PREPRINT

Reference to this paper should be made as follows:

Halkos, G., Moll de Alba, J. and Todorov, V. (2021) "Economies' inclusive and green industrial performance: An evidence based proposed index", *Journal of Cleaner Production*, **279** (10 January 2021), https://authors.elsevier.com/c/1be2U3QCo9Yle1

Economies' inclusive and green industrial performance: An evidence based proposed index

George Halkos[a], Jaime Moll de Alba[b] and Valentin Todorov[b]

a) Department of Economics, University of Thessaly, Volos, Greece

b) United Nations Industrial Development Organization (UNIDO), Vienna, Austria

E-mail: halkos@econ.uth.gr
E-mail: J.Moll-de-Alba@unido.org
E-mail V.Todorov@unido.org

Abstract
This paper develops and introduces a new evidence-based tool to systematically measure and benchmark the industrial performance of economies with emphasis on their inclusive and green dimensions. By means of international data sources, we build up a composite index, the inclusive and green industrial performance (IGIP) index, which captures different dimensions of the industrial socio-economic inclusiveness and green performance of the world's economies. We carry out an analysis of 83 economies in 2016 to conclude that industrialized economies (Switzerland, Denmark, Germany, the Czech Republic and Austria) outperform significantly other economies even if we notice remarkable differences in performance among economies. Our analysis opens up new avenues for future research supporting new approaches for the structural transformation of economies in line with the aspirations put forward by the international 2030 agenda for Sustainable Development and the Sustainable Development Goals (SDGs).

Keywords: SDGs; green manufacturing; composite index; green industrial performance; inclusiveness; sustainable development.

Economies' inclusive and green industrial performance: An evidence based proposed index

Abstract
This paper develops and introduces a new evidence-based tool to systematically measure and benchmark the industrial performance of economies with emphasis on their inclusive and green dimensions. By means of international data sources, we build up a composite index, the inclusive and green industrial performance (IGIP) index, which captures different dimensions of the industrial socio-economic inclusiveness and green performance of the world's economies. We carry out an analysis of 83 economies in 2016 to conclude that industrialized economies (Switzerland, Denmark, Germany, the Czech Republic and Austria) outperform significantly other economies even if we notice remarkable differences in performance among economies. Our analysis opens up new avenues for future research supporting new approaches for the structural transformation of economies in line with the aspirations put forward by the international 2030 agenda for Sustainable Development and the Sustainable Development Goals (SDGs).

Keywords: SDGs; green manufacturing; composite index; green industrial performance; inclusiveness; sustainable development.

1. Introduction

Climate change is one of the most important issues that the world has faced in the last decades. The industrial revolution led to a new world, with a rapid economic growth and excessive usage of fossil fuels, which had a major negative impact on the environment (Höök & Tang, 2013). Global warming caused by human activities was, in 2017, 1ºC above pre-industrial levels and is expected to increase even more in the future (IPCC, 2018). The challenge that the industrialized world faces today is to maintain a high economic and social development and to minimize the environmental harm at the same time. Many countries have already made commitments to mitigate climate change and to transit to sustainable development, by changing the way that necessary but environmentally harmful sectors operate (Meena, 2013).

According to IEA, the field of industry consumed 2.820.887 thousand tonnes of oil equivalent in 2017, which counted as 29% of the world's total final energy consumption. At the same time, industry was responsible for approximately 19% of CO_2 emissions worldwide, since it led to the emission of 6.288 metric tons per capita in 2017. From 1990 to 2017, industry energy consumption was increased by 56.93% and industry related CO_2 emissions were increased by 57.31% (IEA, 2020). It is obvious that there is an urgent need to implement environmentally friendly measures and strategies in the field of industry, which would lead to a cleaner and energy-efficient production.

