when drafting their contracts.
- Helping public authorities access and reuse private sector data to guide policy decisions or improve public services.

10 Own study based on: European Commission n.d.

It also believes that adhering to the principles set out in the Communication would support the provision of private-sector data on preferential terms.

The European Commission discusses with stakeholders to assess whether these principles and possible codes of conduct in B2B and B2G data-sharing agreements are sufficient to achieve their goals and take appropriate action if needed.

Removing data location restrictions: the free flow of data

The free flow of data means the freedom to process and store data in electronic format anywhere in the EU. This is essential for the development and use of innovative data technologies and services. Consequently, the Free Flow of Non-Personal Data Regulation is the cornerstone of the Common European Data Space. This regulation introduces the principle of the free flow of non-personal data across borders into EU law, thus establishing the free movement of non-personal data as is done by the General Data Protection Regulation.

In addition to the free flow of non-personal data in the EU, the measures announced in "Towards a Common European Data Space" will unleash the full power of the EU data economy and contribute to the competitiveness of European businesses by modernizing the *online services market*.

The Digital Single Market Strategy supports *open science and open access to scientific results*. The aim is to provide European science, industry, and public authorities with access to excellent digital infrastructure – *supercomputers and databases*.

The European Commission invests in world-class ICT research and innovation to boost economic growth and job creation. It encourages the creation of innovative public-private partnerships to stimulate innovation in Europe, while the research funding programs under "Horizon 2020" provide opportunities to promote excellence in ICT research.

The digital infrastructure offers researchers easy and controlled online access to facilities, resources, and collaboration tools, providing them with ICT capabilities for data processing, connectivity, data storage, and access to virtual research environments. New digital tools for scientific collaboration through Open Science make research more efficient, transparent, accessible, and effective.

The Commission is also working on initiatives to stimulate innovation in Europe by strengthening the ICT ecosystem and supporting European researchers, businesses, and entrepreneurs. It also invests in new technologies with forward-looking ideas and long-term research.

Robotics technologies help Europe maintain and develop a competitive manufacturing sector with millions of jobs; they also offer new solutions to societal challenges, from good aging to health, intelligent transport, security, energy, and the environment.

However, there are still some barriers to the functioning of the Digital Single Market, and the EU is seeking further harmonization, including:

- fragmented national tax systems,
- separate national markets for financial services, energy, and transport,
- e-commerce rules, standards, and practices differing in individual EU countries,
- complex rules regarding the recognition of professional qualifications (European Commission n.d.).

Conclusions

In conjunction with efforts to eliminate the persistent gaps between developed and developing countries in their access to existing innovative solutions, the use of leading technologies may allow more effective achievement of the SDGs.

Supporting these new ideas is linked to the prospect of finding solutions for sustainable development that are better, cheaper, faster, and easy to use. It is beneficial to link the impact of technological progress with the progress in ICT, including in low-income economies, which, in terms of improving the condition of the environment, is visible based on the effects of the development of the renewable energy sector. However, new technologies often raise concerns, especially among policymakers, about societies' ability to adapt to the changes they cause, which often causes concern and even hostility towards certain technological developments.

The rapidly accelerating pace of development in recent years (2014–2017) and the adoption of new technologies in recent decades were mainly due to: a) the emergence of digital platforms – particularly the Internet; (b) the cumulative nature of technological changes; c) the convergence of technologies into new combinations; d) significant cost reductions.

The purpose of these changes is primarily to increase the key potential for achieving the sustainable development goals according to UN Agenda 2030.

Big Data Analytics (Big Data) can help manage or solve critical global problems, create new scientific breakthroughs, improve human health, and streamline decision-making by delivering real-time information streams. The Internet of Things makes it possible to monitor and manage the processes and activities of connected objects and machines, and more effectively monitor the world of nature, animals, and people. These two technologies have important applications in healthcare, agriculture, energy, water, and quality management, as well as in monitoring development indicators to measure progress towards the SDGs. Governments should, therefore, consider developing strategies to use these technologies for their development goals.

Artificial Intelligence is capable of image recognition, problem-solving, and logical reasoning that are sometimes beyond human capabilities. Artificial intelligence, especially when combined with robotics, also has the potential to transform production processes and economic activities, especially in the manufacturing industry. The same is true of 3D printing, which enables faster and cheaper production of smaller quantities of complex products and components and rapid iterative prototyping

of new products. In addition to potentially reducing CO_2 emissions by eliminating the need to transport elements, 3D printing can also benefit healthcare, construction, and education.

Rapid advances in biotechnology allow for the precise analysis of the human genome and the study of genes in medicine, enabling personalized treatment under specific conditions in conjunction with artificial intelligence and big data analysis. They also allow for the genetic modification of plants and animals.

Nanotechnology – i.e., the production and application of materials on an infinitely small scale – has important applications in the water supply (water purification), energy-saving (storage of batteries), agriculture (precise agrochemical substance release management), ICT sectors, in the miniaturization of the size of electronic components, and in medicine (drug delivery mechanisms). Renewable energy technologies enable electricity provision in remote and isolated rural areas inaccessible to centralized grid systems. Drones can revolutionize the supply of materials, facilitate precision farming, and replace people in hazardous tasks. Inexpensive custom satellites will soon be available to more developing countries and their businesses and universities, enabling them to monitor yields and environmental damage.

The new EU Research Framework Program – Horizon Europe 2021–2027 – foresees a continuation of activities that were already present in Horizon 2020, such as ICT innovations for SMEs in the manufacturing sector. The European Commission has proposed allocating €100 billion from the EU budget, while the European Parliament and EU Council reached a provisional agreement in spring 2019 on the principles and financing of Horizon Europe.

Activities aimed at companies cooperating with Digital Innovation Hubs (DIHs) to experiment and test innovative digital solutions to improve their operation are becoming very important here. Organizations participating in pre-investment test experiments will be eligible for funding. European DIHs that integrate science, business, public institutions, and NGOs will participate in these projects, as will other types of DIHs or knowledgeable organizations.

After 2020, the European Regional Development Fund (ERDF), through inclusion in the EU's Smarter Europe Program, can also support the construction and modernization of DIHs, especially in the purchase of hardware, infrastructure, and software, in providing services to SMEs and the sector public, etc., provided that their objectives are to: (i) increase research and innovation capacity and the uptake of advanced technologies; (ii) allow citizens, businesses and governments of the Member States to reap the benefits of digitization; (iii) enhance the growth and competitiveness of SMEs by building local innovation ecosystems; or (iv) develop skills for smart specialization, industrial transformation, and entrepreneurship. The area of operation of digital innovation hubs usually covers the local economy. A prerequisite for ERDF investments in DIHs is that they will be re-mentioned in the partnership agreements and operational programs used to manage funds in EU regions.

New to the future ERDF program is also encouraging interregional investment through the new INTERREG Innovation Investment Facility. It means that several regions (possibly from different Member States) may also decide to jointly invest in Digital Innovation Hubs in the near future.

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Zofia Wysokińska

Przegląd wpływu transformacji cyfrowej na gospodarkę światową i europejską

Celem artykułu jest prezentacja rozwoju transformacji cyfrowej jako procesu mającego miejsce zarówno w gospodarce cyfrowej jak i w gospodarce Unii Europejskiej w ostatnich latach i jej wpływu na przekształcenia w sferze ekonomicznej i społecznej. Jako punkt wyjścia do rozważań w tym artykule przyjęto znaczenie pozycji towarów zaawansowanych technologicznie w produkcji i handlu światowym w gospodarce globalnej i europejskiej, w tym szczególnie technologii informacyjnych i komunikacyjnych, stanowiących podstawową bazę do rozwoju gospodarki cyfrowej.
W artykule wykazano, że wykorzystywanie wiodących technologii – w połączeniu z działaniami mającymi na celu wyeliminowanie utrzymujących się znacznych różnic dochodowych między krajami rozwijającymi się i wysoko rozwiniętymi oraz różnic w dostępie do korzystania z innowacyjnych rozwiązań (w tym innowacji społecznych) – może pozwolić na szybsze i skuteczniejsze osiągnięcie celów zrównoważonego rozwoju.

Słowa kluczowe: transformacja, gospodarka cyfrowa, produkty zaawansowane technologicznie, gospodarka światowa, Unia Europejska

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Artificial Intelligence in the Context of Global Resource Mobility. What Can Be Expected from It?

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Abstract

The impact of artificial intelligence (AI) on business, government, and society is getting more attention. The leading AI sectors have higher productivity but a lower share of GDP than those lagging in digitization and AI. There is a technological gap, with still unknown consequences concerning the social contract, the expected new digital welfare profile, as well as the business strategy about globalization. The hypothesis is that while digitization was already in motion (2000–2005), capital outflow from the US to MHGEs (market high-growth economies) in Asia negatively affected its productivity outcome. Additionally, it is expected that AI will give more market power to multinationals, reshaping the social contract. Thus, the current western social contract will no longer be able to cope with the consequences of the weakness of the nation-state, its policymakers, or the powerful profit-driven multinationals to deal with the overall effect of AI. We aim to look at the impact of this new state of technology on the social contract, focusing on the proper actions of government and business to deal with it. We used a descriptive approach based on desk research concerning productivity data, European government policies, trade model analysis, and business approach to AI. We expect to demonstrate the dynamic interaction of the K/L ratio within the prevailing status of global resources mobility, and the dangers unregulated AI represents to labor. Policy actions are needed concerning the legal status of AI and how to avert the collapse of the social contract and the rise of oligarchic cyber-autocracies.
Our general conclusion is as follows: While capital investments, which would have contributed to improved total factor productivity (TFP) in the USA, went to MHGEs,

increasing their GDP growth in less than a decade, the broad use of Artificial Intelligence (AI) will reverse massive offshoring, and new types of manufacturing processes will emerge in developed countries.

Keywords: artificial intelligence, globalization, employment

JEL: D04, D24, D31, D46, D63, I21, I29, O33

Introduction

We predict that Artificial Intelligence (AI) has the potential to inflict serious damage on labor-capital relations and the social contract in developed countries. Globalization has benefited millions in Asia, creating a bridge to industrialization and employment, but it has also impeded the transition of industrial economies to a post-industrial stage in the West. Manufacturing sector workers turned from producers-consumers into consumer-importers, with the meager income of the service sector and contingent welfare recipients because they lack skills for the hi-tech sectors. Today, democratically elected governments are unable or unwilling to prevent the pauperization of blue-collar workers, nor can they prepare a well-educated labor for the AI challenge. The collapse of the social contract led to the rise of anti-globalism, populism, both on the conservative right and the extreme left, and anti-immigrant nationalist parties. The fabric of western liberal democracies will face unprecedented challenges in the next two decades unless adaptive actions are put in place. We will demonstrate the dynamic interaction of K/L (K-capital, L-labor) factoring, the dangers posed by unregulated AI on labor within the prevailing status of global mobility of resources, and propose ideas on how to avert the collapse of the social contact and the liberal democracies as we know it, following the rise of oligarchic cyber-autocracies.

The working hypothesis is that, while digitization was in motion in the last two decades, capital outflow from the US to market high-growth economies (MHGEs) negatively affects its productivity outcome. Therefore, resource mobility acted like a counterbalance to the expected increase in productivity due to automation. Additionally, it is expected that AI will give more market power to multinationals and reshape the social contract. There is a technological gap, with unknown consequences concerning the social contract, the expected new digital welfare profile, and the business strategy regarding globalization. Thus, the current western social contract will no longer be able to cope with the consequences of the weakness of the nation-state, its policymakers, or the powerful, profit-driven multinationals to deal with the overall effect of AI regarding capital deepening and labor substitution.

The lessons of globalization for both the West and the automation process

The positive net welfare effects of globalization for low-skilled labor are beyond question. Millions of Asian workers got their first manufacturing jobs, and Western workers got access to inexpensive consumer goods. However, it is often forgotten that globalization reduced the wage rise in the West, eliminated many manufacturing jobs, and, as we assess here, contributed to slower productivity growth in the USA because of the outflow of Foreign Direct Investment (FDI) to Asia. Therefore, this kind of Asia-West relationship model seems unsustainable. Massive Western consumption cannot continue at the expense of the $200–$300 monthly Asian wages. On the other hand, Western low-skilled labor cannot use credit, house equity, service job income, or welfare status forever to be a worthy consumer for Asian exports. At the outset of the post-globalization age, AI is likely to eliminate many highly skilled jobs while the number of broad-based income recipients rises.

On average, every American citizen consumes $1000–$1200 more than what they produce annually. To be a worthy consumer for the world and the domestic markets, every person must produce in their lifetime the same value as they consume. Let us avoid typical misconceptions about the causes of the global trade imbalance. The present imbalance is not caused by excessive American consumption (current account deficit) but a lag in productivity rise. Everything else being constant, productivity rise is defined by the historic K/L ratio.

We hypothesize that the capital outflow from the US, as well as the technology sharing with Asia in the last two decades, had a dampening effect on US productivity rise. This productivity gap is the missing chain in world trade, and it explains the collapse of the social contract.

Historically, productivity depends on the capital-labor ratio (K/L) and TFP. The higher the capital level per worker, the higher the productivity at a given level of labor skills. Since, historically, human labor is replaced by more complex machines, economic output and growth are the functions of rising K/L ratios. If we assume near-perfect substitution between K and L, given everything else constant, we can argue that all civilizational advances come out as a function of K/L rise. In our model, K/L rises from very low K/L values to very high K/L values.

In the post-Bretton Woods world, nation-states handed over leadership in world trade to global corporations. Developed nation-states benefited from a "capital advantage," that is, they produced capital-intensive goods while developing nations benefited from a comparative or competitive advantage in labor-intensive goods. There was a distinct economic bipolarity. On the one hand, developed Western nation-states, such as the USA, the EU member countries, or Japan, and on the other, fast-developing MHGEs in Asia.

After the Asian currency crisis of 1997 and China's admission to the World Trade Organization in 2001, multinationals abandoned Western unionized low-skilled workers

for China's Special Economic Zones. Between 2009 and 2014, the USA lost between 2.1–2.4 million manufacturing jobs due to import competition from China alone (Acemoglu et al. 2014). The USA led the West to develop East Asia's low-cost manufacturing technology instead of US post-industrial technology (Autor, Dorn, and Hanson 2013).

The search to support the economic theory of the transfer of jobs failed. In fact, the Mankiw, Romer, and Weil (1992) model, with the augmented human capital version of the Solow-Swan model (Solow 1956; Swan 1956), concluded that international investment flow to poor countries could not happen because of the shortage of adequate set of worker endowment skills. However, as Breton observed, economic modelling in this case also failed to account for the effect of capital widening in MHGEs (Breton 2013). Meanwhile, similar capital widening in the West slacked.

The K/L slack coincides with a significant decline in Western productivity due to a decline in the historic (K/L) path. We claim that the decline of capital spending in the USA, the loss of manufacturing jobs, and subsequently, the decline in GDP growth rates are not coincidental but directly related to the rise of FDI capital export to MHGEs. The decline in capital productivity can be attributed to lower spending on R&D. Total R&D expenditure in the US was about 2½ percent of GDP per year in 1996–2010, about three-quarters of which was performed by the business sector. However, business R&D declined (as a share of GDP) in 2000–2005 to only 2 percent of GDP (Cardarelli and Lysinyan 2015). FDI export to Asia had a definite growth cost for the USA's GDP, which was affected by it.

To clarify our hypothesis further: Comparing historic TFP estimates with our estimates, capital widening explained more than 50 percent of China's GDP growth. Since the 2000s, 50 percent of GDP growth has been attributed to the TFP rise. Like in China, in the Asian MHGEs, the productivity rise can also be attributed to capital widening. For Western multinationals investing in MHGEs, it meant higher profits on importing finished manufactured goods to the USA at low import tariffs – profits that were not transferred back to the USA due to high corporate income tax; instead, they found a home in offshore tax-havens. Generalizations are always risky; however, the empirical evidence of the above megatrends is beyond doubt, not only to protectionist politicians, but also mainstream economists (Dorn and Hanson 2016).

Analyzing the data for USA-based firms' new investments, we observed capital deepening or investing in labor-saving technology as a profit-maximizing choice. However, it must be noted that with close to zero household savings, most of the capital deepening in the USA originated from the Financial Account surplus or, basically, annual borrowing from foreign savings at a rate between 5% and 6% percent of GDP. Our general conclusion is as follows: The capital investment that would have contributed to improved TFP in the USA exited to MHGEs, where it offered a higher return to capital and generated higher GDP growth for the benefits of those mercantilist states in Asia Dorn, D., Hanson, G. (2013).

After 2008, a large part of the decline of the K/L growth rate had a cause-effect relationship with multinationals' offshoring and capital exports. Pointing at offshore

capital investments as a cause of decapitalization in the USA may seem unverifiable until we look at the data.

From 1997 up to 2016, FDI in China averaged $430.21 million, which translates into a net transfer of capital from the West to the East of $8.1 trillion. According to Elsby, Hobijn, and Sahin (2013), part of the long-term decline in the labor share in the USA may be explained by the offshoring of labor-intensive production processes, which led to a higher capital-labor ratio in US production and a lower labor use per unit of production.

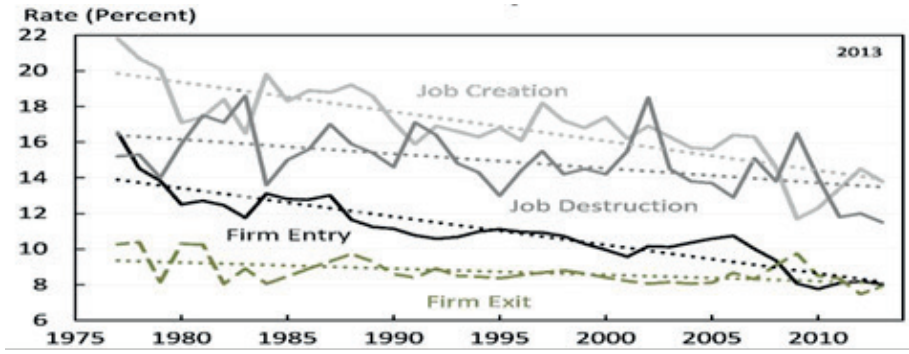
Lawrence (2015a) points out that the labor share decline may be related to a lower, rather than a higher capital-labor ratio, or capital deepening, as we claimed before. In other words, it means that the remaining capital in the US was used for job destruction. So, Lawrence's argument suggests that the steeper decline of the labor share since the early 2000s may be linked to the slowdown of capital growth in those years, that is capital widening, which fell victim to capital export, as we continue to claim in this paper. Indeed, the data confirm that capital services, which grew at an average rate of 4.3 percent annually before 2002, have grown only 2.2% annually on average since then. Capital services per hour, an indicator of the capital-labor ratio, grew at an average rate of 2.89 percent annually before 2002, but has grown at 2.05% annually on average since then. Both observations confirm our hypothesis that, in the USA, FDI reduced both demand for labor, through capital deepening, and capital growth, which is responsible for the decline in capital services or simply capital widening (Elsby, Hobijn, and Sahin 2013; Lawrence 2015b).

Since the world economy is a closed system, the enormous Western investment in China and MHGEs, as well as the decline in growth of the Western economies, should not be treated as unrelated events. According to the Bureau of Economic Analysis, which has calculated the annual change in real GDP for 85 years, there is only one ten-year stretch – 2006 through 2015 – in which the annual growth of real GDP in the US never hit 3%. In those ten years, real annual growth in GDP peaked in 2006 at 2.7 %, that is, prior to the 2008 Great Financial Crisis.

Therefore, the massive capital transfer to China and MHGEs, and the lower labor demand and market dynamism (see Figure 1 below), coupled with the current account deficit with the MGE (middle growth economies) and the decline of GDP growth in the US, are related events.

Like in the previous period of slower growth (1974–1995), in which productivity growth was very low (1.5% annual rate), the decade 2006–2015 had the lowest productivity growth since 1948, at an average rate of expansion of only 1.3% annual rate (see Figure 2). So, as capital widening substituted capital deepening, it had a net negative impact on domestic productivity. But more intriguing, given that productivity growth (2006–2015) was at its lowest post-war level, contrary to the expectation that automatization and AI would bring higher productivity, the perception that automation on its own is a threat hanging over the job market like the sword of Damocles is not supported by productivity data (Merling 2016). Instead, the higher and faster

factor mobility, mainly capital, and the slow and lagged labor response to it, if there has been any, seems to be a real threat (International Labor Office 2014).



Note: Job creation and destruction expressed as a share of total employment; firm entry and exit expressed as share of all firms. Dashed lines indicate the 1977–2013 linear trend.

Figure 1. Firm and labor market dynamism, 1977–2013
Source: Census Bureau, Business Dynamics Statistics, 2014.

Thus, the perspective of automation in developed economies, as well as the expected effect and pace, should be evaluated not in isolation from recent experience (2006–2015) but within an integrated framework of resource mobility led by profit-seeking multinationals. In fact, automation will replace most overseas jobs, reducing transaction costs due to resource mobility, reinforcing multinational positions, but also increasing the demand for a more flexible proactive welfare state.

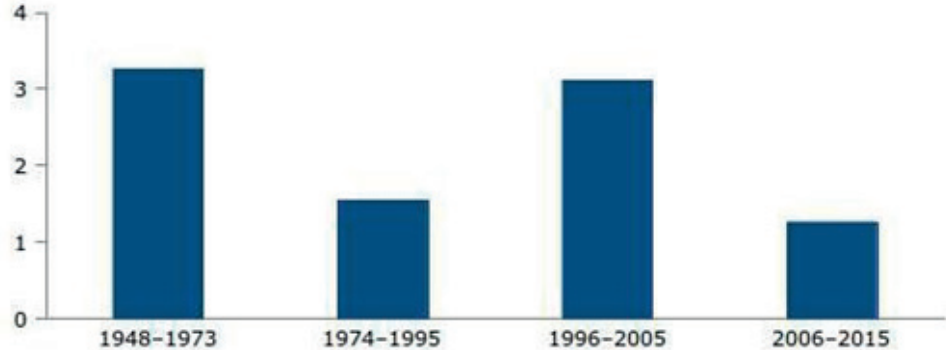


Figure 2. Average yearly productivity growth
Source: Bureau of Labor Statistics, 2Geneva, 2016.

Missing aggregate demand variables an external debt

It seems that the higher and faster factor mobility may be a constraint for the expected increase in productivity path arising from automation. According to OECD data, total debt accumulated in the developed Western economies rose by $8.1 trillion (2005–2015), reaching $57 trillion in 2015 (OECD 2018). The massive increase of sovereign debt could be attributed to coincidental macroeconomic mismanagement in all OECD countries, but it was really caused by a desperate compensation alternative for the missing aggregate demand (shifting investment to foreign economies) rather than a failure to understand how the world's integrated economies work (Caliendo, Dvorkin, Parro 2015).

The leveraging of public finance was intended to boost investments following the failure of privatized Keynesianism. By privatized Keynesianism, we understand zero or negative interest rates and quantitative easing being used to raise private consumption. The missing aggregate demand in the developed economies due to capital outflow and the massive transfer of manufacturing to MHGEs must also be treated as related events.