The industrial sector and its development are extremely important in every country, from an economic and social perspective, but often leads to environmental degradation that needs to be overcome in order to meet the Sustainable Development Goals (UNIDO, 2011). For the last two decades, since the early 2000s, many industries all over the world have started to show interest for measures that would lead to cleaner production and low environmental impact (Aksoy & Gonel, 2015).

Green industry refers to a sustainable way of production and consumption, where no environmental harm is caused throughout the production of the goods and their future lifecycle (UNIDO, 2011). Sustainability is the key in decision-making of the green industry and the goal is to minimize environmental damage that comes from the production or the consumption of its goods and services (Sarkar et al., 2013).

A transition to green industries has become more and more essential, especially since the large quantities of natural resources that have been consumed the last years have led to problems in energy supply and to an energy crisis. In addition, customers are more and more conscious and prefer to choose green products over products that harm the environment throughout their lifecycle. The last few years, governments and policy makers have implemented policies that favor the green industry sector (Chen et al., 2017). Green industry is considered to be necessary for developing a green economy (Chen et al., 2017) and an important step towards a sustainable future (Aksoy & Gonel, 2015).

Inclusive and sustainable industrial development (ISID) refers to all the services that promote all three dimensions of sustainable development (society, economy and environment) in the field of industry. It is an action that promotes industrialization, while minimizing environmental harm and promoting social integration and equity (Yuan et al., 2020). According to UNIDO (2015), for a successful implementation of inclusive and sustainable industrial development, it is important that higher levels of industrialization are achieved, while economic and social growth is promoted in an environmentally friendly framework and the benefits of industrial growth are distributed equally to everyone. In addition to that, it is important that knowledge, technology and innovation are shared and multi-stakeholder partnerships support every step towards inclusive and sustainable industrialization.

Inclusive and sustainable industrialization (ISID) is considered as an important part of the Sustainable Development Goal number 9, "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation", that promotes, among others, the increase of inclusive and sustainable industries' share until 2030 (UNGA, 2015). UNIDO (2015) has provided detailed programs for specific countries and conditions, which concern social inclusion, economic competitiveness and environmental sustainability, which could be implemented in order to support ISID and, therefore, SDG 9. To evaluate the progression in the promotion of ISID and in the raise of industry's share of employment and GDP, the United Nations use two indicators: Manufacturing value added as a proportion of GDP and per capita and Manufacturing employment as a proportion of total employment. In addition, to evaluate the progression of the industries to become more sustainable, the indicator used is: CO_2 emissions per unit of value added. Information about the progression of SDG 9 in 2019 shows that this goal does not have a rapid progress, due to the current global economic environment (United Nations, 2019).

To measure the progression of every SDG in country levels, a plethora of indicators has been proposed. Among others and specifically for ISID and green industry, Moll de Alba and Todorov (2018, 2020) developed the Green Industrial Performance Index (GIP index), an index that reflects the performance of countries in the field of green manufacturing. This index is inspired by the UNIDO's Competitive Industrial Performance Index (UNIDO, 2017) and provides a useful tool in the monitoring process of SDGs' performance and of inclusive and sustainable industrialization progression. The six quantitative indicators used to estimate the GIP index cover every aspect of green growth (economic, social and environmental) and two of them are similar to the ones that UNIDO uses to estimate the progression of SDG 9. These six indicators are:

- Green MVA per capita
- Green manufactured exports per capita
- Share of green MVA in total MVA
- Share of green manufactured exports in total manufactured exports
- Share of green manufacturing employment in total manufacturing employment
- CO_2 emissions from manufacturing per unit of manufacturing value added.

Moll de Alba and Todorov (2018) used their GIP index methodology to analyze the performance of 107 countries for 2014, compared it with that in 2011. They showed that industrialized economies have a much better performance compared to developing economies, while there seems to be a stability among the top and bottom countries in the period 2011-2014. Using a refined GIP index, the analysis of 104 economies for the period 2012-2015 Moll de Alba and Todorov (2020) reached similar conclusions.

Even though the GIP index in its current form faces specific limitations, it is considered to be a significant tool used to evaluate ISID and countries' progression towards the SDGs and sustainability. Additional research and the inclusion of more indicators could optimize the GIP index and would help to overcome the current limitations, evolving it into an important tool that will promote and support ISID, the SDGs and the 2030 Sustainable Agenda in general.

This paper makes a leading contribution to the existing body of knowledge by developing and introducing a new index that provides policy-makers and scholars with a straightforward and evidence based tool to measure and benchmark the performance of economies in terms of their inclusive and green industrial production. By introducing inclusiveness, the new IGIP index addresses the three dimensions of development, i.e., social, economic and environmental, contained in the 2030 Sustainable Development Agenda (UNGA, 2015) with emphasis on industrialisation. It is worth recalling that the 2030 Agenda places outmost importance on leaving no one behind so everyone takes part in the development process regardless of age, sex, economic status, etc. hence why we decide in this paper to add the social and economic dimensions of inclusiveness. Such additional dimension is closely linked to a number of Sustainable Development Goals (SDGs) including SDG 4 on inclusive and equitable quality education for all, SDG 5 that seeks to achieve gender equality and empower all women and girls, SDG 8 on good jobs and economic growth for all and SDG 10 to reduce inequality. The GIP index contributes to the research and policy debate on the measurement of inclusive and green industrial performance, which lies at the core of the SDGs.

2 Methodology and data sources

UNIDO's competitive industrial performance (CIP) index seeks to assess and benchmark national industrial competitiveness (UNIDO 2017). It is based exclusively on objective data measures and comprises eight indicators, coming from recognized international sources, which are usually used to benchmark the industrial performance and competitiveness of countries. Inspired by this leading index for measuring competitive manufacturing performance, Moll de Alba and Todorov (2018, 2020) developed a composite index (Green Industrial Performance, GIP, Index) which helps to gain an overall understanding of the status of green industry at the country level. This index can be used also as a complementary tool to the CIP index for analysing the sustainable industrial development at the country level. Now we extend this index to cover also the inclusiveness aspects of the competitiveness and the manufacturing performance. The selection of indicators that capture the various facets of green growth to form the GIP and their compilation were presented in detail in Moll de Alba and Todorov (2018, 2020). A further study of the rank shifts caused by extreme observations in sub-indicators using distribution-driven winsorisation approach to reduce the influence of extreme values on the composite index ranking, was proposed recently by Boudt et al. (2019). Therefore, here we will briefly review the approach, the framework and computation, and will focus on the changes that were introduced to the methodology.

For building the GIP index two equally important aspects of economic development were considered: the domestic production of goods and their international trade. For this purpose, both the share of green industrial production in the overall manufacturing production and the share of exported green products in the total exported manufacturing products are measured. Next to production, another important concept in our analysis is that of green jobs. These ideas can be wrapped up into a simple, straightforward framework, which captures different aspects of the country's green industrial performance through three key dimensions: (a) the capacity to produce and export green products; (b) the role of green manufacturing; and (c) the social and environmental aspects of green manufacturing. Each of these three dimensions is based on two underlying indicators with a summary of the indicators presented in Table 1. It is interesting to note that one of these indicators is closely related to the SDG 9 indicator "9.2.1: Manufacturing value added as a proportion of GDP and per capita" and another indicator is identical to the SDG 9 indicator "9.4.1: CO2 emission per unit of value added".

The most important component for measuring the indicators related to green industrial production and trade is a list of products considered 'green'. Different approaches to comprehensively list the products that qualify as 'green' have been developed for purposes of research but also to facilitate trade negotiations by reducing or removing tariffs. There is, however, no universally agreed definition of what constitutes such a list of green products. In Moll de Alba and Todorov (2020) a consolidated list of green products is developed, its properties are studied and its limitations and other issues are pointed out.