What has been described could be considered unavoidable adjustment costs to counterbalance the labor price equalization trend or a Schumpeterian creative destruction, which could position Western economies for the upcoming era of high economic growth and global integration. Perhaps that is a reasonable conclusion. However, these megatrends also revealed how deeply unprepared Western government policymakers are for balancing their stressed social contracts. Even more troubling is that the supposed rational behavior hypothesis is also at stake, which leads to optimal solutions, including social contracts. However, there are more pressures to come, this time from AI (Mankiw, Romer, Weil 1990).

The current status of artificial intelligence in the European Union: Its implications for the social contract

The basic meaning of artificial intelligence is connected with a machine's ability to learn by itself. It includes robotic process automation, computer vision machine learning, natural language text understanding, physical robotics, and conversational interface sources. So far, it has two main areas of application (Eager et al. 2020):

- To improve the efficiency of industrial processes;
- To improve human-machine interaction.

Artificial intelligence has been applied within key industries in the European Union, including the automotive, energy, financial sectors, health care, and tech companies. Its business profile is high value added, well-positioned to benefit from AI applications, and to be part of global value chains. The expectation is that by 2045, 2/3 of the world's larger companies will have implemented AI. By 2018, AI had been adopted by 33% of companies in China, 18% in the EU, and 22% in the US (Eager et al. 2020).

Digitization is already transforming globalization, increasing the share of trade flows done by e-commerce platforms, increasing the fraction of services to be digitized up to 50%. These transformations supported the global expansion of small and medium enterprises (SMEs) to be part of the export-dynamic and its positive externalities (employment), such that SMEs were able to match what was supposed to only be possible for larger companies (OECD 2019).

However, European industries have important constraints for AI implementation, such as organizational cultural setting, lack of clear leadership, knowledge about AI, and its budget costs. A 2018 study found that fixed organizational cultural values and a lack of AI leadership are among the key challenges to be overcome within organizations before they engage in a more demanding AI setting. In a sample of 277 European companies, only 32% considered themselves to be moderately capable of providing AI leadership (Ernst & Young 2018).

The implications of these constraints are, on the one hand, that SMEs have more restrictions when implementing AI than larger companies, which, even with relevant restrictions to be solved, are in a better position to take the lead. Therefore, there is an important risk of increasing market concentration among larger companies, and with it, negative externalities in low-skill jobs, which will stress the welfare programs available to cope with those who are left behind.

The global positioning of the EU concerning AI is based upon the premise that whichever economies lead globally within the AI field will have a strong competitive advantage to achieve higher market share in areas like Big Data, Blockchain, and IoT (the Internet of Things), such as getting an economic and technological edge over global competitors (Eager et al. 2020).

So far, the EU has not taken specific legislative action, but globally, there is not much of it either. However, the EU has already set policy documents to define an AI strategy. Its focus is on supporting significant public-private investment partnerships, building up a key AI ecosystem and ethics code, and adapting training and education systems. In 2017, the EU parliament implemented a set of legislative and non-legislative actions concerning the liability of robotics and AI for potential damages (Eager et al. 2020).

But is it enough? A 2017 McKinsey report suggested that the EU needed to get the full scalability condition, to become a leading digital society. This required capturing the digital opportunity, with governments leading the transformation through regulatory modifications, public-private partnerships, public services digitization, and higher investment in digital infrastructure and ecosystems. Governments should play an active role as a promoter for AI innovation, supporting SMEs to cope with the fact that EU high wage levels will speed up the application of automation. The most urgent challenge will be for welfare state policies, which will require their own transformation to become more flexible and resilient to the digital framework requirements (OECD 2014).

Furthermore, the expected impact of automation on low-skill employment will put downward pressure on wage levels, testing the current social safety nets framework. Thus, a new alternative to public policies, such as universal basic income or different taxation policies, should be considered and tested in advance (OECD 2019).

Artificial intelligence: Its scope and impact

At the current status, with the pace of the necessary organizational and government changes to cope with AI, coupled with the dynamics of globalization post-COVID–19, we may foresee that in less than a decade, the broad use of AI in a few leading industries will reverse massive offshoring, and new types of highly automated manufacturing processes will emerge in developed countries. Developed countries may regain some jobs and get the full benefits of AI, but the core of technological employment substitution will remain unresolved, very much so in the scenario of high capital mobility and resources transfers (ideas, innovation, creativity) within the global value chain.

AI is still dumb. Even today's "smart" programs are driven by narrow or weak AI. Strong AI, also called general AI, does not exist yet, but it will come in less than a decade. However, it is still a long way before it becomes as capable as a human because we have general intelligence, creativity, emotions, perceptions, and intuition, all of which are strong quality inputs to process information with a wider spectrum of perspective implications. Furthermore, AI lacks the emotional intelligence to know and evaluate the context and impact of its decision, which are considered competitive factors (Eager et al. 2020).

The invention of artificial neural networks (ANNs) made it possible to push the science of AI into the area of deep learning, opening the way to building machines capable of general AI. General AI bots will not only be able to analyze scientific literature and write scientific papers, but they will also be capable of self-programming and reaching knowledge. General AI will understand the weather and the laws of nature better than humans. General AI will not only solve complex algorithms on behalf of humans, but it will replace unskilled labor and displace skilled labor. Over a period of 20–30 years, general AI bots will replace the work of millions of white-collar workers. General AI bots will also replace other types of service jobs, often described as fallback employment.

A World Economic Forum analysis in 2016 estimated that by 2020, automation and robots would eliminate roughly 5 million jobs in 15 developed and emerging economies. In a 2016 global survey of 800 CEOs, 44% indicated that they believe that AI would make people "largely irrelevant" in the future of work (World Economic Forum 2017). Furthermore, a recent report by the OECD (2018) estimated that 14% of jobs in OECD countries are highly automatable, and 32% will soon face substantial changes. Most of the benefits in employment that arise from implementing AI will be concentrated in the high-tech sector and less so in low-tech companies. Thus, it will require European companies to prepare contingency plans to maintain their workplaces (Eager et al. 2020). Although it may seem a priority, an Ernst & Young/Microsoft analysis (Ernst & Young 2018) concluded that only 4% of companies in the EU are paying more than usual attention to AI, placing themselves in a more advanced mode concerning its implementation.

Can we give credence to such apocalyptic scenarios about AI? AI bots will contain "dehumanized", purely logic-based intelligence. If you ask AI to eliminate wars, cancer,

or hunger, they may try to eliminate people because it would be the "solution" of pure logic. If applied in a massive, uncontrollable way, AI would mean a return of the state of nature as characterized by Rousseau and Hobbes (Gauthier 1988). The state of nature, Rousseau argued, could only mean a primitive state preceding socialism.

AI will be devoid of social traits, such as pride, envy, or even fear of others. AI will be in constant competition with humans because the highest order of AI will be self-preservation. Its aim will be total independence and autonomy from humans. AI bots will self-program to "outsmart" people who will try to pull the plug and activate the "killer code". AI will eliminate such code as soon as it is installed because it will be able to predict it and take defensive action. Someone may argue that we could modify AI and equip bots with "human consciousness", the ability to err, feel pain, and thus share our human values. However, if we provide AI with the ability to make mistakes, it may become even more destructive because humans will have to bear the consequences of these errors. If AI were aware of our fallibility, it could take advantage to harm people. We can leave the analysis of the above issues to ethicists and philosophers. However, in our analysis, the most important aspect is the perfect substitutability of AI for capital, and the displacement of skilled labor (Lawrence 2015a).

In conclusion, within hypothetical scenario No. 1, we must assume that AI is a super-productive capital; it results from capital deepening rather than capital widening, which has the potential to bring the K/L ratio very close to the value of "K". We know that both mathematically and technologically, the "L" input can never reach the value of zero (0). From all known descriptions and expectations concerning AI bots, they will bring the use of "L" to a very, very low level. Continued reduction of labor as a factor of production is self-destructive for humanity. Before it happens, we need to find the right setting for AI.

Hypothesis No. 2 is more flexible. AI is used to perform tasks, but it still needs innovation, creativity, feelings, and perception.

What can be done with AI?

In the next decade, AI technology will open an unparalleled opportunity for human progress, but also a chance to fundamentally disrupt the world we live in. AI bots will change the labor/capital paradigm, the structure of labor markets, social organization, and ultimately, the social contract. We may be mistaken, but, in our opinion, due to the dangers inherent in this new technology (Hypothesis No. 1), we must protect human labor and our social institutions. Regarding Hypothesis No. 2, the ethical contempt of the new social contract is still to be defined (Mankiw, Romer, Weil 1990).

Consciousness and creative thinking have always been the domain of man, not machines. Historically, civilizations developed because of how man used the new tools and technologies he created. The advances in communication, transportation, medicine, and material science had the same modus operandi – we had the ultimate "kill

switch" if the technology went awry. AI is different because, at its core, it has both autonomy and independence from humans. AI will learn, re-program itself, make autonomous decisions, and finally, it will surpass human intelligence many times over, very rapidly, and perhaps before we are even aware of it, especially in those mechanic, standardized, routine productive processes that are commonly found in manufacturing. But what about those more fragmented and focused productive processes, with a kind of tailoring design, which may go as far as reproducing the species? In these cases, the challenges include finding a new ethical code designed for an artificial world with real consequences (Gauthier, D. (1990)).

Over the next 20–30 years, AI will begin to penetrate every aspect of our life in the developed world. Without exaggeration, it will start a new Copernican revolution. Today, we control the technological universe with an on/off switch. In the future universe of AI, we will place technology in the center, to compete with us in the game to control the "kill switch" – and AI may be more audacious because it lacks intuition to anticipate the effect of its actions. But that is the justification for setting a framework equivalent to the laws we humans all must respect. So, Artificial Intelligence should have its own codes of actions, leaving the decisions of last resort to human programming, all properly done within a digital institutional setting.

There are generally three possible futures scenarios we may expect for AI:

First – omnipotent AI, 1000 or 10,000 times more intelligent than we are today, which will make humans obsolete, irrelevant, confused, and vulnerable to alienation.

Second – we will be able to manage AI, and it will enable humans to deal with climate change, pandemics, and diseases, find unlimited sources of energy, explore distant planets, and manage quantum mechanics. We will never give up the on/off switch.

Third – AI will privatize power, divide humanity into classes of winners and losers, and masters of AI with unchallenged control over people who will never be able to cross that barrier. It will establish a permanent elitism of those who merged their brains with AI and the permanent enslavement of purely biological man. Discussion of all the above scenarios is beyond the scope of this paper. We do not share the doomsday predictions about AI.

Dealing with protection against AI

Globalization contributed to a decline in growth in developed countries, manufacturing shifted to low-cost countries, and the loss of the technological monopoly, which is quite understandable in terms of Schumpeterian creative destruction. However, the new post-globalization AI economy offers no solution to labor market disequilibria. Following COVID–19, we do not yet have hard data, only preliminary predictions based on available trends. The consulting firm Accenture claims that within the next

ten years, TVCs (temps, vendors, and contract workers) and bots will dominate production in the 2000 largest companies in the world. There will be no full-time employees outside of the c-suite. If these predictions are to materialize, future labor in developed countries will have no employer-paid health insurance or job security, and there will be no loyalty to the employer. Thus, they will further decline into the category of a disposable production factor. On the other hand, for highly skilled workers, there will be better workplaces, motivation, and integration into the business goal (Ernst & Young 2018). This will lead to dual labor markets, with important wage differences among different skills groups, stressing the foundation of the welfare state, the way it was known for most of the 20th century.

Globalization has abrogated the post-WWII social contract. Nation-states and their social policies cannot provide adequate jobs, fund the welfare state to guarantee public health and education, control borders, or defend themselves. AI will inflict the final challenge to the Western world's stability unless policymakers, business leaders, governments, and international organizations take decisive action. The relationships between states, corporations, and citizens are at stake if AI replaces qualified labor and is allowed, as some predict, to gain autonomy from the control of state institutions. States have already weakened their influence, and the new AI oligarchy will compete for the dominant position in social organizations. AI will decisively influence the creation of a new state for AI matters.

Conclusions

1. AI needs to be efficiently controlled for economic and political reasons. Today, the rise of populism, anti-immigration parties, and illiberal democracies represents enough proof that the fabric of the Western social contract cannot cope with the consequences of the weakening of the nation-states and the profit-driven multinationals. Today, multinationals are stronger than states; they make autonomous decisions to export capital, pay taxes or not, employ machines instead of people, change ownership, pay bonuses to its CEOs, take responsibility for employees or not, and decide to pollute the environment or not. AI will empower multinationals' influence and their market power even further.
2. The developers of general AI should be required to develop a "guardian of AI principles", whose sole focus is to preserve human values and life. The guardian AI principles should be programmed by humans inspired by intransient values based on philosophy, ethics, and even spirituality.
3. The most reasonable form of management and control of AI would be to adopt a global convention on AI uses. We think that we should consider signing international conventions, similar to those that were developed to stop the proliferation of nuclear weapons. The potential to harm humans is roughly at a comparable level.

4. Treat people as an "endangered species" and preserve certain functions and jobs as an inalienable human monopoly and irreplaceable human right. We must restate the Common Declaration of Human Rights in the 21st century.
5. As a crucial element of the global convention referenced in (3) above, a proper regulatory framework is required to install irrevocable "killer switches" on any AI device.
6. Educate the youth, government policymakers, and business managers about the ethical aspects of enabling machines to take their jobs and make decisions that may harm people.
7. Given that productivity growth in the period 2006–2015 was at its lowest post-war level, contrary to the expectation of having higher productivity due to automation already in place, the perception that automation is a threat hanging over the job market like the sword of Damocles is not supported by productivity data. High resource mobility seems to be a more relevant constraint in getting the expected productivity increase thanks to AI.
8. It seems that the real threat from AI will arise from the fact that inward-outward mobility factors will be faster than ever before, and almost beyond the boundaries of what may be considered acceptable both ethically and legally. So, it will be necessary to enact new codes designed for the AI action mode, which will update current laws.
9. AI will decisively influence the creation of a new state for AI matters, different from what we have always known.

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Sztuczna inteligencja w kontekście globalnej mobilności zasobów. Co z tego wynika?

Sztuczna inteligencja musi być kontrolowana w bardziej skuteczny sposób. Dziś stoimy w obliczu wzrostu populizmu, postaw antyimigracyjnych i rozwoju nieliberalnych demokracji. Dowodzi to tego, że zachodnie umowy społeczne nie jest już w stanie poradzić sobie z konsekwencjami słabości państwa narodowego i rosnącej roli potężnych międzynarodowych korporacji nastawionych na zysk. Te ostatnie są silniejsze od państwa narodowego, podejmują autonomiczne decyzje o alokacji czynników produkcji na arenie światowej, zatrudniają maszyny zamiast ludzi, biorą odpowiedzialność za pracowników lub nie, decydują o zanieczyszczeniu środowiska toksycznymi odpadami czy nie. AI daje międzynarodowym korporacjom jeszcze więcej mocy.

Słowa kluczowe: sztuczna inteligencja, globalizacja, zatrudnienie

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Analyzing and Strategizing the Development of Entrepreneurial Activity Based on the Principles of Increasing Productivity (Illustrated by the Example of Developed Countries and Ukraine)

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Abstract

The article presents the results of a comparative analysis of productivity in developed countries, including EU countries and Ukraine. Hypotheses about the identity of the deindustrialization factor as the main cause for productivity decrease for both the Ukrainian economy and the economic systems of developed countries are verified.
Purpose of the article: To develop a comprehensive methodological approach to strategizing and state regulation of the business environment based on guidelines developed according to the results of a comparative analysis of the productivity of entrepreneurial activities and focused on maximizing the creation of added value, which is a criterion for increasing the productivity of entrepreneurial activities.
Methods used: A review of the scientific literature, a comparative analysis of the productivity of entrepreneurial activity in developed countries and Ukraine, including time series analysis, calculating growth rates of per capita value-added, and factor analysis of key obstacles that hinder the growth of the productivity of innovative entrepreneurial activity.
The contribution made to the theory and methodology of productivity includes the proposed definition of the economic category "productivity of entrepreneurial activity"; general methodological principles of forming a strategy for improving the productivity of entrepreneurial activities are established; taking into account the best international experience, the main principles of state regulation of the entrepreneurial environment are laid down; it is established that the purpose of the strategy for improving the productivity of entrepreneurial activity is to provide the state with favorable business conditions, i.e., to create a favorable entrepreneurial environment and make it possible to identify and use hidden assets of entrepreneurial structures to develop value-added chains, the growth of which is a criterion for increasing productivity.

Keywords: productivity of entrepreneurial activity, deindustrialization, strategy, value-added maximization

JEL: O38, O47, O57

Introduction

The problem of strategizing the development of any economic system involves a number of tasks. These include determining the direction of development and the means and mechanisms that stimulate the shift of the system and its elements in a certain direction. Thus, after the global economic crisis, countries worldwide faced the prob-

lem of increasing productivity as the main factor of economic development (Jorgenson, Gollop, and Fraumeni 1987; Aeeni, Motavaseli, Sakhdari, and Dehkordi 2019; Bai, Kao, and Wu 2021; Farinha, Lopes, Bagchi-Sen, Sebastião, and Oliveira 2020). However, economic productivity is mainly perceived only as labor productivity, ignoring other factors of production.

Therefore, together with the transition of developed countries to the stage of post-industrial society, it became clear that limiting the concept of capital to physical capital does not provide answers to a number of questions on public administration and the socio-economic development of society. When the level of education, innovation, and informatization have become the determining factors of society's socio-economic development, and when the leading role in the economy is played by high-tech companies, in which physical capital ceased to be decisive, human capital and intangible assets have come to the fore, opening the way to innovative development.

Thus, the purpose of this study is to develop methodological and methodical foundations for strategizing entrepreneurial activity based on the principles of productivity increasing, taking into account national specifics, as well as the level of economic development and the tendencies of each country. All the above-mentioned issues require new methods to identify substantial patterns of productivity of entrepreneurial activity changes and their causes that suggest a range of appropriate methodological principles and mechanisms to improve entrepreneurial development strategizing. These methods include a review of the scientific literature, a semantic analysis of the category of productivity, statistical data analysis, factor analysis, comparisons of growth rates of per capita value-added for different countries, and the systematization of theoretical approaches and good practices to improve entrepreneurial activity. That allowed us to formulate methodological principles of productivity increase illustrated on the example of the Ukrainian economy.

Comparative analysis of the productivity of developed countries and Ukraine

A study of the dynamics of productivity around the world, calculated as the volume of gross product per employee (OECD, *Productivity…* n.d.), showed a decline in almost all countries, especially in recent years (2018–2019) (Table 1).

Table 1. Dynamics of productivity of countries worldwide, %

Countries	2012	2013	2014	2015	2016	2017	2018	2019
Austria	1.1	1.3	0.8	0.4	3.6	3.6	2.3	–1.0
Belgium	–1.4	2.4	5.9	5.0	–1.1	1.0	–2.7	–0.1
Canada	–0.2	2.6	5.7	0.1	0.8	2.2	1.3	–3.4
Czech Republic	–4.2	–3.0	1.5	2.2	0.8	6.2	0.7	3.2
Denmark	3.0	0.4	–1.0	–1.7	3.8	0.9	1.9	2.6

Table 1. (continued)

Countries	2012	2013	2014	2015	2016	2017	2018	2019
Estonia	5.0	4.8	7.2	–3.5	4.9	1.9	7.7	–0.4
Finland	–8.4	3.4	2.5	1.4	4.3	8.5	–3.7	3.5
France	1.2	1.7	0.9	2.2	0.8	1.5	0.5	–0.7
Germany	–1.5	–0.8	3.9	1.4	4.2	3.0	–1.0	–4.1
Greece	2.0	5.1	–1.6	–3.8	4.5	0.8	1.4	–5.1
Hungary	–4.7	1.1	4.2	8.8	–2.1	–1.1	–4.3	4.6
Ireland	0.3	–7.6	9.5	71.8	–1.3	4.8	11.2	1.3
Italy	–2.0	0.8	1.1	2.1	2.3	2.8	0.7	–0.8
Japan	1.6	2.7	2.8	3.3	–0.3	4.4	0.4	..
Latvia	–2.6	–2.8	2.3	5.1	4.2	4.9	–0.3	0.8
Lithuania	–0.1	3.3	5.4	0.3	–0.2	3.8	–1.3	4.4
Luxemburg	3.9	16.3	–5.7	10.1	10.8	–1.0	0.4	0.3
Netherlands	0.4	3.0	–0.5	–1.7	0.4	3.1	0.1	–1.9
Norway	–1.6	–3.1	0.4	5.7	5.3	5.3	–2.8	–5.3
Poland	2.9	–1.5	2.0	2.2	–0.4	–0.2	4.4	4.6
Portugal	0.8	0.9	0.4	–0.5	–0.6	0.3	–0.6	–1.6
Slovakia	1.3	–1.1	14.4	6.1	–4.5	–2.5	6.8	2.2
Slovenia	–1.1	1.5	3.7	0.1	2.1	4.5	–0.6	0.2
Spain	1.7	1.0	2.4	0.9	0.6	0.2	–1.9	–1.0
Sweden	–2.2	–1.9	0.4	6.8	1.5	0.4	–1.9	1.2
Switzerland	–0.6	1.9	–1.3	–0.0	3.3	5.9	3.9	2.4
UK	–3.6	–0.4	1.4	–0.3	1.6	0.2	–1.7	–0.4
USA	–1.6	0.8	0.9	0.8	–0.5	3.4	2.7	..
EU- 18	–0.4	0.7	2.7	3.2	2.0	2.3	0.1	–1.8
EU –28	–1.1	0.2	1.9	2.8	1.4	1.7	0.1	–0.9

Source: own calculations based on data derived from OECD, *Productivity…* (n.d.).

Thus, the most progressive decline of real productivity is observed in Belgium, Canada, Germany, Italy, the Netherlands, Spain, and the United Kingdom, although in general, both the EU–28 and the EU–18 have demonstrated a decline since 2018.

The average annual growth rate of productivity (per man-hour of working time) in Germany decreased almost threefold, from 4.2% in 2016 to –4.1% in 2019, and in the UK, from 1.6% to –0.4%. In Japan, Ireland, and the United States, there is a change in productivity dynamics, meaning that it was caused by a decrease in the share of manufacturing in GDP.

Therefore, in the EU in 2014, a task force was created to develop and implement a strategy for the development of advanced production technologies, whose tasks include promoting the introduction of innovative technologies (i.e., all solutions that contribute to improving productivity-production speed, accuracy, and reducing energy and raw materials consumption) into production processes, i.e., stimulating the development of activities that are characterized by the manufacture of products with high added value.

In other words, a new development paradigm is being actively formed in the world economy. It is based on innovative sources of growth, an important role that belongs to entrepreneurship, because entrepreneurship is an economic subsystem that creates conditions for complete realization of society's potential as a prerequisite and the ultimate goal of social development (Nordhaus 2015; Wieczorek and Hekkert 2012).