To calculate the composite index, values for all six sub-indicators must be available, and the dealing with missingness through imputation takes place before normalisation and aggregation. The procedures for handling missing data and outliers are described in Annex 2 of Moll de Alba and Todorov (2018).

To add a manufacturing related inclusiveness component to the index we will look for indicators which measure the participation of a broad range of people including the poor and marginalized, such as women and ethnic minorities as well as the equal distribution of wealth and economic opportunities. Thus, the green industrial performance will contribute to the development only if it is related to the inclusiveness in terms of employment, gender, education and income. The last on, the income inequality measure is general and not related to manufacturing while the others reveal the equal opportunities for access to employment, education and earnings of women in in manufacturing.

Table 1: Summary of the GIP indicators

		Indicator	Description	Source
		First dimension: *Capacity to produce and export green manufactures*		
	1	*GMVApc*	Green MVA per capita (current USD)	UNIDO INDSTAT[b)]
	2	*GMXpc*	Green manufactured exports per capita (current USD)	UN COMTRADE[c)]
		Second dimension: *Role of green manufacturing*		
	3	*GMVAsh*	Share of green MVA in total MVA (%)	UNIDO INDSTAT[b)]
	4	*GMXsh*	Share of green manufactured exports in total manufactured exports (%)	UN COMTRADE[c)]
		Third dimension: *Social and environmental aspects of green manufacturing*		
	5	*GEMPsh*	Share of green manufacturing employment in total manufacturing employment (%)	UNIDO INDSTAT[b)]
	6	*CO2VA*[a)]	CO2 emission from manufacturing per unit of manufacturing value added (ton/USD)	IEA[d)], UNIDO MVA[e)]

Notes:

a) Indicators for which higher values indicate lower performance in the measured phenomenon

b) UNIDO (2020b)

c) United Nations Statistics Division (2020)

d) OECD (2020a)

e) UNIDO (2020a)

An important criterion for the selection of the indicators is the availability of data over time and across countries. One important disadvantage of the composite indices is the fact that all sub-indicators must be present in order to compute the corresponding index; even if a single indicator is missing for a given country, this country has to be excluded from the index. Therefore, indicators that lack data for long periods or have very low coverage across countries will be excluded from consideration. Furthermore, the indicators must come from official, reliable data sources with clear methodology behind the data collection and estimation process and to be sustained also in the future. These four indicators are collected into one dimension, Inclusiveness, and they are added to the rest six indicators of GIP to form the new proposed index, Inclusive Green Industrial performance (IGIP) with a summary of these indicators presented in Table 2.

Table 2: Summary of the inclusiveness indicators in IGIP

		Indicator	Description	Source
		Fourth dimension: *Inclusiveness*		
	1	*FEMsh*	*Labor force participation of women in manufacturing* (in per cent)	ILO[b)]
	2	*GPG*	Gender pay ratio (in per cent)	ILO[c)]
	3	*EDUsh*	Share of female in relevant tertiary education (in per cent)	UIS[d)]
	4	*GINI*[a)]	Inequality measure	WB[e)]

Notes:

a) Indicators for which higher values indicate lower performance in the measured phenomenon

b) ILO (2020a) (c) ILO (2020b) (d) UIS (2020) (e) WB (2020)

Let us next describe the data sources and the methodology of data collection for each of the four additional indicators and then continue with a brief overview of the descriptive statistics of these indicators. Eventually, the computation of the index based on the 10 indicators will be briefly described.