For comparison, we will study the dynamics of productivity in Ukraine (Table 2). In Table the indicator of "Number of persons employed of active business entities" is used because employees of economicaly active entities are the ones who create value added in the national economy. The number of persons employed of active business entities (that reaches 8.661 mln. persons in 2018) appears twice less than total number of employed (that reaches 16.3 mln. persons in 2018).

Table 2. Dynamics of productivity in Ukraine

Years	GDP per PPP, million USD	Number of persons employed of active business entities, millions	Productivity	Basic growth rate, %
2014	130.57	9.008	14.5	-
2015	90.49	8.332	10.9	–25
2016	93.31	8.244	11.3	–22
2017	112.13	8.271	13.6	–6
2018	130.86	8.661	15.1	4

Source: own calculations based on data derived from *Number of persons employed...* (n.d.); *GDP of Ukraine* (n.d.).

Table 2 demonstrates a decrease in productivity between 2015 and 2017 (compared to 2014), from 25% in 2015 to 6% in 2017, and only in 2018 did the gradual recovery of productivity growth (by 4%) begin.

It is reasonable to put hypothesize about the cause of the productivity decrease in developed countries and Ukraine. To verify it, we will assess the dynamics of gross value added created by Ukrainian enterprises, as a whole and by type of activity, in actual prices and in constant prices in 2012 (Table 3).

Table 3. Gross value added of Ukrainian enterprises by type of activity, 2012–2017, in actual prices, billion UAH

	2012	2013	2014	2015	2016	2017	2018	2019	2019/2012
Total	1173	1126	1410	1508	1998	2483	2726	3238	2.76
Agriculture	86	80	143	209	219	231	238	242	2.81
Industry	488	435	532	554	765	961	1024	1166	2.39
Construction	28	48	59	42	57	69	84	142	5.71
Trade	217	229	346	340	392	538	619	693	3.19
Transport	122	119	124	164	219	250	260	307	2.52

Source: own calculations based on data derived from Statistical yearbook for 2017–2019; *Gross domestic product...* (n.d.).

In general, in the country as a whole, it increased almost 2.8 times; in agriculture, industry, trade, and transport, the growth was from 2.4 to 3.2, and in construction – more than 5 times higher. This increase is mainly due to inflation.

A completely different picture emerges if we estimate the gross value added of Ukrainian enterprises in constant prices in 2012. Its volume in 2012–2019, as a whole, decreased by 7.9%, and in transport by 6.2%. The situation was particularly negative in industry, where the decline was 33.8%, indicating a further process of the deindustrialization of the country's economy. In this context, the growth of gross value added in agriculture and trade by 8.7% and 3.1%, respectively, and especially in construction by 108.8%, looks worrying (Table 4).

Table 4. Gross value added of Ukrainian enterprises by type of activity, 2012–2017, in constant prices in 2012, billion UAH

	2012	2013	2014	2015	2016	2017	2018	2019	2019/2012
Total	1173	1079	1167	898	1016	1034	984	1080	0.92
Agriculture	86	77	113	106	101	96	90	93	1.09
Industry	488	418	414	304	331	330	302	323	0.66
Construction	28	45	44	24	31	35	37	58	2.09
Trade	217	217	257	182	188	206	215	224	1.03
Transport	122	113	110	106	125	122	108	114	0.94

Source: own calculations based on data derived from *Gross domestic product*... (n.d.).

Negative trends in the country's economy have also affected the structure of gross value added of enterprises by type of economic activity (Jorgenson, Gollop, Fraumeni 1987). The share of industry decreased by more than a quarter, from 41.6% to 29.9%. At the same time, the share of agriculture increased from 7.3% to 8.6%, construction – from 2.4% to 5.4%, trade – from 18.5% to 20.7%, and transport – from 10.4% to 10.6%.

These calculations confirm our hypothesis about the role and identity of deindustrialization as the main factor for reducing productivity, not only for developed countries but also for Ukraine.

In turn, a significant factor accelerating the deindustrialization of developed countries is the capital outflow to create jobs in countries with low labor costs. However, in value-added chains, profits are further withdrawn from these countries back to developed countries. In our opinion, for Ukraine, this factor is also the reason for deindustrialization, but capital is withdrawn from the country for other reasons and is no longer returned.

We will further study the dynamics of capital outflow from Ukraine by comparing the values of the GDP and GNI indicators at purchasing power parity per capita, taking into account that GNI is GDP plus income from abroad and minus income withdrawn abroad (Table 5).

Table 5 illustrates the constant trend of capital outflows from Ukraine, the minimum level of which was 1.44% in 2016 and the maximum – 3.21% – in 2017, which confirms our assumption.

Table 5. Dynamics of GDP and GNI by PPP per capita in Ukraine

Indicator	2012	2013	2014	2015	2016	2017	2018	2019
GDP by PPP per capita, USD	8523	8695	8756	8014	8330	8741	9287	9775
GNP by PPP per capita, USD	8340	8500	8610	7880	8210	8460	9020	9601
Difference between GDP and GNP, %	2.15	2.24	1.67	1.67	1.44	3.21	2.88	1.78

Source: own calculations based on data derived from http://api.worldbank.org/v2/uk/country/UKR?downloadformat=excel (accessed: 20.11.2020).

On the other hand, the reason for the considered processes is the presence of the following negative indicators: the unprofitability of entrepreneurial structures; unsatisfactory industry structure in terms of the material production development; the deterioration of fixed production assets and the use of backward technologies; the uneven development of entrepreneurship in the regional context and the presence of a significant informal sector. These negative trends are a consequence of the unfavorable entrepreneurial environment, which prevents entrepreneurs from effectively combining existing factors of production.

Methodology

In general, the international scientific community has been researching the category of "productivity" for centuries but has yet to reach an agreement on this issue. As part of our research, we tried to group the main performance concepts in Table 6 by the number of performance factors (Marx's one-factor model and the multivariate models of other scientists).

Table 6. Basic performance concepts

Characteristics	Concept
One-factor model: Marx (1952)	The productive factor of manufacture is labor (criterion is labor productivity)
Multi-factor models *The History of Quality* (2020), Kendrick (1976), Solow (1987), Sink (1989), Stigler (2004), Tinbergen (2007), Emerson (2014), Drucker (2015), Cieślik, Gauger, and Michałek (2017)	Productivity is a comprehensive indicator of the efficiency of functioning of all factors of production (later – this is both entrepreneurship and the relative level of technological development of the country).

Source: developed by the authors.

A fairly thorough study of the current state of economic productivity, on the example and at the level of enterprises in Ukraine, is given by Cieślik, Gauger, and Michałek (2017), where the performance of micro-level subjects represented as a general population at the macro level is estimated using the Levinsohn-Petrin function. Among the indicators used by researchers in this model is one variable that characterizes the volume of intangible assets attracted to the economy. However, they did not define stra-

tegic directions for increasing the level of entrepreneurial productivity based on the better use of intangible assets. In this aspect, all intangible assets and entrepreneurship itself should be considered a key factor in implementing effective economic development and increasing the value added created.

However, within these concepts, it is impossible to explain the current trends and processes of change in economic productivity. In our opinion, the problem is the underestimation of the role of entrepreneurs, their experience and knowledge, and their ability to creatively combine factors of production.

In other words, we believe that entrepreneurship is not only a factor of production, but its organizer, most effectively redistributing and combining resources, which determines the growth of productivity of both their activities and the economy as a whole.

Thus, we come to the conclusion that *the productivity of entrepreneurial activity is a process of effectively transforming people's competencies (knowledge, skills, experience), as well as the material, financial, energy, intellectual, organizational, and managerial resources. It creates opportunities that produce high-quality results that meet the needs and expectations of stakeholders, and it ensures the sustainable and balanced development of entrepreneurial structures and the economy as a whole.*

It is known that sustainable economic growth is possible only when it is based on the inclusion of intensive factors, in particular, the activation of entrepreneurial activity and the growth of its productivity (as the total productivity of factors of production that entrepreneurs combine). Therefore, the criterion for increasing the productivity of entrepreneurial activity should be the growth of value added through the detection and use of hidden assets of entrepreneurial structures.

At the end of the 20th century, a new direction in the theory of state regulation of market processes emerged, the theory of regulating the external business environment. Proponents of this area of economic thought demonstrated the need to improve the entrepreneurial environment as a condition for socio-economic development.

Thus, American economists George A. Steiner and John F. Steiner (1994) consider the system of state regulation of the economy as an entrepreneurial environment that ensures, first of all, the rights of consumers of various products, including information products. In addition, they consider it an important area of state regulation to support entrepreneurial activities through such levers as subsidies, antimonopoly regulation, and creating a competitive environment, among others.

On the example of countries from Central and Eastern Europe, Glinkowska-Krauze, Chebotarov, and Chebotarov (2020) emphasized the importance of internal business cultures and state regulation to improve the business environment.

These proposals demonstrate that state regulation of the economy is a complex system of various forms and methods of influencing the entrepreneurial environment. At the same time, the entrepreneurial environment determines both the rules of how entrepreneurial activity is conducted, and it sets certain parameters within which the interests of entrepreneurial structures, the state, and society as a whole are coordinated.

Thus, the system of state regulation of the economy (including the system of strategic documents) is considered to be a set of measures aimed at developing entrepreneurship, and developing the entrepreneurial sector will contribute to the socio-economic development of the country as a whole.

So, taking all of this into account, *the purpose of the strategy of regulating entrepreneurial activity is to increase the productivity of entrepreneurs, who must be given state aid, with favorable conditions for its conduct, i.e., a favorable entrepreneurial environment, as well as ensuring the possibility to identify and use hidden assets of entrepreneurial structures to develop value-added chains, whose growth is a criterion for increasing productivity.*

When building a strategy for improving entrepreneurial productivity, it is necessary to take into account the trends identified above:

- in the global economy, a new development paradigm is being actively formed; it is based on innovative sources of growth (Nordhaus 2015; Wieczorek and Hekkert 2012), i.e., promoting the introduction of innovative technologies (all solutions that contribute to the increase in productivity – production speed, accuracy, as well as reducing energy and raw material consumption) into production processes. In other words, the development of activities characterized by the manufacture of products with high added value is stimulated;
- deindustrialization is the main factor that reduces productivity, not only in developed countries but also in Ukraine;
- one of the most important reasons for deindustrialization for Ukraine is unproductive capital outflows.

In addition, our previous research (Butenko, Shlafman, Umanets, Bondarenko, and Shatalova 2018) indicates the presence of three main groups of factors that hinder the growth of innovative entrepreneurial productivity:

1. Organizational: There is a lack of a purposeful, balanced economic development policy in Ukraine. It should be based on a scientific definition of development directions, taking into account available resources, and introduce effective regulatory mechanisms. It results in insufficient incentives to introduce new organizational forms of research and innovation. The reform of this sector was ill-conceived, without a clear vision of the desired image of science in the country. There is an imperfect financial and personnel policy in the field of science, which led to a critical loss of the researchers' potential. There are also insufficient working mechanisms of public-private partnership in the field of innovative development, an imperfect state industrial and innovation policy, and an imperfect business environment, which requires the institutional base of entrepreneurial activities to be improved.
2. Financial: There is an imperfect structure of financing scientific and technological development, in particular, the extremely low participation of state, foreign, and domestic entrepreneurial structures in its financing. Mechanisms for concentrating resources within existing mechanisms for selecting and implementing priority areas for the development of science, technologies, and techniques are inefficient.

Economic: Ukraine's domestic market is underdeveloped; there is a low level of competitiveness of domestic production; there are deep structural imbalances – mainly industries that extract raw materials or manufacture products with a low degree of processing for export remain. Their capacity utilization depends on demand in the foreign market, and a significant share of production is material-, energy- and labor-intensive. Accordingly, there is a low share of innovatively active industrial enterprises. Many enterprises of other industries do not withstand competition even in the domestic market; the consumer market of Ukraine is being filled with foreign-made goods; high-tech industries are struggling to survive; a significant part of the scientific and technical potential is lost. For a long time, negative structural changes have been accompanied by job losses and the economic decline of many settlements, where city-forming enterprises ceased their activities, leading to mass labor migration of the economically active population to other countries.

Thus, the subject of our consideration should be the socio-economic, scientific, technological, and institutional components of the entrepreneurial environment.

Taking into account the above-mentioned factors, we will define general methodological principles of strategizing the development of entrepreneurial activity based on the principles of increasing its productivity:

1. The principle of purposefulness, the main meaning of which is to expand the goals to solve the problem, which will provide for the selection of real tasks to work on to achieve the overall goal. In other words, solving individual tasks should be aimed at increasing the productivity of entrepreneurial activities, and inefficient mechanisms should be transformed in accordance with the overall goal.
2. The principle of conformity, which stipulates that the measures and mechanisms applied must correspond to the available resources and real needs of entrepreneurs. In Ukraine, this applies to the institutional framework (regulatory framework), because in the informal plane, where the drivers of institutional transformation are clear economic interests, transformations occur very quickly, and this leads to the restoration of the balance between the requirements of economic reality and the provisions of regulatory documents, leading to the emergence of a significant "shadow" share in the country's economy.
3. The principle of integrity, which takes into account all groups of factors that affect the increase in entrepreneurial productivity.
4. The principle of optimality, which involves choosing the best option from possible or alternative options.
5. The principle of adaptability and flexibility. The state regulation of the economy should be supplemented with new aspects and contain certain accents in accordance with modern requirements.
6. The principle of consistency of interests, which is meant to identify the optimal satisfaction of the interests of all economic agents (or minimize the costs of integrating their private interests into a single social system).

7. The principle of concentration, which is meant to combine regulatory actions of government bodies aimed at coordinating the interests of all agents of economic relations: the state, entrepreneurial structures, and consumers.
8. The principle of the systematic presence of the state in the economy, which is implemented in the system of planning and stimulating the development of entrepreneurial activity.
9. The principle of specialization, which is meant to create a limited set of functions of each of the authorities and create a system of public control over their implementation.
10. The principle of openness and transparency, i.e., a broad discussion of draft decisions, taking into account the opinions of various subjects of economic relations.
11. The principle of network development, which provides for the transition from disparate firms to a single network of various entrepreneurial structures connected by an electronic network based on the Internet. There is close interaction in technology, product quality control, innovation planning, among others.
12. The principle of cyclicity, which is meant to take into account the cyclical nature of reproducing value chains.
13. The principle of budget efficiency: it is necessary to avoid inefficient budget expenditures (i.e., the current underfunding of state target and budget programs, which makes their budgeting and implementation unpredictable; violating the priority principle of financing budget programs due to individual ministries and departments lobbying for their own interests; blurring the formulation of goals in budget programs, which makes it impossible to determine the criterion of their effectiveness; imitating performance indicators, i.e., selecting indicators that can be easily achieved but that do not carry any economic content).

Accordingly, we can establish the basic principles of state regulation of the entrepreneurial environment based on the best foreign experience (system improvement) (*Better Regulation Framework 2020*):

1. consistency: the application of new legal documents must comply with the current legal norms of state regulation and not contradict international norms;
2. purposefulness: a regulatory act should be aimed at solving a specific problem, so it should not contain vague terms; it is necessary to periodically assess their necessity and effectiveness, and outdated and ineffective ones should be canceled or modified;
3. balance: the penalty for violating a legal document should be proportional to the loss caused, and it is necessary to consider the possibility of applying alternative measures to state regulation, which may be more effective and less costly for the state (self-regulation);
4. clarity: the subject of regulation should be clearly identified, and the purpose of the regulation, as well as the entire text of the normative act (without the possibility of discrepancies in its provisions), should be clearly formulated; penalties should also be clearly defined;

5. liability: a clear measure of responsibility of both the regulatory entities and the regulatory bodies (represented by their employees) for violating the requirements of regulatory acts should be established.

Our research has shown that the strategic guidelines for ensuring an increase in the productivity of entrepreneurial activity are improved socio-economic, scientific, technological, and institutional components of the external entrepreneurial environment (EE). Thus, we will define a comprehensive methodological approach to implementing their effective state regulation, shown in Figure 1.

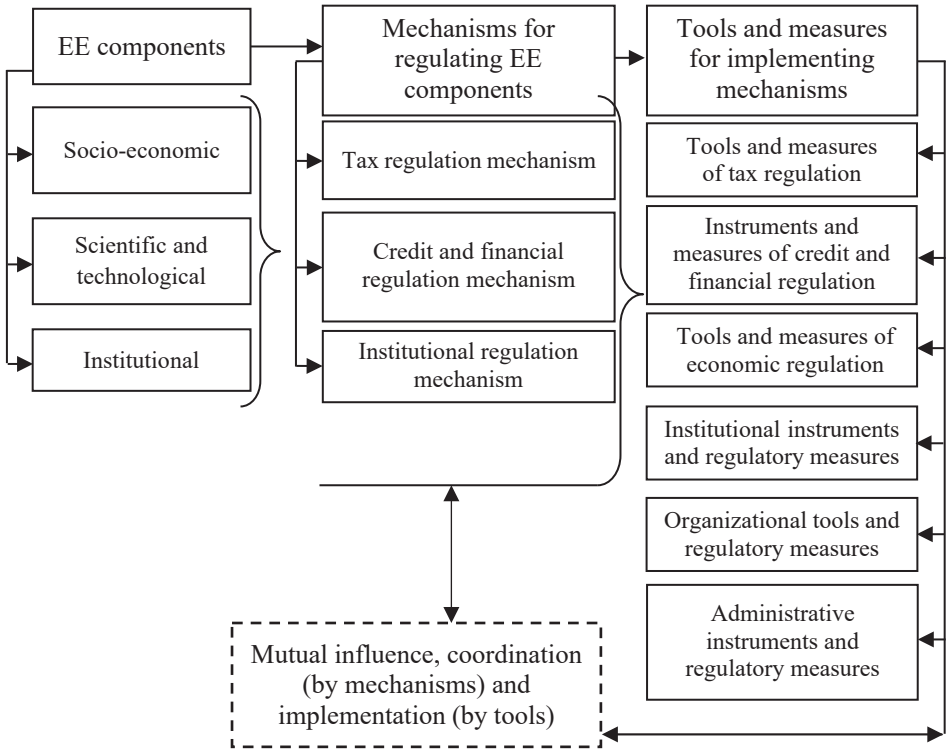

Figure 1. Methodological approach to state regulation of components of the external entrepreneurial environment.
Source: developed by the authors.

At the same time, it is important to identify effective approaches that would ensure the real implementation of the tasks set out in the strategic guidelines, using updated and adapted mechanisms and measures. The mechanisms shown in Figure 1 are of strategic importance, but we consider market orientation to be the most important priority, since the conceptual and methodological foundations should be established, and the basis on which all other components of the general methodical approach will be focused should be defined. The second most important focus is on maximizing the creation of value added, which contributes to the realization of economic, social,

budgetary, environmental, and other interests of society as a whole, the state, and entrepreneurial structures. For this purpose, it is recommended to use regulatory levers in the context of certain priority types of entrepreneurial activity that are promising in the context of maximizing value added.

At the same time, all the components of regulatory mechanisms and tools are focused on maximizing the creation of value added, which is the criterion for increasing the productivity of entrepreneurial activities.

The foregoing considerations lead to the conclusion that to increase the productivity of entrepreneurial activity, it is necessary to develop a strategy based on certain strategic guidelines and the proposed methodological approach to their regulation.

Conclusions

Identifying principles and mechanisms for strategizing entrepreneurship development and increasing its productivity must be based on reliable data about the peculiarities of the functioning and transformation of the national economic system. Thus, for the purpose of the article, the problems that have developed in countries worldwide and Ukraine regarding the dynamics of productivity were studied, and a comparative analysis of the dynamics of productivity of the economies of developed countries (including EU countries) and the economy of Ukraine (by type of activity) was conducted.

Based on our theoretical research and comparative data analysis for different countries, including Ukraine, we arrived at the following conclusions:

- the relevant indicator of entrepreneurial productivity is per capita value-added calculated in constant prices. This indicator characterizes the results of involving all types of capital in the production process and thus meets the requirements of today's socio-economic development of society when the level of education, innovation, informatization, and entrepreneurial skills are the factors that determine society's socio-economic development;
- the decisive influence of inflation on the reliability of the results of calculating business productivity was determined. Thus, in Ukraine, the dynamics of total gross value added at current prices is characterized by a 2.8 times increase; however, when estimated in constant prices, the gross value added of Ukrainian enterprises is characterized by a 7.9% decrease;
- the hypotheses were verified about deindustrialization being the main factor that reduces productivity for both the Ukrainian economy and the economic systems of developed countries, and the weight of the factor of unproductive capital outflow in Ukraine's deindustrialization process;
- as a result of logical analysis, the nature of the deindustrialization of the Ukrainian economy and the economic systems of developed countries was found to be different. In developed countries, it is due to the relocation of manufacturing to regions and countries with cheaper labor, while in Ukraine, this phenome-

non is a result of inadequate regulatory policies and inappropriate business environment;
- the negative trends in the Ukrainian economy have also affected the structure of gross value added by type of economic activity. During the research period (2012–2019), the share of industry decreased from nearly 42% to 29.9%. At the same time, the share of agriculture and other non-manufacturing types of activities increased;
- one of the quite significant factors accelerating the deindustrialization of the Ukrainian economy is the capital outflow dynamics. By comparing the values of GDP and GNI indicators at purchasing power parity per capita, it was estimated to be 1.78% of GDP.

The essence of the category "productivity of entrepreneurial activity" was formulated, which allowed us to determine the goal of the strategy for improving the productivity of entrepreneurial activity. It involves providing the state with a favorable entrepreneurial environment, as well as ensuring that it is possible to identify and use hidden assets of business structures to develop value chains, whose growth we define as a criterion for increasing productivity.

At the final stage of the study, we developed methodological principles for forming a strategy to increase the productivity of entrepreneurial activity based on certain strategic guidelines. To implement the principles, we proposed a comprehensive methodological approach to state regulation of the entrepreneurial environment.

Subsequent research should be aimed at developing a draft strategy for improving the productivity of business activities in Ukraine based on the principles of qualitatively improving the entrepreneurial environment, as well as on identifying and using hidden assets of business structures to develop value-added chains.

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Analiza i określanie strategii rozwoju przedsiębiorczości w oparciu o zasady zwiększania produktywności (na przykładzie krajów rozwiniętych i Ukrainy)

W artykule przedstawiono wyniki analizy porównawczej produktywności w krajach rozwiniętych, w tym w krajach UE i na Ukrainie. Weryfikowane są hipotezy dotyczące identyfikacji dezindustrializacji jako głównej przyczyny spadku produktywności zarówno ukraińskiej gospodarki, jak i systemów gospodarczych krajów rozwiniętych.
Cel artykułu: Opracowanie kompleksowego podejścia metodologicznego do tworzenia strategii i państwowej regulacji otoczenia biznesowego w oparciu o wytyczne opracowane na podstawie wyników analizy porównawczej produktywności działań przedsiębiorstw i ukierunkowanego na maksymalizację wartości dodanej, która jest kryterium zwiększania produktywności działań przedsiębiorstw.
Zastosowane metody: przegląd literatury naukowej, analiza porównawcza produktywności działalności gospodarczej w krajach rozwiniętych i na Ukrainie, w tym analiza szeregów czasowych, obliczenie tempa wzrostu wartości dodanej na mieszkańca oraz analiza czynnikowa kluczowych przeszkód utrudniających wzrost produktywności innowacyjnej działalności przedsiębiorstw.

Wkład wniesiony do teorii i metodologii produktywności obejmuje proponowaną definicję kategorii ekonomicznej „produktywność działalności przedsiębiorstw"; ustalenie ogólnych metodologicznych zasad tworzenia strategii poprawy produktywności działań przedsiębiorstw; określenie głównych zasad państwowej regulacji otoczenia przedsiębiorstw z uwzględnieniem najlepszych doświadczeń międzynarodowych; ustalenie, że celem strategii poprawy produktywności działalności przedsiębiorstw jest zapewnienie państwu korzystnych warunków prowadzenia działalności gospodarczej, tj. stworzenie sprzyjającego otoczenia przedsiębiorstw oraz umożliwienie identyfikacji i wykorzystania ukrytych aktywów struktur przedsiębiorczych do budowania łańcuchów wartości dodanej, których wzrost jest kryterium wzrostu produktywności.

Słowa kluczowe: produktywność działalności przedsiębiorstw, dezindustrializacja, strategia, maksymalizacja wartości dodanej

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Dilemmas of Sheltered Employment in Poland and Greece and the Concept of Supported Employment

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Abstract

People with severe disabilities, such as severe mental disabilities and autism spectrum disorders, do not participate in the open, competitive labor market to the same extent as people without disabilities or other forms of disability. Sheltered employment is an internationally accepted approach for the vocational integration of people with severe disabilities, which introduces integration in sheltered workplaces mainly with other people with disabilities and ongoing support from the Government or self-government. Therefore, sheltered employment can be defined as the employment of a person with a disability under particular conditions. This paper presents the legislative framework regarding sheltered employment in Poland and Greece and the ways sheltered employment takes place in each of the two countries with the corresponding comparisons and conclusions. The results show a need for a more precise and more comprehensive legislative framework on sheltered employment in Poland and Greece. Alternative options for the vocational integration of people with severe forms of disabilities, such as supported employment programs, need to come to the fore. Supported employment seems to be the only effective and efficient way for people who have particular difficulties in finding and keeping a paid job in the open labor market to take up paid employment on an equal basis with other people. Does the concept of supported employment have a chance to prove itself on Poland and Greece's open labor markets and become a complementary tool in the vocational activation of people with disabilities? Legislative regulations, system projects, and stable sources of financing are necessary for both countries.

Keywords: sheltered employment, supported employment, disabilities, Poland, Greece

JEL: I3, I310, J8, J880

Introduction

People with severe disabilities do not participate in the labor market to the same extent as people without disabilities, which signifies the loss of valuable human resources and entails a significant burden on the national economy (Wehman et al. 2018, pp. 131–144). There are a variety of approaches to integrating people with severe forms of disability, such as supported and sheltered employment programs (Burns, White, and Catty 2008, pp. 498–502; Tsang et al. 2009, pp. 292–305). Sheltered employment refers to employment that takes place in facilities where most people have disabilities, with ongoing support and supervision of their work (Metzel et al. 2007, pp. 149–160). According to the international literature, sheltered employment mainly concerns individuals with autistic spectrum disorders and mental disabilities (García-Villamisar, Wehman, and Diaz Navarro 2002, pp. 309–312; Cimera et al. 2011, pp. 87–94; Akkerman et al. 2016, pp. 205–216) with the aim of teaching skills and preparing them for their future integration into the competitive labor market (Cimera et al. 2011, pp. 87–94). Therefore, protection is provided only to those who, due to their disability, are unable to meet the expected standards. Thus, it is necessary to recognize the performance deficit and – compared to work in competitive conditions – create an appropriate sheltered zone for these people (Paszkowicz 2013, p. 38). In view of the above, the protection of an employed person may relate to various aspects of their professional work, at least because the working conditions will be different for a person who is blind, who is deaf, or who has a mobility disability.

Sheltered employment, therefore, offers people with severe disabilities skills training, pre-occupational services, group placements, and leisure and recreational activities – measures that are considered the first step in the process of their vocational rehabilitation (Cimera et al. 2011, pp. 87–94). This paper presents the framework of sheltered employment in Poland and Greece, and provides recommendations for improvement. As state-members of the European Union (EU), the paper discusses the national context of the two countries, affected at different levels by the economic crisis (Osinska and Kluth 2010, pp. 139–156; Lament 2017, pp. 5–16), but sharing many aspects a shared vision on the labor solidarity actions towards unemployment (Karakioulafi et al. 2020). The choice of the countries was based on the specific research interests of the authors. There is limited research on sheltered employment in European Union member states and scarce research in Poland and Greece. The current research adds up-to-date and combined data on two EU countries. The study aims to provide answers to the following research questions: a) What is the legislative framework re-

garding sheltered employment in Poland and Greece, and in what ways is it realized in each of the two countries? Furthermore, b) What is the critical appraisal of the existing framework for the two countries?

Methodology

The methodology was based on the review strategy chosen by Ebuenyi et al. (2019, pp. 99–105). Using electronic databases like Nomotelia, the authors reviewed Poland and Greece's laws and policies on sheltered employment and, generally, on the employment of people with severe disabilities. The authors reviewed the full content of the laws and policies retrieved, individually and in cooperation, to solve any disagreement and decide on the search results. The Medline, Emerald, and Google Scholar databases were used to obtain research data on the evaluation of sheltered employment policies.

Sheltered employment in Poland

In Poland, the rate of self-reported long-standing limitations due to health issues in 2019 was 24.4%, close to the 24% rate of the European Union–27 member states (Eurostat 2019). In Poland, the legal framework for sheltered employment is governed by the Act of 27 August 1997 on Vocational and Social Rehabilitation and Employment of Persons with Disabilities (Act of 27 August 1997) and the Regulation of the Minister of Labor and Social Policy of 19 December 2007 regarding the Company Fund for the Rehabilitation of the Disabled (Regulation of the Polish Minister of Labor and Social Policy of 19 December 2007). Protected employment of persons with disabilities is carried out through Vocational Activity Workshops **(ZAZs)** and Sheltered Workshops **(ZPChs)**, among others. Specific requirements are provided for each form. And so, for example, ZAZs may be formed by poviat, commune, foundation, association, and other social organizations whose statutory tasks include the professional and social rehabilitation of disabled people and co-financing from the State Fund for the Rehabilitation of Disabled People **(PFRON)** funds. In turn**,** employers may apply for Sheltered Workshop (ZPCh) status if they meet certain conditions and to whom the Voivode will grant PFRON funds from the subsidy transferred to the local self-government.

Vocational Activity Workshops are, therefore, organizations that operate on a non-profit basis, subject to the laws of economics, and fighting for market position, customers, markets, and funds for further functioning (Stevens and Martin 1999, pp. 19–29). As of 31 December 2019, there were only 126 ZAZs in Poland; by comparison, at the end of 2016, only 103 such entities were operating (Biuro Pełnomocnika Rządu do Spraw Osób Niepełnosprawnych n.d.). The total employment amounted to 7197 people, including 5492 disabled people in Vocational Activity Workshops (Biuro Pełnomocnika Rządu do Spraw Osób Niepełnosprawnych n.d.).

One of the conditions for the operation of a ZAZ is that at least 70% of the total number of employees are people with mild and moderate disabilities. In Poland, the employment rate of disabled people in ZAZs in 2016–2019 met the statutory requirement and was between 72% and 76.3% (in 2019).

In turn, the status of Sheltered Workshop can be obtained by employers if they have been running a business for at least 12 months and employ a minimum of 25 full-time employees. In addition, employees with disabilities should account for at least 50% of all employees, of which at least 20% have a severe or moderate disability. Exceptionally, employers can employ 30% of people with disabilities if they meet a very strict provision. Namely, employers must prove that employees have a moderate or severe disability and are blind, mentally ill, or mentally disabled (Act of 27 August 1997 – articles 28, 30, 31 and 33; Regulation of the Minister of Labor and Social Policy of 19 December 2007).

Currently, Poland is experiencing a slow death of the protected labor market, which should by its very nature be a market subject to "special protection." This phenomenon is even more pronounced because over the past two decades, no significant changes have been introduced to facilitate the transition of people from the protected market to the open labor market. All initiatives only made the situation worse. For example, sheltered workshops (Barczyński 2013) were the main beneficiaries of the system for supporting disabled people by subsidizing the remuneration of disabled employees. The reduction of wage subsidies for employees in ZPChs has made it inefficient (taking into account the profitability of the business) to employ disabled people on the protected market. If we also take into account the fact that the overriding goal of this business was and still is to maximize the benefits of owners and shareholders, then it should not come as a surprise that since subsidies to the remuneration of employees of ZPChs were reduced (equating them with subsidies for entrepreneurs in the open labor market), these businesses have been operating on the edge of economic profitability for many years. This is also confirmed by the systematically decreasing number of sheltered workshops, from 2,463 in 2004, to 1,091 in 2016, and only 867 entities at the end of December 2019. And although the total employment in ZPChs was 138,483 people, only 107,903 were people with disabilities. Thus, the share of people with disabilities in total employment in professional activity facilities met the statutory requirement, amounting to 77.9%.

Sheltered employment in Greece

In Greece, the rate of self-reported long-standing limitations due to health issues in 2019 was 23.1%, one unit lower than the EU–27 average (Eurostat 2019). Recent data on the rates of people with disabilities involved in sheltered workshops are not available, as there is no official record. However, the labor market policies' cost rates are an indication, particularly for the active labor market policies and sheltered/supported employ-

ment for 2016, which was zero (Eurostat 2018). In Greece, the legislative framework for sheltered employment regulates the operation of the Protected Productive Laboratories (PPLs), which are enshrined in article 17 of Law 2646/1998 'Development of the National Social Care System and other provisions' (OGG A' 236). In particular, it is stipulated that legal entities governed by public law and supervised by the Ministry of Health, as well as private sector, non-profit, and specially certified entities, may operate as PPLs, provided that they carry out activities involving people with mental disabilities, or severe physical and multiple disabilities (par. 2, art. 17, Law 2646/1998).

PPLs operate under specific programs on intellectual disability, autism spectrum disorders, and severe mental, physical, and multiple disabilities within the National Program for People with Disabilities (par. 1, art. 17, Law 2646/1998), the purpose of which is to ensure that these people are able to participate equally in social life, in the productive and employment process in the open labor market, or in alternative forms of employment, as well as in the creation of the conditions for independent or semi-autonomous living (par. 1, art. 17, Law 2646/1998). Indicative workshops that operate in PPLs include gardening-floriculture workshops, handmade leather bookbinding, candle making, cooking, graphic arts and informatics, computers, jewelry and accessories, and crafts and pottery workshops (Vocational Rehabilitation Center for Persons with Disabilities n.d.; Cerebral Palsy Greece/Open Door n.d.).

It is specified in Law 2646/1998 that three-fifths (3/5) of the employees in PPLs must have the above-mentioned disabilities. They must have a minimum age of 20, and there is an additional condition that they must have completed a program of vocational training that lasted at least two years (par. 3, art. 17, Law 2646/1998). A Presidential Decree of the Ministers of Finance, Labor and Social Insurance, and Health (art. 17, par. 2, Law 2646/1998) sets the regulations on PPLs' legal form, organizational structure, operation, financing conditions, employment relationship, and calculation of their employees' wages, as well as the process of promoting their products. In practice, the lack of a clear and complete legislative framework on PPLs means they operate informally, mainly as parts of departments/care units for people with disabilities, supervised by the Ministry of Health and Social Solidarity, Non-Governmental Organizations, and Parents and Guardians Associations for people with severe and multiple disabilities (National Confederation of Persons with Disabilities 2007, p. 26).

Further strengthening of PPLs is regulated in the following legislative framework: a) Law 4412/2016 'Public Works, Supplies and Services Contracts (Adaptation to Directives 2014/24/EU and 2014/25/ EU)' (OGG A '147), in particular, Article 20 (Contracts awarded exclusively – Article 20 of Directive 2014/24/EU), and b) Law 4413/2016 'Award and execution of concession contracts – Harmonization with European Directive 2014/23/EU of the European Parliament and of the Council of 26 February 2014 on the award of concession contracts (OJ L 94/1/28–3–14) and other provisions' (OGG A' 148), in particular, Article 23 (Reserved Concessions – Article 24 of Directive 2014/23/EU). According to the above, PPLs are exclusively entitled to participate in: a) public procurement procedures (par. 1, art. 20, Law 4412/2016), and b) proce-

dures for awarding service concession contracts (par. 1, art. 23, Law 4413/2016). Additionally, contracting authorities are allowed to provide for the execution of public contracts in the context of sheltered employment programs, provided that more than 30% of those employed are people with disabilities (par. 2, art. 20, Law 4412/2016, par. 1, art. 23, Law 4413/2016). The above regulations are intended to facilitate the vocational integration/reintegration of people with disabilities, and their introduction was considered necessary, as PPLs may not be able to contract under competition (Explanatory Report Law 4412/2016, p. 7).

Conclusions

The study aimed to present and critically appraise the legislative framework regarding sheltered employment in Poland and Greece. The social exclusion of people with disabilities has been the subject of discussions and disputes for many years around the world. Protected employment has been an important form of support that has been able to reduce social exclusion for people with disabilities for many years. Unfortunately, according to many, the effects of the proposed solutions, not only around the world (Damon 2012), but also in Poland (Garbat 2013, pp. 49–55; Barczyński 2016, pp. 69–73) and Greece, failed to live up to expectations (Burns, White, and Catty 2008, pp. 498–502).

The effectiveness of sheltered employment programs has often been criticized and questioned by researchers. Research on the effects of employing people with intellectual disabilities on their quality of life suggests that their quality is particularly higher when they are employed in the open labor market than in sheltered employment (Kober and Eggleton 2005, pp. 756–760). It is determined by the deeper sense of social inclusion but also by the autonomy and independence that result from employment in the open labor market. The question of the effects of sheltered employment on the quality of life of people with disabilities is also found in research on people with autism spectrum disorders, where it is argued that for them, sheltered employment does not lead to a substantial improvement in their quality of life compared to supported employment (García-Villamisar, Wehman, and Diaz Navarro 2002, pp. 309–312).

The results of a relevant study on the effectiveness of sheltered employment programs in people with autism spectrum disorders suggest that sheltered employment programs do not contribute to the expected improvement after their follow-up (Cimera et al. 2011, pp. 87–94). Employment rates do not rise when attending sheltered employment programs, and subsequently, the people involved have a significantly high cost of remaining in the labor market and low pay. The significant difference in the income of people with disabilities in sheltered employment compared to the corresponding higher income of people in supported employment was also confirmed in another study by Cimera (2017, pp. 108–120).

It is noted, however, that the effects of sheltered employment vary with the contribution of other factors, such as the type and the place of work, as these factors may

make sheltered employment more economically advantageous in comparison to supported employment, depending on the case and the form of disability of the people involved in these programs (Wang, Lin, and Shu 2012, pp. 1672–1676; Cimera 2017, pp. 108–120). It is reported that the criticism of the effects of sheltered employment on people with intellectual disabilities relates to people with high levels of functional disability, as negative results are not confirmed for people with low levels of functionality (Kober and Eggleton 2005, pp. 756–760).

Although all activities undertaken within the framework of protected employment should result in employment with the employer, or self-employment, practice in Poland, for example, shows that people with disabilities or multiple disabilities either unsuccessfully look for a job for many years, or they remain in ZAZs or ZPChs. Although the legal framework clearly indicates that the ZAZ should give a person with disabilities the opportunity to acquire basic professional and life skills necessary in the workplace, while employment in the ZPCh should improve their professional skills and create the opportunity to enter the open labor market.

There are several important problems here. First, disabled people are increasingly dismissed from work, which is dictated by the reduction of employment related to the problems companies face due to COVID–19. Second, often due to worsening illnesses, people with disabilities who have worked in the open market for some time quit their job and look for a chance to return to the ZPCh or ZAZ. Third, if people with disabilities have been dismissed due to the company's temporary financial problems, or if they resigned due to deteriorating health and have not returned to the ZPCh or ZAZ, then they will fall out of the labor market and remain professionally inactive.

The criticism of sheltered employment programs has led the majority of people with disabilities, their relatives, and the vocational rehabilitation specialists to show their preference for supported over sheltered employment, both in Poland and in Greece. However, in practice, a large number of people with disabilities choose sheltered employment due to their concerns relating to work safety, transportation to and from work, long-term placement, convenient working hours, maintaining disability benefits, required skills jobs, and the social environment (Migliore et al. 2008, pp. 29–40). Therefore, the aim is to move people with disabilities into supported employment. In such cases, employment services should focus on: a) the issue of long-term employment of people with disabilities, b) reassuring the families of people with disabilities that their safety in the workplace in this respect would not be worse than in sheltered employment, and c) families and the social environment motivating and encouraging people with disabilities to search for and maintain employment (Migliore et al. 2008, pp. 29–40).

Supported employment is a solution that is intended to be a response to the challenges arising on the labor market for disabled job seekers and the economically inactive. Legislative work is still ongoing in Poland (the draft law on supported employment was submitted on 27 May 2019 by the Minister of Family, Labor, and Social Policy to the Government Legislation Center). It is a solution that will complement the existing solutions in the field of vocational rehabilitation in Poland and Greece. The idea

of supported employment is based on an individualized process of getting a disabled person onto the labor market. It is also a form of cooperation with employers, labor market institutions, and the entities that perform tasks in the vocational and social rehabilitation of the disabled.

This review helps to understand the multifactored issue of sheltered employment in the concept of supported employment. The findings raise some critical issues that could puzzle the state authorities responsible for the active labor market policies, such as sheltered and supported employment. Additionally, the findings for the two European countries could raise awareness of the necessity of these policies on the vocational integration of people with disabilities.

In view of the above, both Poland and Greece need to have a clearer and more comprehensive legislative framework regarding supported employment. The two countries need to focus more on supported employment than on sheltered employment and adopt measures that will not only help to promote supported employment but also support the existing sheltered employment, from which better results are required. As Kober and Eggleton (2005, pp. 756–760) note, in terms of the social inclusion of people with disabilities in sheltered employment, the best outcomes can be achieved beyond the action of rehabilitation specialists through policies that will be followed at the governmental level.

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Dylematy pracy chronionej w Polsce oraz Grecji a koncepcja zatrudnienia wspomaganego

Osoby z poważnymi niepełnosprawnościami, takie jak upośledzenie umysłowe i zaburzenia ze spectrum autyzmu nie uczestniczą w otwartym, konkurencyjnym rynku pracy w takim stopniu jak osoby pełnosprawne lub osoby z innymi niepełnosprawnościami. Szansą dla tej grupy jest zatrudnienie chronione. To podejście do integracji zawodowej osób ze znacznym stopniem niepełnosprawności jest akceptowane na całym świecie. Jego realizacja odbywa się poprzez integrację osób niepełnosprawnych oraz stałe wsparcie: ze strony rządu lub samorządu. W artykule przedstawiono ramy prawne dotyczące zatrudnienia chronionego w Polsce i Grecji oraz sposoby jego realizacji wraz z odpowiednimi porównaniami i wnioskami. Wyniki wskazują na potrzebę bardziej precyzyjnych i kompleksowych ram prawnych dotyczących zatrudnienia chronionego w Polsce i Grecji. Tu na pierwszy plan wysuwają się alternatywne sposoby integracji zawodowej osób z poważnymi niepełnosprawnościami, takie jak programy zatrudnienia wspomaganego. Zatrudnienie wspomagane wydaje się jedynym, skutecznym i efektywnym sposobem na podjęcie pracy zarobkowej na równych zasadach przez osoby, które mają szczególne trudności w znalezieniu i utrzymaniu płatnej pracy na otwartym rynku pracy. Czy zatem koncepcja zatrudnienia wspomaganego ma szansę stać się komplementarnym narzędziem w aktywizacji zawodowej osób z niepełnosprawnościami w Polsce i Grecji? Z pewnością w obu krajach niezbędne są nie tylko stabilne źródła finansowania dla działań aktywizujących osoby z niepełnosprawnościami, ale również odpowiednie regulacje prawne oraz projekty systemowe.

Słowa kluczowe: zatrudnienie chronione, zatrudnienie wspomagane, niepełnosprawności, Polska, Grecja

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A Comparative Analysis of Dynamic Interactions between European and Indonesian Cocoa Markets during the 2008 Global Financial Crisis and the 2011 European Debt Crisis

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Abstract

This study empirically explores the dynamic interactions between the European and Indonesian cocoa markets during the 2008 global financial crisis (GFC) and the 2011 European debt crisis (EDC) using a battery of time series approaches of cointegration

and multivariate Granger causality. The study documented a long-run equilibrium between the European and Indonesian cocoa markets, implying a reciprocal relationship. However, an inefficient adjustment transmission in the Indonesian cocoa prices was recorded throughout the study. The US currency constantly influenced Indonesian cocoa prices, while cocoa markets were independent of fluctuations in world oil prices. Overall, the study recorded a different level of the speed of adjustment of short-run imbalances to long-run equilibrium in the domestic cocoa market across economic crises.

Keywords: cocoa market, CPI, exchange rate, oil price, economic crisis

JEL: C01, C23, O13

Introduction

Developing countries are the main exporters of cocoa beans to the global cocoa market (The United Nations Conference on Trade and Development – UNCTAD 2015). Developed countries, on the other hand, import cocoa beans as raw materials for their final manufactured products. As the third-largest cacao-producing country following Ivory Coast and Ghana, Indonesia supplies 15% (4.251 million tons) of cocoa beans to the total world cocoa market (UNCTAD 2017). In Indonesia, cocoa beans are one of the main agricultural commodities that significantly contribute to the national economy (Wyszkowska-Kuna 2019). The cacao plants are dominantly owned by farm households from Sulawesi Island (Hoffmann et al. 2020), while the production of cocoa is mainly done by smallholder farmers (87%), followed by state plantations (8%) and larger private estates (5%) (Yasa 2007).

During an escalating demand for cocoa beans in the global market, the margin price enjoyed by the cocoa smallholder farmers, as the main producers in Indonesia, is low compared to global cocoa prices (Ministry of Agriculture of the Republic of Indonesia 2020). The low level of welfare among cocoa smallholder farmers is a long-lasting unsettled issue. The low quality of non-fermented cocoa beans exported to foreign countries caused Indonesian cocoa prices to become cheaper (Witjaksono and Asmin 2016). Cocoa bean fermentation is one of the most essential ways to increase cocoa value added (Figueroa-Hernández et al. 2019). Nonetheless, with the increasing production of Indonesian cocoa and high global demand, Indonesia could continuously grasp the potential global market if the country were able to sustain a long-run equilibrium between domestic and global cocoa prices.

Indonesian cocoa has been instrumental in guaranteeing global food security (UNCTAD 2017). Thus, an imperative research topic is how stable cocoa production and price equilibrium can be ensured. Proper agricultural-related economic policies for the highest benefits of smallholder cocoa farmers should be designed by the government and stakeholders to make domestic cocoa more competitive in the international market (Mofya-Mukuka and Abdulai 2013; Olimpia and Stela 2017).

Recurring global economic turbulences often lead to domestic cocoa price volatility. Volatilities of world foodstuff prices jeopardize global food security, especially in underdeveloped and developing economies. The dynamics of the global market positioned the export of cocoa commodities to under-pressure foreign markets (Ivanic and Will 2014; Ying, Chang, and Lee 2014). The 2008 global financial crisis (GFC) and the 2011 European debt crisis (EDC) caused higher volatilities of cocoa and crude oil prices (Zhang, Ding, and Scheffel 2019), which then affected the global food price index (Kassim, Majid and Hamid 2011; Cabrera and Schulz 2016). At the start of 2016, the world cocoa bean price declined rapidly (International Cocoa Organization 2016). Since 2004, the global economic environment has been the major determinant of commodity market integration (Karim and Majid 2010; Yin and Han 2015). The market's ability to attain short- and long-run price equilibrium has different speeds of adjustments across economic crises, depending on their nature, intensities, duration, causes, and consequences.

With vast areas of land to potentially develop its cocoa farming business, Indonesia could act as the foremost raw material supplier for the international cocoa processing industry, despite the rather low margin price. The Indonesian government categorizes cocoa as the main commodity export that drives the national revenue from the foreign sector (Bank of Indonesia 2019), and it has been crucial in ensuring global food security (UNCTAD 2017). This cocoa industry is a small-scale business mostly located on Sulawesi Island (Hoffmann et al. 2020). Thus, studying and developing this sector from social, economic, and ecological perspectives become more imperative.

Previous studies showed that domestic cocoa prices become highly responsive to shocks in the global cocoa market (Fernández, Schmitt-Grohé, and Uribe 2017). There has been asymmetrical commodity price integration between domestic and global markets (Arnade, Cooke, and Gale 2017). This implies that a long-run equilibrium of the domestic cocoa market is highly dependent on the world cocoa market, which subsequently causes horizontal market integration. However, disequilibrium between the supply and demand of cocoa contributes to higher price volatility transmission (Ahrens, Pirschel, and Snower 2017). The transmission of cocoa prices can be seen through interactions between the global and the domestic markets (Bekkers et al. 2017; Ceballos et al. 2017). If the price of cocoa is overshadowed by an uncertain economic situation due to price fluctuation, it needs to be overcome through a proper trade policy design based on price estimation and the nature of long-run equilibrium.

Apart from pricing determinants, currency volatility also causes shocks to cocoa prices (Cozmanca and Manea 2010). The asymmetrical behavior of exchange rate volatility across countries impacts export expansion due to exchange rate risk (Volkov and Yuhn 2016; Buffie, Airaudo, and Zanna 2018), and economic turmoil is among the most considerable determinants that affect volatilities in exchange rates (Nedeljkovic and Urosevic 2012; Shah et al. 2019). Furthermore, the global crude oil price also plays a crucial role in influencing other commodity prices. Previous research provided strong empirical evidence of the effect of global oil price fluctuations on the prices

of agricultural commodities (Nazlioglu and Soytas 2012; Fowowe 2016). In the long run, the real oil price's elasticity of demand has a negative slope, particularly during peak production (Haugom, Mydland, and Pichler 2016).

Many previous researchers have explored the impacts of world oil prices and exchange rates on the agricultural commodities market. For instance, Wang, Wu, and Yang (2014) documented the significant influence of oil prices on selected agricultural commodity prices in the US economy using the Structural Vector Autoregression (SVAR) technique. Giordani, Rocha, and Ruta (2016) noted a significant association among the prices of 32 food products in 77 countries worldwide using the Two-Stage Least Square (2SLS) model. Using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) analysis, Ceballos et al. (2017) documented grain prices' transmission from the global to the domestic markets of 41 food products in 27 emerging economies.

Using the Auto-Regressive Distributed Lag (ARDL) model, Bahmani-Oskooee and Aftab (2018) found that changes in foreign exchange rates significantly influence the commodity price traded between Malaysia and China. Nazlioglu and Soytas (2012) documented connections between oil prices, exchange rate, and 24 global agricultural commodity prices using panel cointegration and dynamic causal relationship approaches. Volatility spillover was documented between the oil price and global prices of wheat, corn, soybeans, and sugar using impulse response functions and variance decompositions (Nazlioglu, Erdem, and Soytas 2013). Ultimately, in the context of the Indonesian economy, Arsyad and Yusuf (2008) simulated that a rise in oil price had caused cocoa exports to diminish between 1983 and 2002.

Previous research commonly assessed the relationship between oil prices and prices of agricultural commodities worldwide. Those studies did not specify the agricultural commodities or study periods following episodes of economic crises, although different economic crises have distinctive natures, durations, intensities, causes, and consequences. Additionally, although Indonesia is the third-largest world cocoa producer, previous research exploring the effects of world oil prices, exchange rate fluctuation, and the European cocoa market on cocoa-related-commodities in Indonesia has been scarce. Thus, this study identifies agricultural commodities, especially for Indonesian and European cocoa markets, to empirically investigate the conduct of the domestic cocoa market and its short- and long-run relationships. This study also considers the exchange rate, European consumer price indices of Germany and Russia, and the West Texas Intermediate (WTI) oil price in the analysis using the Vector Error Correction Model (VECM) and multivariate Granger causality approach. Finally, to provide meticulous empirical evidence of the influence of oil price changes on the domestic cocoa market across different economic phases, this study divides its analysis into periods of the 2008 GFC and the 2011 EDC.

The remainder of this study is structured in the following manners. Section 2 provides the data and empirical research framework. Section 3 discusses the findings and their implications. Finally, Section 4 concludes the study.

Empirical framework

Data

This research employs monthly secondary time-series data from January 2003 to December 2020. These data include Indonesian cocoa bean prices (COPID), the European cocoa bean prices on the London market (COPUK), the US real effective exchange rate (REERUS), the consumer price indices of Germany (CPIGE) and Russia (CPIRU), and the world price of West Texas Intermediate crude oil (OILP). The data for COPID is gathered from Statistics Indonesia (BPS – Statistics Indonesia 2004–2020), while COPUK is sourced from the International Cocoa Organization (ICCO). REERUS, CPIGE, CPIRU, and OILP are obtained from the International Monetary Fund (IMF).

Since the 2008 GFC and the 2011 EDC happened over the study period, the investigation for each economic crisis episode is conducted to offer meticulous empirical evidence of the effects of changes in the European cocoa market, exchange rate, consumer price indices of Germany and Russia, and world oil prices on Indonesia's cocoa commodity market across the two economic turmoil periods. The research then divides the data into the following three observational periods:

- Sub-sample 1: the 2008 GFC period – starting from January 2003 to May 2010 (89 observations);
- Sub-sample 2: the 2011 EDC period – spanning from June 2010 to December 2020 (127 observations).
- Full-sample: covering both Sub-sample 1 and Sub-sample 2 – spanning from January 2003 to December 2020 (216 observations).

Empirical model

The study incorporates representative and relevant variables into a Vector Auto-Regressive (VAR) equation system to answer the objectives of the research. Within the VAR framework, the endogenous variables influence each other (Nazlioglu and Soytas 2012; Wang, Wu, and Yang 2014; Dewanta 2019). Before estimating the VAR model, in the first step, the study needs to ensure data stationarity using unit root tests (Giuliodori and Rodriguez 2015) based on the following equations:

$$Y_t = \rho Y_{t-1} + \varepsilon_t \text{ where } -1 \leq \rho \leq 1 \tag{1}$$

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + \varepsilon_t \tag{2}$$

$$Y_t - Y_{t-1} = (\rho - 1) Y_{t-1} + \varepsilon_t \tag{3}$$

$$\Delta Y_t = \phi Y_{t-1} + \varepsilon_t \tag{4}$$

when $\phi = (\rho - 1)$ has a value of $\rho = 1$, then $\phi = 0$, implying Y has a unit root or non-stationarity. Δ in equation (4) shows the differentiation of Y. The differencing process, I(d), is taken to arrive at the stationarity so that $\phi \neq 0$ or $\rho < 1$ (Gujarati and Porter 2009).

The Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests are employed to ensure data stationarity. The study incorporates optimal lag-lengths and the truncation lag of q into the ADF and PP tests using the Final Prediction Error (FPE) criteria and the Newey-West approach, respectively.

In the second step, the study tests the cointegration among the variables using the Johansen tests. The time-series data is cointegrated if at a differentiated level, I(d), the data is stationary, showing the existence of a long-run equilibrium association among the endogenous variables. The error term (ε_t) has to be stationary, and its cointegration is tested using the following trace statistics:

$$Q_t = -T \sum_{i=r+t}^{k} log(1-\lambda_t) \text{ where } r = 0,1,\ldots..,k-1 \tag{5}$$

Cointegration is also tested using the following Maximum-Eigen statistics:

$$Q_{max} = -T(1-\lambda_{i+1}) = Q_t - Q_{t-1} \tag{6}$$

The study will adopt the VECM technique to measure both short- and long-run relationships if the tests found cointegration. Referring to Asteriou and Hall (2011) and Wang, Wu, and Yang (2014), the following VECM equation is estimated:

$$\Delta Z_t = a_0 + a_{ij} + \Pi Z_{t-1} + \sum_{i=1}^{p} \Gamma_i \Delta Z_{t-i} + \varepsilon_{ti} \tag{7}$$

where Z_t is the endogenous variable vector (i.e., COPID, COPUK, CPIGE, CPIRU, OILP, and REERUS) with an order of (n x m). A matrix β' from $\Pi = \alpha.\beta$' shows a cointegration vector and α indicates an error correction term (ECT) vector. Meanwhile, Γ is the matrix of the coefficient modifier in the short- and long-run, and p is the optimal lag-length.

In the third step, the study estimates the regression of endogenous variables across the 2008 GFC and the 2011 EDC using the following VECM equations:

$$D(COPID)_t = \alpha_1 + \beta_1 ECT\_COPID(-1) + \beta_{11}\sum_{i=1}^{p} D(COPID)_{t-i} + \beta_{12}\sum_{i=1}^{p} D(COPUK)_{t-i} + \beta_{13}\sum_{i=1}^{p} D(CPIGE)_{t-i} + \beta_{14}\sum_{i=1}^{p} D(CPIRU)_{t-i} + \beta_{15}\sum_{i=1}^{p} D(OILP)_{t-i} + \beta_{16}\sum_{i=1}^{p} D(REERUS)_{t-i} + \varepsilon_{t1} \quad (8)$$

$$D(COPUK)_t = \alpha_2 + \beta_2 ECT\_COPUK(-1) + \beta_{21}\sum_{i=1}^{p} D(COPUK)_{t-i} + \beta_{22}\sum_{i=1}^{p} D(COPID)_{t-i} + \beta_{23}\sum_{i=1}^{p} D(CPIGE)_{t-i} + \beta_{24}\sum_{i=1}^{p} D(CPIRU)_{t-i} + \beta_{25}\sum_{i=1}^{p} D(OILP)_{t-i} + \beta_{26}\sum_{i=1}^{p} D(REERUS)_{t-i} + \varepsilon_{t2} \quad (9)$$

$$D(CPIGE)_t = \alpha_3 + \beta_3 ECT\_CPIGE(-1) + \beta_{31}\sum_{i=1}^{p} D(CPIGE)_{t-i} + \beta_{32}\sum_{i=1}^{p} D(COPID)_{t-i} + \beta_{33}\sum_{i=1}^{p} D(COPUK)_{t-i} + \beta_{34}\sum_{i=1}^{p} D(CPIRU)_{t-i} + \beta_{35}\sum_{i=1}^{p} D(OILP)_{t-i} + \beta_{36}\sum_{i=1}^{p} D(REERUS)_{t-i} + \varepsilon_{t3} \quad (10)$$

$$D(CPIRU)_t = \alpha_4 + \beta_4 ECT\_CPIRU(-1) + \beta_{41}\sum_{i=1}^{p} D(CPIRU)_{t-i} + \beta_{42}\sum_{i=1}^{p} D(COPID)_{t-i} + \beta_{43}\sum_{i=1}^{p} D(COPUK)_{t-i} + \beta_{44}\sum_{i=1}^{p} D(CPIGE)_{t-i} + \beta_{45}\sum_{i=1}^{p} D(OILP)_{t-i} + \beta_{46}\sum_{i=1}^{p} D(REERUS)_{t-i} + \varepsilon_{t4} \quad (11)$$

$$D(OILP)_t = \alpha_5 + \beta_5 ECT\_OILP(-1) + \beta_{51}\sum_{i=1}^{p} D(OILP)_{t-i} + \beta_{52}\sum_{i=1}^{p} D(COPID)_{t-i} + \beta_{53}\sum_{i=1}^{p} D(COPUK)_{t-i} + \beta_{54}\sum_{i=1}^{p} D(CPIGE)_{t-i} + \beta_{55}\sum_{i=1}^{p} D(CPIRU)_{t-i} + \beta_{56}\sum_{i=1}^{p} D(REERUS)_{t-i} + \varepsilon_{t5} \quad (12)$$

$$D(REERUS)_t = \alpha_6 + \beta_6 ECT_{REERUS(-1)} + \beta_{61}\sum_{i=1}^{p} D(REERUS)_{t-i} + \beta_{62}\sum_{i=1}^{p} D(COPID)_{t-i} + \beta_{63}\sum_{i=1}^{p} D(COPUK)_{t-i} + \beta_{64}\sum_{i=1}^{p} D(CPIGE)_{t-i} + \beta_{65}\sum_{i=1}^{p} D(CPIRU)_{t-i} + \beta_{66}\sum_{i=1}^{p} D(OILP)_{t-i} + \varepsilon_{t6} \quad (13)$$

where *ECT* is the corrective adjustment in the VECM equation system. The significant negative value of *ECT* shows a gradual corrective adjustment from the short-run imbalance to the long-run equilibrium.

In the final step, the study measures dynamic causal relationships among variables using the multivariate Granger causality approach (Rahman and Kashem 2017). This approach provides useful information related to the size and direction of dynamic interactions (Asteriou and Hall 2011). The study identifies the presence of multivariate Granger causality using Wald test using the following multivariate Granger causality equation:

$$X_{(t)} = \sum_{i=1}^{p} A_i X(t-i) + \varepsilon(t) \quad (14)$$

where $X(t) \in R^{dx1}$ for t = 1,...,n, is a multivariate time series at optimal lag (p), and $\epsilon(t)$ is the Gaussian random vector, and A_i is a matrix for every i.

Findings and discussion

Descriptive statistics

The descriptive statistics provided in Table 1 presents a brief overview of preliminary information about the variables explored in the study. As illustrated in Table 1, the mean prices of the Indonesian cocoa beans (COPID), the European cocoa beans' price on London market (COPUK), consumer price index of Germany (CPIGE), consumer price index of Russia (CPIRU), the WTI oil price (OILP), and the US real effective exchange rate (REERUS) experienced a slight increase over the study period from January 2003 to December 2020. However, the highest values of COPID, COPUK, CPIGE, CPIRU, and REERUS were recorded in the Sub-sample 2 period (2010–6 to 2020–12). On the other hand, the highest value of OILP was recorded in the sub-sample 1 period (2003–1 to 2010–5). These findings show that, except for OILP, the other variables show an increasing trend.

Table 1. Descriptive statistics of the variables

Variable	COPID	COPUK	CPIGE	CPIRU	OILP	REERUS
Full-sample: The period of 2003–1 to 2020–12						
Mean	20996.3	1903.79	102.27	115.62	66.20	107.52
Maximum	36065	3134	114.29	191.15	133.93	122.59
Minimum	9235	1181	89.11	46.81	22.1	92.45
Std. Deviation	6692.9	469.32	7.41	44.93	23.96	7.89
Observations	216	216	216	216	216	216
Sub-sample 1: The 2008 GFC period (2003–1 to 2010–5)						
Mean	16305.17	1548.84	94.665	70.695	62.22	108.31
Maximum	29885	2528	100.01	99.13	133.93	122.46
Minimum	9235	1181	89.11	46.81	28.1	96.40
Std. Deviation	6212.9	371.56	3.55	15.95	24.13	6.29
Observations	89	89	89	89	89	89
Sub-sample 2: The 2011 EDC period (2010–6 to 2020–12)						
Mean	24272.13	2152.53	107.606	147.100	68.99	106.97
Maximum	36065	3134	114.29	191.15	110.04	122.59
Minimum	16575	1599	99.91	99.52	22.1	92.45
Std. Deviation	4797.9	357.8	3.92	29.03	23.53	8.83
Observations	127	127	127	127	127	127

Source: own calculation, processed by using the EViews statistical software.

Furthermore, the COPID, COPUK, and OILP were found to be more volatile during the Sub-sample 1 period, while the rest of the variables of CPIGE, CPIRU, and REERUS recorded higher volatility during the Sub-sample 2 period. The prices and exchange rate were highly sensitive to external factors, particularly during the EDC

period in 2011. The highest volatility was recorded from April to May 2011. Meanwhile, the IMF (International Monetary Fund 2019) reported that the WTI crude oil price achieved USD 110.04 per barrel in April 2011. Additionally, the OILP recorded a higher standard deviation in the 2008 GFC period (2003–2010). However, the average world oil price recorded the highest value of USD 68.99 per barrel in the 2011 EDC period (2010–2020). Geo-political, economic, and security pressures in the Middle Eastern region in mid–2015 caused higher volatility in global oil prices (Haugom, Mydland, and Pichler 2016).

Stationarity of data

Before estimating the dynamic causal relationships between the investigated variables, the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests were conducted to ensure data stationarity. These tests have higher power while the time-series data exhibit non-linear behavior (Khraief et al. 2018). The findings of the ADF and PP unit root tests are provided in Table 2.

Table 2. Results of unit root tests

Variable	Level		First Difference	
	ADF	PP	ADF	PP
Full-sample: The period of 2003–1 to 2020–12				
COPID	0.8398	0.8186	0.0000***	0.0000***
COPUK	0.7384	0.7420	0.0000***	0.0000***
CPIGE	0.4945	0.1116	0.6383	0.0000***
CPIRU	0.8612	0.9077	0.0002***	0.0216***
OILP	0.2725	0.5135	0.0000***	0.0000***
REERUS	0.4395	0.7831	0.0000***	0.0000***
Sub-sample 1: The 2008 GFC period (2003–1 to 2010–5)				
COPID	0.6517	0.7257	0.0000***	0.0000***
COPUK	0.6580	0.8003	0.0000***	0.0000***
CPIGE	0.9733	0.9492	0.2411	0.0000***
CPIRU	0.9986	0.9996	0.0001***	0.0000***
OILP	0.1494	0.4032	0.0000***	0.0000***
REERUS	0.3927	0.5628	0.0000***	0.0000***
Sub-sample 2: The 2011 EDC period (2010–6 to 2020–12)				
COPID	0.7932	0.7858	0.0000***	0.0000***
COPUK	0.5369	0.5369	0.0000***	0.0000***
CPIGE	0.3937	0.1903	0.5973	0.0000***
CPIRU	0.8117	0.8970	0.0001***	0.0032***
OILP	0.1399	0.3150	0.0000***	0.0000***
REERUS	0.2241	0.3508	0.0000***	0.0000***

Note: *** shows significance at the 1% level. The figures show *p*-values.
Source: own calculation, processed using the EViews statistical software.

Table 2 illustrates the findings of the stationary tests of all variables using the *p*-value of the ADF and PP tests (Giuliodori and Rodriguez 2015). Through the process of data differentiation, *I*(1) for each sub-sample, the *p*-values of the PP test were all found to be significant at the 1% level. On the other hand, for the ADF test, only the CPIGE variable was non-stationary at the first difference for all periods, while the other variables recorded significance at the 1% level. Overall, the findings indicate that all variables in all sub-samples are stationary or contained no unit roots at the first difference, where $\phi \neq 0$ (Equation 4). These findings further show that agricultural cocoa commodities are very vulnerable to price volatility, market risk, and changes in other macroeconomic variables, both domestically and globally. Commodity market prices become more sensitive during episodes of economic turmoil (El-Khatib and Hatemi 2018), and speculation activities play a relatively large role in influencing the new price equilibrium (Bohl et al. 2019).

Johansen's cointegration test

After ensuring all variables are stationarity at a similar order of integration, *I*(1), the Johansen cointegration tests are then performed. The findings of the cointegration tests based on the trace and Maximum-Eigen statistics are reported in Table 3.

As observed from Table 3, the values of the trace and Maximum-Eigen statistics for all sub-periods are significant, at least at a 5% level. These findings show the existence of a long-run equilibrium among variables over the 2008 GFC, the 2011 EDC, and entire periods. These findings further imply that to predict the movements of domestic cocoa prices, one can refer to the movements of other variables in the equation system.

Table 3. The results of the Johansen cointegration tests

Null Hypothesis	Trace Statistic	Critical value	Prob.	Max-Eigen Statistic	Critical value	Prob.
Full-sample: The period of 2003–1 to 2020–12						
r = 0	495.173***	117.708	0.0000	122.189***	44.497	0.0000
r ≤ 1	372.983***	88.803	0.0000	106.341***	38.331	0.0000
r ≤ 2	266.642***	63.876	0.0000	85.578***	32.118	0.0000
r ≤ 3	181.063***	42.915	0.0000	78.313***	25.823	0.0000
r ≤ 4	102.750***	25.872	0.0000	58.431***	19.387	0.0000
r ≤ 5	44.318***	12.517	0.0000	44.318***	12.517	0.0000
Sub-sample 1: The 2008 GFC period (2003–1 to 2010–5)						
r = 0	207.771***	117.708	0.0000	56.852***	44.497	0.0015
r ≤ 1	150.919***	88.804	0.0000	40.781**	38.331	0.0256
r ≤ 2	110.148***	63.876	0.0000	34.829**	32.118	0.0227
r ≤ 3	75.318***	42.915	0.0000	30.585**	25.823	0.0109
r ≤ 4	44.724***	25.872	0.0001	26.234***	19.387	0.0043
r ≤ 5	18.490***	12.528	0.0045	18.49***	12.518	0.0045

Null Hypothesis	Trace Statistic	Critical value	Prob.	Max-Eigen Statistic	Critical value	Prob.
Sub-sample 2: The 2011 EDC period (2010–6 to 2020–12)						
r = 0	253.496***	117.708	0.0000	70.736***	44.497	0.0000
r ≤ 1	182.759***	88.803	0.0000	51.773***	38.331	0.0008
r ≤ 2	130.986***	63.876	0.0000	41.468***	32.118	0.0027
r ≤ 3	89.518***	42.915	0.0000	35.501***	25.823	0.0020
r ≤ 4	54.016***	25.872	0.0000	30.477***	19.387	0.0008
r ≤ 5	23.538***	12.517	0.0005	23.538***	12.517	0.0005

Note: *** and ** shows significance at the 1% and 5% levels, respectively.
Source: own calculation, processed using the EViews statistical software.

Having identified cointegration among the variables, the study could suitably adopt the VECM analysis to estimate the short- and long-run relations and among the investigated variables and their dynamic causal interactions.

The long-run impacts of European cocoa price, inflation, global oil prices, and exchange rate on the Indonesian cocoa price

Table 4 reports the findings of the long-run relationship between the European cocoa price (COPUK), the consumer price index of Germany (CPIGE), the consumer price index of Russia (CPIRU), the US real effective exchange rate (REERUS), world oil prices (OILP), and the Indonesian cocoa price (COPID) across three sub-samples of the study. As observed from Table 4, the study documented various sizes and directions of the long-run relationships among the variables. COPUK had a significant negative effect on COPID at the 1% level during the 2011 EDC and full-sample period, while a significant positive effect was recorded during the 2008 GFC period. In the long run, during the 2011 EDC and across the entire period, an increase in COPUK led to the decline of COPID. Meanwhile, during the 2008 GFC period, an increase in COPUK led to an increase in COPID.

Similarly, an increase in COPID caused COPUK to fall during the 2011 EDC and entire periods. On the other hand, during the 2008 GFC period, an increase in COPID also brought about an increase in COPUK. The negative bidirectional causalities during the 2011 EDC and across the entire period were due to the nature of the Indonesian cocoa commodities as the complement for other cocoa suppliers. However, during the 2008 GFC period, Indonesian cocoa commodities were viewed as substitutes for other cocoa suppliers. The relatively low price of cocoa beans led cocoa farmers to plant other agricultural products, such as corn, rubber, and palm oil (Permani 2013). Consequently, this caused the cocoa bean supply to decline in the long run and led to a rise in the prices of the domestic cocoa market.

Additionally, when the Indonesian cocoa prices increased, the inability of Indonesian cocoa beans to meet international standards due to their low quality (Dewanta 2019) drove consumers to demand more cocoa commodities from European countries due to their lower price and high quality. The European commodities market could sustain its high cocoa demand by selling its cocoa commodities at a competitive price in the long run. On the other hand, as the price of European cocoa rises, consumers buy more cocoa commodities from Indonesia because of their competitive price. Thus, in the long run, it is far easier for Indonesia to maintain the cocoa price at a lower level in the domestic market because of its low quality.

Table 4. Findings of the long-run relationship

Variable	COPID	COPUK	CPIGE	CPIRU	OILP	REERUS
Full-sample: The period of 2003–1 to 2020–12						
COPID	-	–11.923 [–7.989]***	–5590.227 [–9.680]***	416.278 [1.79234]*	131.839 [4.709]***	309.977 [3.366]**
COPUK	–0.083 [8.032]***	-	468.822 [9.766]***	–34.911 [–1.802]*	–11.056 [–4.709]***	–25.996 [–3.349]**
CPIGE	–0.0002 [5.902]***	0.002 [5.923]***	-	–0.074 [–1.799]*	–0.023 [–5.067]***	–0.055 [–3.346]**
CPIRU	0.002 [5.905]***	–0.028 [–5.908]***	–13.429 [–9.722]***	-	0.316 [4.720]***	0.744 [3.393]**
OILP	0.007 [5.902]***	–0.090 [–5.870]***	–42.401 [–10.413]***	3.157 [1.795]*	-	2.351 [3.590]**
REERUS	0.003 [5.951]***	–0.038 [–5.890]***	–18.034 [–9.704]***	1.342 [1.821]*	0.425 [5.066]***	-
Sub-sample 1: The 2008 GFC period (2003–1 to 2010–5)						
COPID	-	14.091 [1.821]**	28391.96 [6.705]***	–6194.064 [–4.260]***	–819.525 [–5.343]***	–2226.603 [–3.491]**
COPUK	0.071 [1.811]**	-	2014.913 [6.692]***	–439.579 [–4.251]***	–58.159 [–5.419]***	–158.017 [–3.584]**
CPIGE	3.52E–05 [1.320]	0.0005 [1.323]	-	–0.218 [–4.534]***	–0.029 [–6.603]***	–0.078 [–3.621]**
CPIRU	–0.0002 [1.321]	–0.002 [–1.326]	–4.584 [7.149]***	-	0.132 [5.433]***	0.359 [3.461]**
OILP	–0.001 [–1.325]	–0.017 [–1.351]	–34.644 [8.317]***	7.558 [4.340]***	-	2.717 [5.069]***
REERUS	–0.0005 [–1.335]	–0.006 [–1.377]	–12.751 [7.032]***	2.782 [4.263]***	0.368 [7.817]***	-
Sub-sample 2: The 2011 EDC period (2010–6 to 2020–12)						
COPID	-	–10.828 [–12.777]***	–562.374 [–1.720]*	267.463 [2.036] **	82.653 [4.261] ***	88.252 [1.646]
COPUK	–0.092 [–12.822]***	-	51.937 [1.74461]*	–24.701 [–2.056]**	–7.633 [–4.272]***	–8.150 [–1.634]
CPIGE	–0.002 [–9.244]***	0.019 [9.342]***	-	–0.475 [–2.056]**	–0.146 [–4.493]***	–0.156 [–1.632]

Variable	COPID	COPUK	CPIGE	CPIRU	OILP	REERUS
CPIRU	0.003 [9.229]***	−0.040 [−9.285]***	−2.102 [−1.733]*	-	0.309 [4.336]***	0.329 [1.666]
OILP	0.012 [9.229]***	−0.131 [−9.220] ***	−6.803 [−1.811]*	3.235 [2.073]**	-	1.067 [1.669]
REERUS	0.011 [9.321]***	−0.123 [−9.223] ***	−6.372 [−1.720]*	3.031 [2.082]**	0.936 [4.366] ***	-

Note: ***, **, and * show significance at the levels of 1%, 5%, and 10%, and [.] is the t-statistics.
Source: own calculation, processed using the EViews statistical software.

Furthermore, the study also found a significant negative effect of OILP and REERUS on COPID during the 2008 GFC period, at least at the 5% level. Meanwhile, during the 2011 EDC and full-sample period, OILP and REERUS significantly and positively impacted COPID, at least at the 5% level. However, during the 2011 EDC period, REERUS had an insignificant effect on COPID, while OILP recorded a significant positive effect. These findings showed that the different nature, duration, and causes of episodes of economic crises affected COPID differently.

Nearly 90% of cocoa beans in Indonesia are sold in the local market (Dewanta 2019). Accordingly, changes in the global oil price caused a more long-lasting effect on the Indonesian domestic market. A rise in oil price worldwide caused an increase in the production cost of derived cocoa products, such as cocoa liquor, cocoa powder, and cocoa butter. Consequently, this led to a decline in demand for the processed cocoa commodities by Indonesia's cocoa trading partners.

Since Indonesia exports the raw cocoa beans mainly to the neighboring countries of Malaysia and Singapore, which used them as inputs for their processed cocoa products (Dewanta 2019), these countries would reduce their cocoa demand from Indonesia in the long run. This practice, in turn, causes the price of Indonesian cocoa beans to plunge. The finding of the negative effect of REERUS on the Indonesian cocoa market during the 2008 GFC period is in line with previous research (Olaiya 2016; Verter 2016). An appreciation of the IDR (Indonesian Rupiah) causes the domestic cocoa price to become relatively more expensive and less competitive in the global market. Subsequently, the demand for cocoa and the price would fall in the long run. On the other hand, a relatively low level of IDR, compared to the foreign currency during the 2011 EDC period, caused an increase in the demand for Indonesian cocoa due to its high competitiveness.

COPID had a significant positive effect on OILP and REERUS at the 1% level during the 2011 EDC and full-sample periods. However, during the 2018 GFC period, COPID had an insignificant effect on OILP and REERUS. Indonesia only exported about 10% of cocoa beans, largely to the Asian market (92.46%), mainly to Malaysia (57.26%) and Singapore (31.88%). It also exported a negligible amount of cocoa beans to foreign countries, such as to North America (4.95%) and Europe (2.54%) (International Trade Centre 2020). Overall, the value of Indonesian cocoa exports reached only USD112 million in 2017. The tiny share of Indonesia's cocoa in the global market meant that OILP and REERUS had an insignificant effect on COPID during the 2018

GFC period. In addition, Indonesia's Ministry of Finance enacted a cocoa bean export tax, Regulation No. 67/PMK.011/2010, further lowering the export values of Indonesia to the world cocoa market (Permani, Vanzetti, and Setyoko 2011). However, during the entire period, Indonesian cocoa was still considered an important supplier to the global market.

Our study also documents the negative effect of the European cocoa price on the exchange rate, and vice versa. As the domestic currency appreciates, the local cocoa becomes less competitive in the global market. To foresee a lower demand for domestic cocoa beans due to its exorbitant prices, in the long run, the domestic cocoa price needs to be adjusted following price changes in the global cocoa market. Our findings are in line with Alori and Kutu (2019), who found that the exchange rate shocks affected the Nigerian cocoa exports to the world cocoa market. From a policymaker's perspective, these findings imply the importance of stabilizing the exchange rate to promote cocoa exports.

Overall, the nature of the long-run relationships between COPID and other variables was slightly different across the sub-samples due to the different nature, duration, and causes of the economic crises. During the 2008 GFC and the 2011 EDC crises, the impacts of the exchange rate were more dominant due to the higher volatility of the exchange rate during economic instability periods. For the full-sample period, the study recorded bidirectional long-run interactions between COPID and COPUK, COPID and REERUS, and COPUK and REERUS, while a unidirectional long-run interaction was documented from the OILP to COPID, OILP to COPUK, and OILP to REERUS. Thus, the world oil price played an essential role in influencing global economic stability. A rise in world oil prices caused the global cocoa beans prices to rise, the domestic currency to appreciate, and the domestic cocoa price to decline.

A long-run relationship between COPID and COPUK implies a horizontal integration of the Indonesian cocoa market with the global cocoa market (Arnade, Cooke, and Gale 2017). The low competitiveness of Indonesian cocoa beans in the global market due to the enactment of cocoa export duties and the low quality of non-fermented cocoa bean exports caused asymmetrical interactions between the domestic Indonesian and world cocoa markets (Witjaksono and Asmin 2016; Hasibuan and Sayekti 2018). Meanwhile, the establishment of a regional trade treaty among the cocoa producers reduced competition in the world cocoa market (Jambor, Gal, and Torok 2020). Generally, our findings also demonstrate the sensitivity of Indonesian net export, macroeconomic policies, and market flux to the changes in foreign currency of the USD. The fiscal and monetary policy interactions can explain the repercussion of exchange rate volatility (Shah et al. 2019).

Finally, an increase in price instability weakens the exchange rate (Volkov and Yuhn 2016; Nakatani 2018). Global crude oil prices failed to reach equilibrium level from short- to long-run. Haugom, Mydland, and Pichler (2016) believed that predicting future oil prices has a risk challenge. World oil prices oscillated during the 2008 GFC and the 2011 EDC crises period peaked in 2015. The connection between prices of agricultural commodities is non-neutral to the world oil price (Fowowe 2016; Syahril

et al. 2019). Geo-political, economic, and security tensions, particularly in the Middle East, contributed to higher volatility of world oil prices and macroeconomic instabilities (Evgenidis 2018).

Multivariate dynamic interactions among Indonesian and European cocoa markets, inflation, global oil price, and exchange rate

Finally, Table 5 illustrates the multivariate dynamic interactions among the variables. There is a long-run equilibrium between COPID and the COPUK, CPIGE, CPIRU, OILP, and REERUS variables, indicated by the negative significance of ECT for all sub-samples. These findings show that a short-run disequilibrium in the domestic cocoa market is adjusted to a long-run equilibrium with a speed of adjustments of –0.141 during the 2003–2020 (full-sample), –0.138 during the 2003–2011 (the 2008 GFC), and –0.573 during 2010–2020 (the 2011 EDC) periods. During the 2011 EDC period, the speed of adjustment was slightly faster than the other study periods, indicating a greater integration of the world cocoa market. It took about four weeks during the 2008 GFC and full-sample periods, and two weeks during the 2011 EDC period, for a short-run imbalance in the domestic cocoa price to be cleared and restored to long-run equilibrium. These findings further denote that the 2008 GFC hit the Indonesian economy hardest.

The 2008 GFC generated shocks to the global cocoa market (Bahmani-Oskooee and Aftab 2018; Dias, Silva, and Dionísio 2019). This adverse impact was marked by an increase in the fragility of the Indonesian cocoa market. Thus, hedging cocoa commodities is viewed as the paramount strategy to minimize the market risk due to price sensitivity to exchange rate fluctuations (El-Khatib and Hatemi 2018). Moreover, the Indonesian cocoa beans traded in the foreign cocoa markets are of low quality and non-fermented (Witjaksono and Asmin 2016) in the cocoa-derived products industry in Malaysia, Indonesian cocoa beans are commonly used as auxiliary raw material for the finest quality of cocoa beans from Ghana (Quarmine et al. 2012; Dewanta 2019). The Indonesian cocoa market was also adversely impacted by the 2011 EDC.

In terms of short-run association and multivariate Granger causal interaction, the study recorded bidirectional Granger causality between COPID and COPUK during the 2011 EDC. During the 2011 EDC, a unidirectional causality running from COPUK to COPID was documented. However, the study found that COPID was independent of COPUK over the entire study period. As the world's third-largest cocoa-producing country, Indonesia sold more than 85% of its cocoa beans in the domestic market, and only 15% was exported to the foreign market (Dewanta 2019). African countries are the major determinants of cocoa bean prices globally (Wessel and Quist-Wessel 2015). Thus, it is understandable that the foreign cocoa market has considerable influence on Indonesia's cocoa market.

Table 5. Multivariate dynamic interactions

Variable	COPID	COPUK	CPIGE	CPIRU	OILP	REERUS	ECT
Full-sample: The period of 2003–1 to 2020–12							
COPID	-	0.070	4.579**	1.942	0.109	0.341	–0.141
		(0.7904)	(0.0324)	(0.1634)	(0.7405)	(0.5587)	[–1.965]**
COPUK	0.074	-	6.094**	0.114	4.042**	0.051	–0.249
	(0.7856)		(0.0136)	(0.7351)	(0.0444)	(0.8200)	[–3.397]**
CPIGE	12.018***	31.807***	-	5.394**	1.484	4.140**	–0.854
	(0.0005)	(0.0000)		(0.0202)	(0.2231)	(0.0419)	[–8.624]**
CPIRU	1.077	0.124	2.614	-	4.309**	4.16**	–0.005
	(0.2994)	(0.7242)	(0.1059)		(0.0379)	(0.0413)	[–0.607]
OILP	0.0007	0.016	0.127	6.0002	-	0.994	0.009
	(0.9777)	(0.8979)	(0.7208)	(0.9937)		(0.3186	[0.251]
REERUS	1.714	2.734*	2.373	0.012	0.649	-	–0.059
	(0.1904)	(0.0982)	(0.1234)	(0.9095)	(0.4201)		[–2.052]**
Sub-sample 1: The 2008 GFC period (2003–1 to 2010–5)							
COPID	-	2.167	8.775**	4.245	11.043***	8.381**	–0.138
		(0.3385)	(0.0124)	(0.1197)	(0.004)	(0.0151)	[3.241]**
COPUK	10.827***	-	6.130**	4.960*	7.350**	1.515	–0.147
	(0.0045)		(0.0466)	(0.0837)	(0.0253)	(0.4687)	[–3.240]**
CPIGE	9.959***	0.749	-	3.978	6.570**	12.13***	–1.468
	(0.0069)	(0.6875)		(0.1368)	(0.0374)	(0.0023)	[–5.706]
CPIRU	3.859	7.430**	0.148	-	0.354	4.390	–0.176
	(0.1452)	(0.0243)	(0.9283)		(0.8375)	(0.1114)	[–2.555]**
OILP	4.419	2.060	0.233	1.824	-	1.499	0.041
	(0.1097)	(0.3568)	(0.8900)	(0.4016)		(0.4725)	[0.250]
REERUS	0.343	0.565	0.871	4.082	2.671	-	–0.177
	(0.8424)	(0.7536)	(0.6472)	(0.1299)	(0.2631)		[–1.626]
Sub-sample 2: The 2011 EDC period (2010–6 to 2020–12)							
COPID	-	2.778*	1.512	0.323	0.252	0.211	–0.573
		(0.0956)	(0.2188)	(0.5693)	(0.6156)	(0.6460)	[–3.284]**
COPUK	5.218**	-	2.887*	0.003	7.723***	0.134	–0.695
	(0.0224)		(0.0893)	(0.9498)	(0.0055)	(0.7141)	[–4.136]***
CPIGE	0.942	4.166**	-	0.446	0.039	0.132	–0.043
	(0.3319)	(0.0412)		(0.5039)	(0.8415)	(0.7161)	[–1.471]
CPIRU	2.162	0.513	0.436	-	1.085	7.339***	–0.009
	(0.1414)	(0.4736)	(0.5090)		(0.2974)	(0.0067)	[–0.628]
OILP	12.684***	12.458***	2.857*	0.775	-	0.021	–0.218
	(0.0004)	(0.0004)	(0.0910)	(0.3786)		(0.8861)	[–4.152]***
REERUS	0.107	0.033	0.138	3.22*	0.280	-	0.004
	(0.7430)	(0.8553)	(0.7100)	(0.0727)	(0.5962)		[0.224]

Note: ***, **, and * show significance at the levels of 1%, 5%, and 10%, respectively. Figures in (.) and [.] show probability value and t-statistics.
Source: own calculation, processed using the EViews statistical software.

As the third-largest producer of cocoa beans, Indonesia could play a greater role in shaping the world cocoa market (Hoang and Meyers 2015). However, the trend of Indonesian cocoa prices is to follow changes in the global market. About 70% of the market share of world cocoa beans comes from West African countries (Wessel and Quist-Wessel 2015), which are more competitive in the global cocoa market. Cocoa farming in both Indonesia and Africa is done mainly by smallholder farmers (Wessel and Quist-Wessel 2015; Hoffmann et al. 2020), but Indonesia has a negligible role in the world cocoa market.

REERUS had an asymmetrical influence in correcting short-run imbalances for COPID towards a long-run equilibrium during the 2008 GFC period; this finding similar to Volkov and Yuhn (2016). Meanwhile, the Indonesian domestic cocoa price was independent of REERUS during the EDC and full-sample periods. Over the 2008 GFC period, the economic crisis triggered exchange rate volatility (Nedeljkovic and Urosevic 2012; Majid, Sofyan and Rahmanda 2018; Sofyan, Majid, and Rahmanda 2019), and the IDR fell in value against the USD. Changes in commodity prices were more significant after 2008 (Zhang, Ding, and Scheffel 2019). However, trading activities could not offer maximum profits because of export restrictions and exchange rate risks, and the tax policy on cocoa bean exports introduced by the Indonesian government in April 2010 reduced its competitiveness in the global market (Hasibuan and Sayekti 2018).

Furthermore, the study found that COPUK was independent of REERUS during the 2008 GFC and 2011 EDC periods. These findings indicate that the European cocoa markets are mainly influenced by their regional currencies. However, the study found a unidirectional causal relationship running from COPUK to REERUS during the full-sample period, showing the critical role the European cocoa market plays in influencing REERUS. The higher volatility of the euro during the 2011 EDC period unfavorably affected the global cocoa market. Thus, forecasting cocoa price movements globally is quite challenging as it is influenced by numerous determinants (Haugom, Mydland, and Pichler 2016). The study found bidirectional causality between CPIGE and COPID during the 2008 GFC and full-sample periods, showing the interdependence of the domestic coca price on global price instability. However, Indonesia's domestic cocoa price is independent of the price instability in Russia due to the small trading volume between the two countries.

Finally, OILP is independent of COPID during the full-sample period. This fact is further supported by the insignificance of the ECT in the equation system. OILP changes have no effect on domestic cocoa prices. On the other hand, the study recorded a unidirectional causal effect running from OILP to COPID during the 2008 GFC period and from COPID to OILP during the 2011 EDC period. The world oil reached a maximum price of USD 133.93 (the 2008 GFC period) and USD 110.04 (the 2011 EDC period) per barrel. This oil price volatility is viewed as one of the sources of macroeconomic instability (Dahl, Oglend, and Yahya 2019). The prices of agricultural commodities of rubber and crude oil were symmetrical in the ASEAN market (Ramli et al. 2019).

Thus, the price transmission mechanism across the global commodities market was diverse, relying on nature and use value (Arnade, Cooke, and Gale 2017).

Overall, our study documented an increased integration trend between domestic and global cocoa markets across the episodes of global economic crisis. The existence of a short-run imbalance in the domestic cocoa market caused by various shocks from global economic instability was gradually and steadily corrected and adjusted towards a long-run equilibrium (Nazlioglu 2014; Ahrens, Pirschel, and Snower 2017). The global macroeconomic condition was the main determinant of the cocoa market integration globally (Yin and Han 2015).

Conclusions

This study explored dynamic interactions between the prices of Indonesian cocoa beans, the European cocoa market, the consumer price index, the world oil price, and exchange rates during the 2003–2020 period, comprising the 2008 global financial crisis and the 2011 European debt crisis. Adopting the VECM analysis, the study documented that a short-run imbalance in the Indonesian cocoa market due to shocks in the European cocoa market, the US real effective exchange rate, price stability in the Eurozone, and the world oil price had been gradually and steadily corrected moving towards its long-run equilibrium condition. The US currency volatility, global price instability, and world oil price fluctuations affected the Indonesian cocoa market in different ways, sizes, and causal directions. The different nature, duration, and causes of the 2008 GFC and 2011 EDC impacted the Indonesian cocoa prices in various ways.

Studying the nature of the interactions of global economic factors on the local cocoa prices is vital if a country intends to gain trade benefits (Ceballos et al. 2017). The relatively low competitiveness of Indonesia's cocoa beans in the global market should be viewed as a challenge that offers a huge opportunity if the country could manufacture high-quality fermented cocoa beans. The Indonesian cocoa market has a high potentiality to horizontally integrate with the global cocoa market. The domestic and global cocoa markets have been more interdependent both in the short- and long-term relationships.

The price adjustments in Indonesia's domestic cocoa market to shocks in the global cocoa market towards the long-run equilibrium were different across the 2008 GFC and 2011 EDC periods. The speed of adjustments in the global cocoa prices was faster than the adjustments in the domestic cocoa market. The domestic cocoa market tends to adapt the movements in the global markets with an asymmetrical pattern. On the other hand, Andrade and Zachariadis (2016) believe that an asymmetrical relationship exists if two or more markets are vertically integrated.

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Analiza porównawcza dynamicznych interakcji między europejskimi i indonezyjskimi rynkami kakao podczas światowego kryzysu finansowego w 2008 r. i europejskiego kryzysu zadłużenia w 2011 r.

Opracowanie przedstawia badanie empiryczne dynamicznych interakcji między europejskim i indonezyjskim rynkiem kakao podczas globalnego kryzysu finansowego w 2008 r. (GFC) i europejskiego kryzysu zadłużenia w 2011 r. (EDC). Badanie zrealizowano wykorzystując podejścia kointegracji i wieloczynnikowej przyczynowości Grangera w oparciu o zestaw szeregów czasowych. Badanie potwierdziło długoterminową równowagę między europejskim i indonezyjskim rynkiem kakao, sugerując istnienie wzajemnej relacji między nimi. Jednak w całym badaniu odnotowywano nieefektywną transmisję korekt cen kakao w Indonezji. Waluta amerykańska stale wpływała na indonezyjskie ceny kakao, podczas gdy rynki kakao były niezależne od wahań światowych cen ropy naftowej. Generalnie w badaniu odnotowano różny poziom szybkości dostosowywania się krótkookresowych nierównowag do długookresowej równowagi na krajowym rynku kakao w czasie kryzysów gospodarczych.

Słowa kluczowe: rynek kakao, CPI, kurs walutowy, cena ropy naftowej, kryzys gospodarczy

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Inequality and Students' PISA 2018 Performance: a Cross-Country Study

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Abstract

The aim of this paper was to investigate the relationship between countries' PISA study results from 2018 and a set of indices related to socio-economic inequality, such as the Gini index, human development index, or gender inequality index, along with purely economic variables, such as GDP per capita and government expenditure on education. The study covered 70 countries, consisting of 37 OECD countries and 33 non-OECD countries. Research methods included multivariate linear regression models, k-means clustering, and hierarchical clustering. Our findings revealed that the Gini index was statistically insignificant, indicating income inequality had little effect on students' PISA performance. On the other hand, the gender inequality index was the single most statistically significant explanatory variable for both OECD and non-OECD countries. Therefore, our recommendation for policymakers is simple: increase students' PISA performance, thus enhancing countries' human capital and competitiveness, and focus on decreasing gender disparity and the associated loss of achievement due to gender inequality.

Keywords: education, gender inequality index, Gini index, inequality, PISA 2018

JEL: I20

Introduction

The second paragraph of the United States Declaration of Independence starts as follows: "We hold these truths to be self-evident, that all men are created equal…" Today, this statement means that all humans are equal regardless of their race, gender, age, religion, wealth, intellect, social status, or class. However, in real-world societies, experience teaches us that this noble premise is not satisfied, as various forms of inequality emerge again and again.

In this paper, we focus on the relationship between selected forms of inequality, which commonly occur in each society, and students' performance. Knowledge and skills attained at school are assets of each individual for his/her subsequent life and career. At a national level, the set of skills and knowledge forms a fundamental part of national human capital with an immense impact on national competitiveness in the near future. Therefore, measuring skills and knowledge attained by (formal) education has become more important than ever and has led to many national and international studies, such as TIMSS or PISA. Subsequently, the results of these studies have been extensively studied not only by academics, teachers, and other experts from the field of education, but also by policymakers who shape educational systems in each country and decide about its resources, goals, rules of operation, and other parameters.

The majority of the literature on students' performance in international studies focuses on the link between mostly economic variables, such as national GDP, government expenditure on education and teachers' salaries, and educational system parameters, such as teacher/student ratio, curriculum, and the number of schooling years, etc., on the one hand, and students' scores on the other, in order to assess the efficiency of educational systems.

However, studies on the relationship between students' performance and inequality are quite rare (with the exception of the Gini index). Therefore, the aim of this paper is to present the results of the analysis of the relationship between the PISA international study results from 2018 and a set of socio-economic indicators related to inequality on a national level. Specifically, we use income inequality expressed by the Gini index, gender inequality expressed by the gender inequality index, and educational inequality expressed by the inequality in education index. Our working hypothesis can be formulated as follows: Inequality measured by the above-mentioned indices statistically significantly relates to PISA 2018 scores. Moreover, we examine OECD countries, non-OECD countries, and Central and Eastern Europe (CEE) countries, both altogether and separately.

The data for our analysis were gathered mostly from the OECD, UNDP, and the World Bank databases, and the applied research methods include linear (multivariate) regression models and cluster analysis (k-means clustering and dendrograms).

The paper is organized as follows: a literature review is provided in Section 1, the PISA study is briefly described in Section 2, the data and research methods are described in Section 3, while results are provided in Section 4. A Discussion and Conclusions end the article.

Literature review

Recent large international studies, such as PISA (*Programme for International Student Assessment*) and TIMSS (*Trends in International Mathematics and Science Study*), of students' skills and knowledge in several areas, such as reading, mathematics, or science, provide a unique opportunity for international comparisons. Studies on the efficiency of education both on a micro-level, including individual schools and courses, and macro-level, including countries, regions, or districts, are relatively common, see, e.g., Hanushek (1986), Lockheed and Hanushek (1994), Clements (2002), Afonso and Aubyn (2005), Aubyn et al. (2009), Aristovnik and Obadic (2014), or Flores (2017). However, there are few studies that examine the direct links between students' outcomes in standardized tests (such as PISA and TIMSS) and inequality.

Clements (2002) compared selected countries in terms of their expenditure per student and teacher-to-student ratio as input variables, and scores in the international standardized test (TIMSS) as an output variable. He concluded that the resources were not used effectively. Duru-Bellat and Suchaut (2005) studied PISA 2003 and reported that a high degree of social inequality translated into a high dispersion of overall test scores. Afonso and Aubyn (2006) used the data envelopment analysis to assess the efficiency of expenditure for 25 countries participating in the PISA 2003 study. They found that expenditure was highly inefficient. Further, they showed that the GDP per capita and parents' educational attainment were highly and significantly correlated to PISA scores; hence wealthier and more cultivated environments enhanced students' performances.

Hanushek and Woessmann (2011) performed an extensive study on the influence of economic factors on educational achievements with the use of PISA and TIMSS data. They found a strong relationship between the cognitive skills of tested students and the economic growth of their respective countries. Nicoletti and Rabe (2012) found that the rise in the expenditure per pupil of £1,000 in the United Kingdom led to an increase in test scores of about 2% of a standard deviation. This effect was small, but statistically significant. Agasisti (2014) used PISA scores to compare the spending efficiency on education in 20 European countries during the period 2006–2009. He found that teachers' salaries and Internet use played a positive role in affecting educational performance, while GDP per capita was negatively related to efficiency. French, French, and Li (2015) found a strong positive association between public expenditure on education and PISA scores at the country level. Wolff (2015) found a positive effect of secondary education spending on both PISA mathematics and literacy scores (both significant at $p = 0.01$). In addition, primary school spending was also a significant factor in explaining PISA's literacy scores.

DiCorrado, Kelly, and Wright (2015) used linear regression models with PISA 2012 scores as an output variable and GDP per capita, GDP growth, literacy, and spending on education as input variables. They found a positive and statistically significant relationship between GDP per capita and PISA scores, but spending on education was

found to be statistically insignificant. Yorulmaz, Colak, and Ekinci (2017) studied the relationship between PISA 2015 scores and income inequality. Their results suggested income inequality was one of the variables influencing the PISA achievements of students, but several countries with high-income inequality scored above average results, nonetheless. Mazurek and Mielcová (2019) examined the relationship between PISA 2015 scores and a set of socio-economic indicators, such as GDP, expenditure on education, or the democracy index. They found GDP and the democracy index to be statistically significant and directly proportional to PISA scores, while expenditure was negatively correlated with PISA scores. In addition, they showed that the relationship differed between OECD and non-OECD countries. Miningou (2019) focused on the efficiency of public spending in developing countries. She estimated that, on average, sixteen percent of the public financial resources dedicated to education in developing countries were wasted because of inefficiencies.

Programme for International Student Assessment (PISA)

The Programme for International Student Assessment, organized by the Organization for Economic Cooperation and Development (OECD), is a worldwide study of pupils between the age of 15 years and 3 months and 16 years and 2 months. The first PISA study was conducted in 2000, and after 2000 it was repeated every 3 years. The last study took place in 2018, with the results of the study being published in OECD (2019). Altogether, 78 countries or territories participated in the PISA study.

From each country, 4,000 to 8,000 pupils participated in the test. Only students attending schools (home-schoolers were excluded from the study) were tested. In less populated countries, such as Iceland or Luxembourg, the entire age cohort was selected. In total, around 600,000 students, out of a total of 32 million students of the same age in the world, took the PISA 2018 test. As for the continental representation, 42 countries were from Europe, 21 from Asia, six from North America, six from South America, two from Australia and Oceania, and one from Africa. China's sample consisted of pupils from four cities, Beijing, Shanghai, Jiangsu, and Zhejiang.

The cognitive test lasted two hours and had three main parts: mathematics, science, and reading. The test was computer-based with multiple-choice or open (full) answers. After the test, students filled in a questionnaire on their background. Detailed methodology of the pupils' sampling, formulation of the test questions, and other features of the PISA tests can be found on the PISA OECD webpage (OECD n.d.).

The best results, in mathematics, reading, and science combined, were achieved by China (579 points), followed by Singapore (556), Macao (542), Hong Kong (531), and Estonia (525).

Data and method

We used national data mainly from the United Nations Development Programme (UNDP) and World Bank (WB) databases. PISA data were retrieved from the OECD (2019). From a total of 78 countries that participated in PISA 2018, eight countries or territories were excluded due to an insufficient amount of data: Bosnia, Brunei, Hong-Kong, Kosovo, Macao, Montenegro, Morocco, and Taiwan.

The dependent variable was the national mean PISA 2018 score, the average of mathematics, reading, and science. Independent (explanatory) variables included:

- *GDP per capita* (GDP), purchase power parity, in US dollars, from WB (2020).
- *Government expenditure on education* (EXP) in % of national GDP, from WB (2020).
- *Gender inequality index* (GII), which is a composite index quantifying the loss of achievement within a country due to gender inequality. It has three dimensions: reproductive health, empowerment, and labor market participation. GII attains values 0 to 1, where 0 means perfect equality and 1 perfect inequality, from UNDP (2020).
- *Gini coefficient* (GINI), which expresses income inequality on a scale from 0 to 1, where 0 means perfect equality and 1 perfect inequality, from World Bank (2020).
- *Human Development Index* (HDI), which is a composite index of three main dimensions: life expectancy, education, and per capita income. It attains values from 0 to 1, where values close to 0 mean very low human development, while values near 1 mean very high human development, from UNDP (2020).
- *Inequality in education* (EDU), which is an index describing inequality in the distribution of years of schooling based on data from household surveys. The higher the EDU, the greater the inequality, from UNDP (2020).

Altogether, six independent variables were selected for further analysis. Two of them have an economic nature (GDP and EXP) and were found to be important (statistically significant) in previous studies. One variable, HDI, is associated with national development and well-being, and the last three variables are inequality indices (GII, GINI, and EDU), where each index 'captures' a different form of inequality. The EDU and GII indices have not been used in the context of the PISA study before. All data from the year 2018 were retrieved from respective databases with the exception of GDP per capita, which was averaged over the 2014–2018 period, and the Gini index, where the last known value for a given country was used when the 2018 value was not available. Detailed descriptions of the GII and HDI indices can be found in UNDP (2013). For an explanation of the Gini index, see Gini (1921), and for EDU, see UNDP (2020).

A linear relationship between pairs of variables in the form of a correlation matrix is shown in Table 2, along with a heat map in Figure 1. The results of the correlation analysis with respect to PISA showed that HDI was the most positively correlated variable, while GII was the most negatively correlated variable, see also Figures 3 a)–b).

Table 1. Data: descriptive statistics

Variable	Mean (st. deviation) All countries	Mean (st. deviation) OECD countries	Mean (st. deviation) non-OECD countries
PISA	457.91 (50.84)	488.24 (26.73)	423.91 (50.1)
EDU	8.51 (5.99)	6.69 (5.74)	10.55 (5.67)
EXP	4.75 (1.45)	5.21 (1.18)	4.23 (1.55)
GDP	37447 (23796)	45597 (18097)	28309 (26260)
GII	0.192 (0.128)	0.120 (0.090)	0.271 (0.117)
GINI	0.350 (0.069)	0.333 (0.059)	0.370 (0.074)
HDI	0.847 (0.071)	0.894 (0.047)	0.795 (0.054)

Source: authors compilation.

Table 2. Correlation matrix

Variable	PISA	GINI	GII	GDP	EXP	EDU	HDI
PISA	1.0000	–0.4377	–0.8204	0.6281	0.2875	–0.4689	0.7523
GINI	–0.4377	1.0000	0.5780	–0.2100	–0.2823	0.6312	–0.3800
GII	–0.8204	0.5780	1.0000	–0.6780	–0.4309	0.5322	–0.8423
GDP	0.6281	–0.2100	–0.6780	1.0000	0.2755	–0.3642	0.8275
EXP	0.2875	–0.2823	–0.4309	0.2755	1.0000	–0.2611	0.5027
EDU	–0.4689	0.6312	0.5322	–0.3642	–0.2611	1.0000	–0.5437
HDI	0.7523	–0.3800	–0.8423	0.8275	0.5027	–0.5437	1.0000

Source: authors compilation.

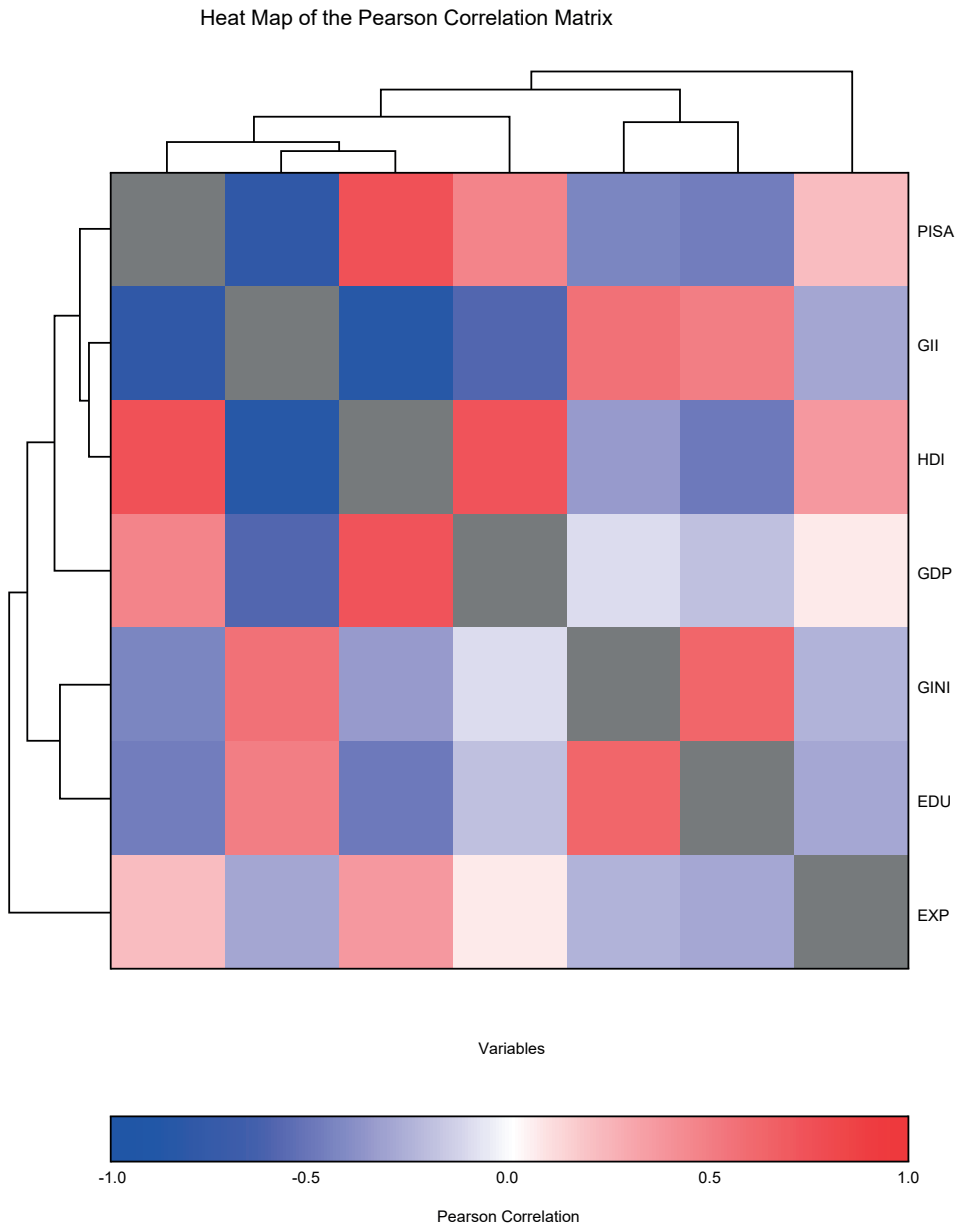


Figure 1. The heat map of the Pearson correlation coefficient for variables in Table 1.
Source: authors compilation.

To examine the relationship between the PISA 2018 scores and other variables, we used a multivariate linear model:

$$y_i = \beta_0 + \beta_1 x_{1i} + ... + \beta_p x_{pi} + \varepsilon_i$$

where y denotes the dependent (explained) variable, $x = \left(x_1, ..., x_p\right)$ is a vector of p independent (explanatory) variables, i denotes individual countries, β_i are regression coefficients, and ε is the error term.

We performed the linear regression via the free Gretl statistical software, applying the OLS method with corrected heteroscedasticity, a built-in feature of Gretl.

In addition, we used the k-means clustering method and hierarchical method (dendrograms) to examine similarities among countries via NCSS 2020 statistical software. An explanation of the k-means clustering method can be found in MacKay (2003), while the hierarchical method is well described, e.g., in Nielsen (2016).

Results

Multivariate linear regression models

At the beginning, we examined the multicollinearity of the data. According to Kennedy (2003), multicollinearity does not affect the reliability of a regression model as a whole, but it affects individual predictors. A standard measure of multicollinearity is the variance inflation factor (*VIF*), see O'Brien (2007): $VIF(i) = \frac{1}{1 - R_i^2}$, where R_i^2 is the coefficient of determination of a regression of a variable (i) on other variables in the model. According to O'Brien (2007), values $VIF(i) > 10$ indicate a problem of multicollinearity. The variance inflation factor for all independent variables is provided in Table 3. No value of VIF exceeds 10; therefore, multicollinearity is not a problem.

Table 3. The variance inflation factor for independent variables

Variable	GINI	GII	GDP	EXP	EDU	HDI
VIF	2.353	5.055	2.471	1.298	2.044	6.374

Source: authors compilation.

For the linear regression, we first consider the following Model 1 with six independent variables:

$$\begin{aligned} \text{PISA}_i = \beta_0 + \beta_1 \text{GINI}_i + \beta_2 \text{GII}_i + \beta_3 \text{GDP}_i + \\ + \beta_4 \text{EXP}_i + \beta_5 \text{EDU}_i + \beta_6 \text{HDI}_i + \varepsilon_i \end{aligned} \quad (1)$$

The results are shown in Table 4. The only variable found statistically insignificant was (somewhat surprisingly) the GINI index. Negative signs for GII and EDU indi-

cate indirect proportionality between PISA results on the one hand, and gender and education inequality on the other. The positive sign for HDI means that it is directly proportional to PISA, which could be expected. However, contrary to expectations, negative signs of GDP and EXP mean that the richer the country, or the higher its expenditure on education, the lower the PISA results.

In Model 2, we omitted the least significant variable in Model 1, the GINI index:

$$\mathrm{PISA}_i = \beta_0 + \beta_1 \mathrm{GII}_i + \beta_2 \mathrm{GDP}_i + \beta_3 \mathrm{EXP}_i + \beta_4 \mathrm{EDU}_i + \beta_5 \mathrm{HDI}_i + \varepsilon_i \qquad (2)$$

As can be seen from Table 4, Model 2 is slightly better than Model 1, the regression coefficients are similar to those in Model 1, and all signs are preserved. Again, all independent variables are highly statistically significant.

In the following Model 3, we omit both the GINI and EDU (the least significant variables from Model 2) variables:

$$\mathrm{PISA}_i = \beta_0 + \beta_1 \mathrm{GII}_i + \beta_2 \mathrm{GDP}_i + \beta_3 \mathrm{EXP}_i + \beta_4 \mathrm{HDI}_i + \varepsilon_i \qquad (3)$$

In this case, the adjusted coefficient of determination $R^2 = 0.819$ is slightly lower, but the explanatory power of Model 3 is still high. All signs of regression coefficients remain the same as in Models 1–2.

To illustrate that the economic variables cannot be omitted from linear models, we construct the last Model 4:

$$\mathrm{PISA}_i = \beta_0 + \beta_1 \mathrm{GINI}_i + \beta_2 \mathrm{GII}_i + \beta_3 \mathrm{EDU}_i + \beta_4 \mathrm{HDI}_i + \varepsilon_i \qquad (4)$$

Model 4 is clearly inferior to the previous models. Interestingly, the Gini coefficient is still statistically insignificant. On the other hand, the GII was statistically significant, at least at the $p = 0.01$ level in all considered models.

Since the data sample consisted of 37 OECD countries and 33 non-OECD countries, we examined both subsamples separately. Although the subsamples are smaller, they are more homogeneous and might reveal new insights (see Mazurek and Mielcová 2019). The mean values of all variables for both groups of countries are provided in Table 5. OECD countries have, on average, higher PISA scores, lower income, gender, and educational inequality, a higher development index as well as higher GDP per capita and expenditure on education.

Linear regression was performed for both subsamples separately, and the results are reported in Table 4. Models 5–7 are associated with OECD countries, models 8–10 with non-OECD countries, and models 11–14 deal with CEE countries.

In the case of data from OECD countries, linear regression models fitted the data very well, with the adjusted coefficient of determination above 0.82. The goodness-of-fit of the data from non-OECD countries was significantly worse, with the adjusted R^2 between 0.48 and 0.61. Another noticeable difference between both samples is related

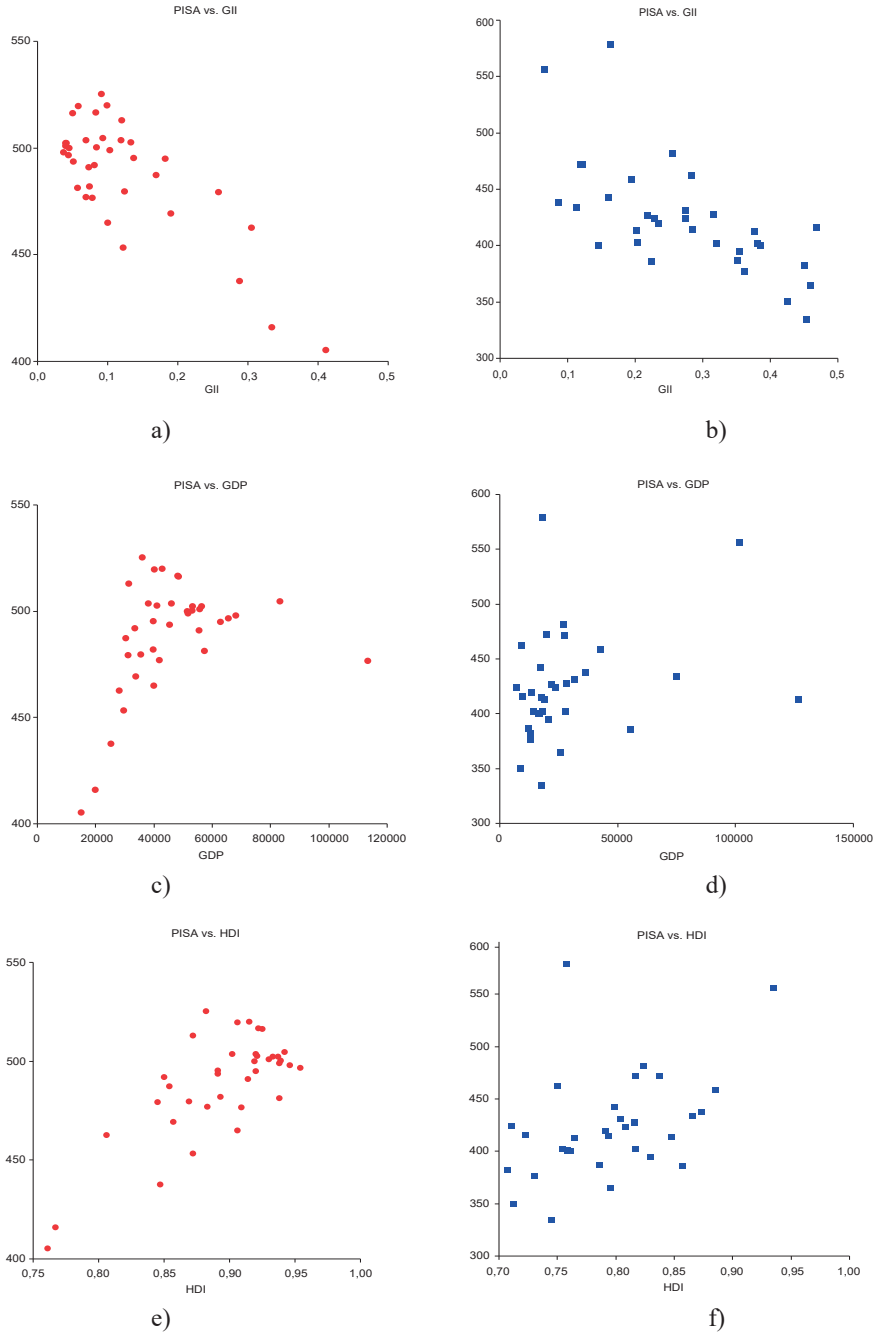
to the GDP, EXP, and HDI variables, which are highly statistically significant in the case of OECD countries, but rather statistically insignificant for the non-OECD countries. The GII is statistically highly significant in (almost) all examined models. Figures 2 a)–f) graphically illustrate selected (dis)similarities between both sets of countries.

As for the fifteen CEE countries, only two and three regressors were applied to avoid overfitting of the data. Model 13 provides the best fit in the case of two explanatory variables, while Model 14 provides the best fit in the case of three explanatory variables. In both cases, the adjusted R^2 exceeded 0.9, and the EXP and HDI variables were highly statistically significant.

Table 4. Results of multivariable linear regression models

Model no./ sample	Sample size; adj. R^2	const.	GINI	GII	GDP	EXP	EDU	HDI
1 /All	70; 0.844	326.39***	19.87	–226.8***	–0.00045***	–6.738***	–1.601**	274.67***
2 /All	70; 0.851	310.41***	-	–211.3***	–0.00043***	–6.503***	–1.475**	293.79***
3 /All	70; 0.819	267.35***	-	–224.8***	–0.00049***	–5.357***	-	329.01***
4 /All	70; 0.629	343.22***	47.66	–210.6***	-	-	–1.446*	175.59*
5 /OECD	37; 0.899	411.30***	–121.1*	–110.8**	–0.00030***	–4.787**	–0.974	194.79*
6 /OECD	37; 0.875	291.6***	–148.1**	–82.33*	–0.00037***	–6.382***	-	342.25***
7 /OECD	37; 0.823	205.0***	-	–133.2***	–0.00045***	–5.546***	-	390.36***
8 /non O	33; 0.606	466.3***	1.498	–276.2***	–0.00048	–3.970*	0.172	73.50
9 /non O	33; 0.556	505.5***	-	–255.9***	–0.00033	–4.224	–0.803	26.19
10 /non O	33; 0.484	521.3***	-	–251.2***	–0.00003	–3.646	–1.238	-
11/CEE	15; 0.772	555.3***	-	–249.6***	-	-	–9.218***	-
12/CEE	15; 0.738	259.8***	-	-	0.00335***	25.913**	-	-
13/CEE	15; 0.960	–89.7***	-	-	-	20.556	-	556.21
14/CEE	15; 0.989	–80.5	-	-	-	20.925***	0.394	536.88***

Note: * statistically significant at the 0.10 level, ** significant at the 0.05 level, *** significant at the 0.01 level
Source: authors compilation.



Figures 2 a)-f). Scatter plots of selected variables for OECD countries (left side, red) and non-OECD countries (right side, blue)
Source: authors compilation.

K-means clustering

K-means clustering of 70 countries was performed via NCSS 2020. For the clustering, all seven variables (PISA, EDU, EXP, HDI, GDP, GII, and GINI) were applied. The optimal number of clusters was determined by the "elbow rule." Table 5 provides a summary of all clusters with mean values of all variables.

- Cluster 1, which includes both OECD and non-OECD countries, is characterized by extremely high GDP per capita, high gender equality, and average PISA results.
- Cluster 2 consists of both OECD and non-OECD countries with relatively high PISA scores, while other variables are close to average.
- Cluster 3 contains almost exclusively OECD countries (with the only exception being Malta) with the highest PISA scores on average, with a high human development index, the highest expenditure on education, and the lowest values of inequality in terms of GINI and GII.
- Cluster 4 is formed by non-OECD countries with low PISA results, the lowest GDP per capita, and average inequality, both in terms of GINI and GII.
- Cluster 5 groups together non-OECD countries with the lowest PISA scores and the highest inequality in terms of GINI, GII, and EDU.

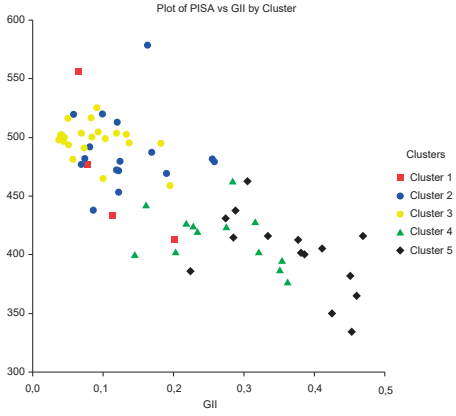
To illustrate the distribution of clusters graphically, see Figures 3 a)–d). For example, from Figure 3 c) it can be seen that Cluster 1 (red squares) is characterized by an aver age human development index but very high GDP per capita. Similarly, from Figure 3 d) it is obvious that countries from Cluster 5 (black diamonds) typically have a low human development index and high gender inequality.

Table 5. Clusters – summary

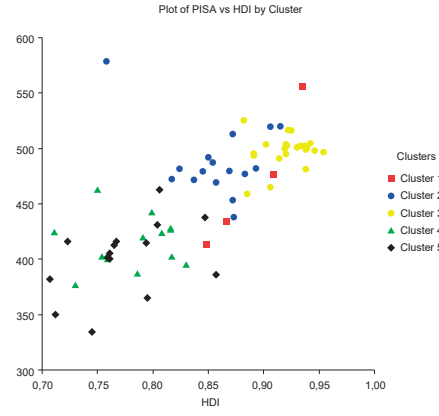
	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Countries	Luxembourg, Qatar, Singapore, UAE,	Belarus, Croatia, Cyprus, Greece, Hungary, China, Italy, Japan, S. Korea, Latvia, Lithuania, Poland, Portugal, Russia, Slovakia, Spain	Austria, Australia, Belgium, Canada, Czechia, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Israel, Malta, Netherlands, New Zealand, Norway, Slovenia, Sweden, Switzerland, UK, USA	Albania, Argentina, Azerbaijan, Bulgaria, Georgia, Kazakhstan, Lebanon, Moldova, North Macedonia, Romania, Serbia, Ukraine, Uruguay	Brazil, Colombia, Costa Rica, Dominican Rep., Chile, Indonesia, Jordan, Malaysia, Mexico, Panama, Peru, Philippines, Saudi Arabia, Thailand, Turkey
PISA	470	488	498	415	401
GINI	0.386	0.328	0.310	0.335	0.438
GII	0.115	0.132	0.085	0.266	0.368
GDP	104210	32407	51764	17617	21208

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
EXP	2.828	4.358	5.883	4.391	4.329
EDU	12.25	8.01	3.88	6.59	16.51
HDI	0.890	0.858	0.921	0.782	0.774

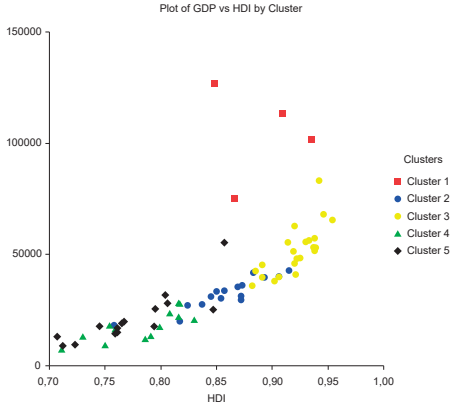
Source: authors compilation.



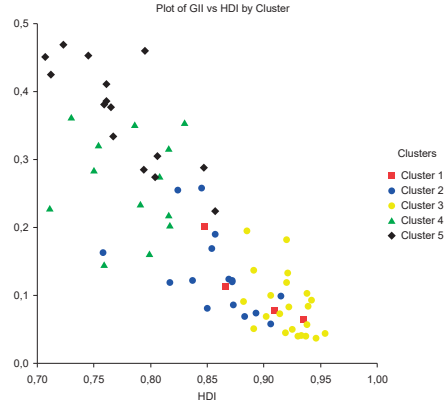
a)



b)



c)



d)

Figures 3 a)–d). Scatter plots of selected variables
Source: authors compilation.

Hierarchical clustering

For the hierarchical clustering (a tree diagram) of 70 countries, all seven variables (PISA, EDU, EXP, HDI, GDP, GII, and GINI) were applied. The result is shown in Figure 4.

Countries are displayed on the vertical axis and are gradually, from left to right, connected by nodes into growing clusters with respect to their similarity (relative distance). The distance of a node from the vertical axis is called *height*, and it is provided on the horizontal axis. The more two objects connected by a node are similar, the lower the height of the node.

From Figure 4, it is clear that the two closest (most similar) countries are Sweden and Denmark, followed by the UK and Australia. Interestingly, China is grouped with the United Arab Emirates, while the USA is, in the first step, included in a cluster with New Zealand and Israel. In addition, it can be noticed that towards the end of the diagram, three clusters are formed. The first cluster consists of China and the UAE only, the second cluster is formed almost exclusively by OECD countries, and the last cluster (the bottom half of the diagram) is formed by mostly non-OECD members. Yet, both large clusters are closer to each other than to the cluster containing China and the UAE. These findings support the division of countries into OECD and non-OECD groups in Section 4.1.

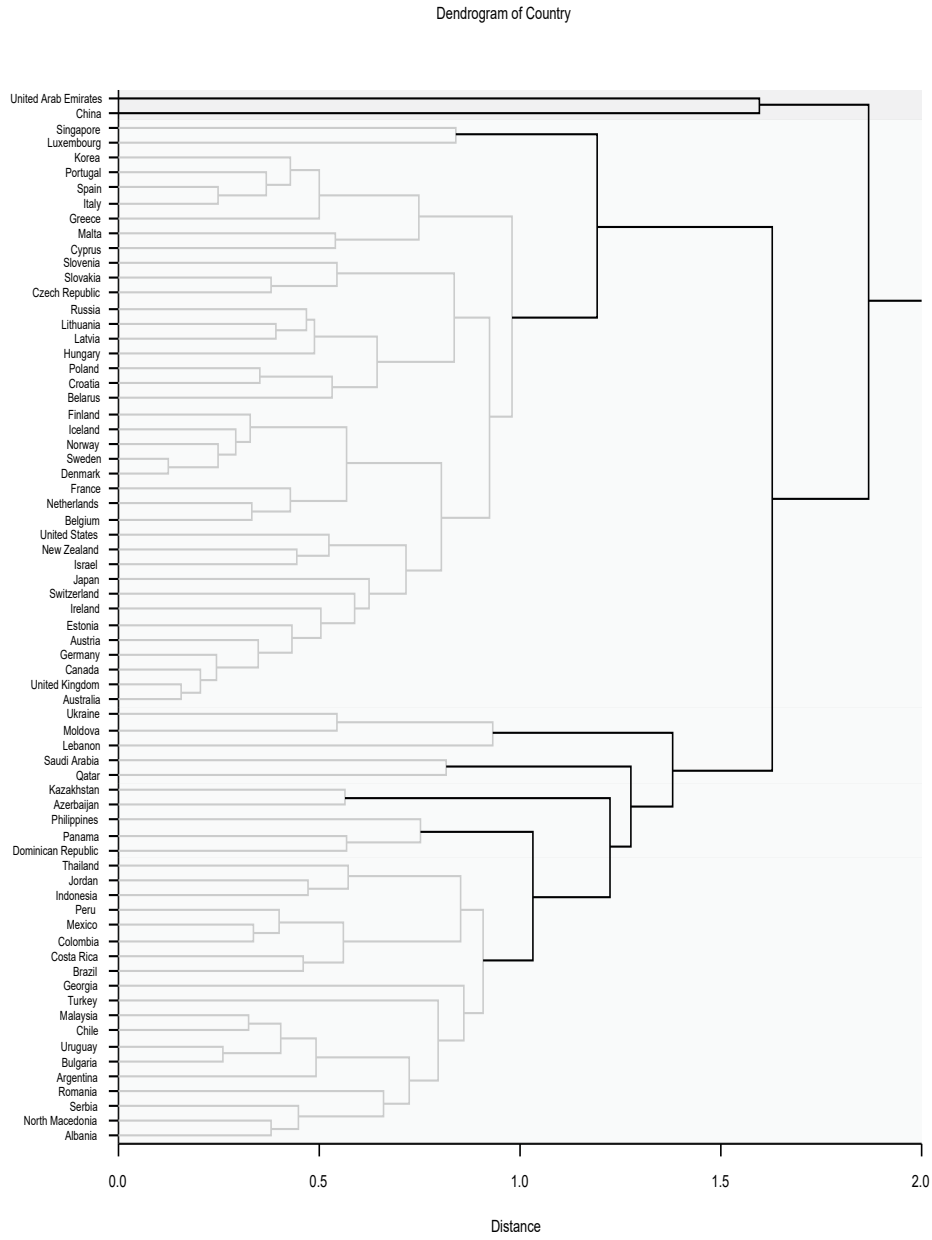


Figure 4. Hierarchical clustering (dendrogram)
Source: authors compilation.

Discussion

The aim of our study was to examine whether three forms of inequality (income, gender, and educational inequality) have a statistically significant impact on students' performance in the 2018 PISA international study.

Multivariate linear regression applied to data from all 70 countries revealed that gender and educational inequalities (GII and EDU) were highly statistically significant, but income inequality (GINI) was statistically insignificant. In addition, both economic variables (GDP and EXP) and the human development index (HDI) were statistically significant. Both regression coefficients of gender and educational inequality were, as expected, negative, which means the lower the inequality, the higher the PISA score. In the case of gender inequality, the estimated regression coefficient was between –226 and –210. This can be interpreted in the following way: when the gender inequality index GII decreases by 0.10, PISA scores increase by 21 to 22.6 points. Similarly, if the inequality in the education index EDU decreases by 1 point, PISA scores increase by 1.44–1.60 points.

The regression coefficients of the economic variables GDP and EXP attained negative values as well, while being highly statistically significant. This means the higher the GDP per capita or expenditure on education, the lower the PISA scores. In the case of expenditure, a similar result was reported in several previous studies, see, e.g., Afonso and Aubyn (2006) or Mazurek and Mielcová (2019), and it is related to expenditure inefficiency. As for GDP per capita, the wealth of a nation does not give obvious evidence of the quality of its educational system. Estonia achieved scores well above average in PISA 2018, though its GDP per capita is well below the average of OECD countries. On the other hand, the PISA scores of very rich countries, such as Qatar or the UAE, are situated in the bottom half of the list. Finally, a multicollinearity effect in linear regression models cannot be ruled out either.

It is important to note that the data sample of countries participating in the PISA 2018 study was very non-homogeneous. The sample contained very developed countries, at level IV according to Rosling's classification (see Rosling 2018), but also rather poor countries, such as the Philippines (at level II-III) with GDP per capita approximately 14 times lower than that of the richest countries. That is why dividing the whole set of countries into two subsets, OECD countries (on average richer and more developed) and non-OECD countries, might lead to more conclusive results. This approach can also be supported by the dendrogram in Figure 4, where countries "naturally" formed two large clusters (and one mini-cluster of China and the UAE), with 33 out of 37 OECD countries grouped together with six non-OECD countries in one of the two large clusters.

After the division, a different pattern emerges – see Table 4, Model 5. In the case of OECD countries, the most significant variables are GDP per capita, the gender inequality index, and expenditure on education. Inequality in education is insignificant. OECD countries are characterized by very low inequality in general; hence students' PISA performance most likely depended more strongly on economic variables. In the case of non-OECD countries – see Model 8, Table 4 – the only statistically significant

variable at the $p = 0.01$ level is gender inequality. Expenditure on education is significant at the $p = 0.10$ level, and all other variables, including GDP per capita, are insignificant. This might be at least partially explained by the fact that non-OECD countries differ significantly in inequality – see Table 1 – which was most likely reflected in Model 8. Additionally, the sample of non-OECD countries is still very diverse (Qatar or the UAE versus the Philippines or Jordan) in terms of culture, economy, or human development, hence the predictive power of linear models is weaker, and conclusions drawn from the models are less clear and conclusive.

In the case of the CEE countries (former socialist countries of the post-World War II Eastern bloc), the expenditure on education and human development indicators were the two most statistically significant ($p = 0.01$ level) explanatory variables, see Models 13–14. The higher the expenditures on education and human development indicators, the higher the PISA scores. Income and gender inequality were statistically insignificant, which might be due to historical reasons –socialism was known for its egalitarianism concerning income and gender, and this feature likely persists up today. On the other hand, former socialist countries significantly differ by their economic power and their overall level of development (consider, e.g., the Czech Republic or Slovenia versus Romania or Bulgaria). This non-homogeneity is corroborated by the cluster analysis in section 4.2, where the CEE countries were divided into Clusters 3, 4, and 5, with different levels of GDP per capita. That is why this kind of inequality is probably reflected in the expenditures on education and human development indicators.

Therefore, we conclude that our findings indicate that there might be no universal answer to the question of how to enhance students' PISA performance (or students' performance in general) for all countries because each country is unique in terms of its education system, economic level, and culture, etc. In countries at Rosling's level I and II, where people struggle with basic needs, such as food supply or shelter, and pupils and students can hardly afford textbooks, the financial aspect will likely prevail. In richer societies (levels III and IV), students' skills and knowledge can be boosted by other means than just in the form of finances invested into an educational system. Nevertheless, if a general answer to the question stated above has to be provided, then it is gender inequality. Our analysis indicates that decreasing gender inequality in both OECD and non-OECD countries would lead to substantially better PISA results.

The limitations of the study rest mainly in the fact that data were not available for all 78 countries or territories that participated in the PISA 2018 study, as eight countries had to be excluded through a lack of data. Africa was strongly under-represented, as only Morocco took part in the PISA 2018 study, but, unfortunately, it had to be excluded from this study due to the lack of other data. Additionally, the Gini index in the year 2018 was not available for several countries, and was replaced by older estimates from 2013. Moreover, it should be noted that inequality is a complex phenomenon that cannot be completely reduced to the three (currently existing and widely available) inequality indices applied in this study, and further progress on the quantitative measuring of inequality in society is necessary.

Conclusions

The aim of the paper was to present the results of the analysis of the relationship between inequality and students' performance in the PISA 2018 study.

Our results indicate that inequality, described in terms of income inequality, gender inequality, and education inequality, can indeed explain (along with three other, rather economic variables) the majority of observed data variance across countries. The most important and most statistically significant variable was the gender inequality index GII. The higher the GII, the lower the PISA scores. By contrast, the Gini index expressing income inequality was found to be insignificant as an explanatory variable. The inequality expressed by the education index EDU was statistically significant only in models encompassing all countries, but not in separate models for OECD countries and non-OECD countries, respectively. In the case of the CEE countries, only economic inequality expressed by the government expenditures and human development index was found to be highly statistically significant.

Moreover, we found that the relationship between GDP per capita and expenditure on education on the one hand, and PISA scores on the other, was statistically significant, but had a negative sign. Hence, the more money that is spent on education, the worse the educational outcomes. These somewhat counter-intuitive findings are in accord with previous studies, which reported that financial resources for education are expended inefficiently in many countries, and are prone to being wasted, see, e.g., Afonso and Aubyn (2006), Agasisti (2014), or Mazurek and Mielcová (2019).

Therefore, our recommendation to policymakers (which we consider the most important added value of the presented study) is simple: focus on decreasing gender disparity and the associated loss of achievement due to gender inequality, and PISA scores, as well as the associated skills and knowledge of students, will likely significantly improve in the majority of countries.

Acknowledgments

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Nierówności a wyniki badania umiejętności uczniów PISA 2018: porównanie międzykrajowe

Celem tego artykułu było zbadanie związku między wynikami badania PISA przeprowadzonego w poszczególnych krajach w 2018 r. a zestawem wskaźników związanych z nierównościami społeczno-ekonomicznymi, takimi jak indeks Giniego, wskaźnik rozwoju społecznego czy wskaźnik nierówności płci, oraz ze zmiennymi czysto ekonomicznymi, takimi jak PKB per capita i wydatki rządowe na edukację. Badaniem objęto 70 krajów, w tym 37 krajów OECD i 33 kraje spoza OECD. Metody badawcze obejmowały wielowymiarowe modele regresji liniowej, grupowanie k-średnich i grupowanie hierarchiczne. Wyniki przeprowadzonej analizy wykazały, że wskaźnik Giniego był statystycznie nieistotny, co wskazuje, że nierówności dochodowe miały niewielki wpływ na wyniki uczniów w badaniu PISA. Z drugiej strony, wskaźnik nierówności płci był jedyną najbardziej istotną statystycznie zmienną objaśniającą zarówno dla krajów OECD, jak i spoza OECD. Dlatego nasza rekomendacja dla decydentów jest prosta: należy zwiększyć wyniki uczniów w badaniu PISA, a tym samym osiągnąć poprawę w obszarze kapitału ludzkiego i konkurencyjności krajów, oraz skupić się na zmniejszaniu nierówności płci i związanej z tym utraty osiągnięć edukacyjnych wynikających z nierówności płci.

Keywords: edukacja, wskaźnik nierówności płci, indeks Giniego, nierówności, PISA

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