2.1 Labor force participation of women in manufacturing (FEMsh)

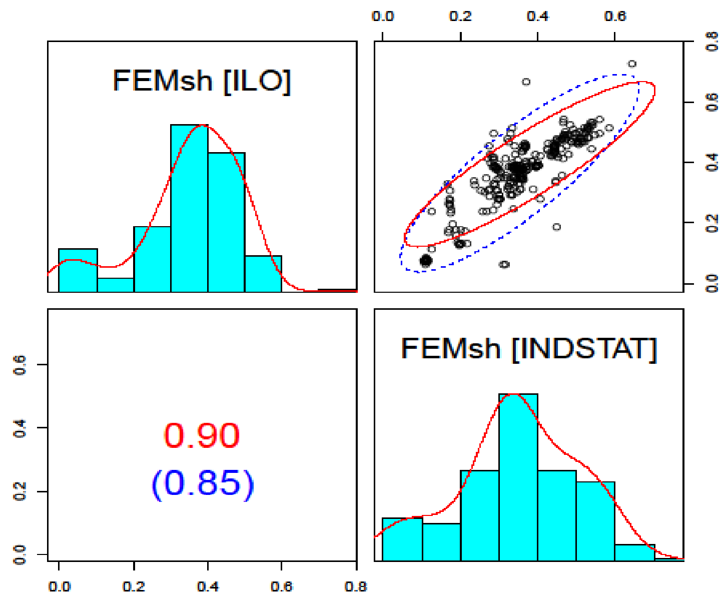
The first indicator to consider is the *labor force participation of women in manufacturing (FEMsh)* which is an important driver (and outcome) of growth and development. The most reliable source of these data are establishment surveys in manufacturing routinely done by the NSOs in the countries and maintained in the UNIDO Statistics database INDSTAT. However, not many countries report regularly these data to UNIDO and we could calculate the indicator for around 47 countries which is insufficient for the constructing of the index, therefore we turn to the ILO database ILOSTAT “Employment by sex and economic activity (thousands) 2006-2018“ (ILO, 2019). The employed comprise all persons of working age who, during a specified brief period, were in the following categories: a) paid employment (whether at work or with a job but not at work); or b) self-employment (whether at work or with an enterprise but not at work). The data are disaggregated by economic activity according the International Standard Industrial Classification of All Economic Activities (ISIC) (Revision 3 or Revision 4).

An economic activity refers to the main activity of the establishment in which a person worked during the reference period and does not depend on the specific duties or functions of the person's job, but on the characteristics of the economic unit in which this person works. Main data source is a kind of labour force survey however, for many developing countries, particularly in Africa, the data comes from Household surveys and also in a few cases the data come from population census, administrative sources or official estimates. The data source contains all available data for a given country, i.e. more then one survey is used for the same years. This leads to duplicated observations and we had to decide country by country which particular data item to choose.

From the ILO database we could extract 173 countries but many of them have data for only one single year (mainly in Africa) and on the other hand countries like China, Jordan, Lebanon, Kenya, Iraq and Congo are missing (i.e., even if data are provided, they are not disaggregated by sex). In 2016, 106 countries are present. The data are stored as integer numbers in thousands, which leads to loosing information for small numbers (for example Micronesia has in 2014 100% female occupation in manufacturing, because the numbers recorded are 1 and 0 (for female and male respectively).

We try to recover some of the missing countries from the INDSTAT database (UNIDO, 2020b) and first compare the indicator computed in these two databases. Figure 1 presents the correlation analysis of the two series. After removing several multivariate outliers (visible in the scatterplot in the top right panel), the correlation becomes 90%. The numbers in the bottom left panel are the robust (in red) and classical correlation. The top right panel presents a scatter plot of the indicators with 0.975 tollerance ellipses (robust and classical). Also, comparing visually the numbers (for countries and years where data in both database are available), we see that the differences are minimal. Therefore, we recover several countries (China, Jordan, Lebanon, Kenya, and Iraq) from INDSTAT and thus increase the number of countries to 180.

Figure 1: Correlation analysis of the indicator *female labour force participation in manufacturing* (FEMsh) computed from the two databases (ILOSTAT and INDSTAT).



Source: ILO (2020a) and UNIDO (2020b)

2.2 *Gender pay ratio (GPG)*

The second indicator of inclusiveness which we will consider is related to the gender pay gap (in manufacturing) which reflects inequalities that affect mainly women, notably horizontal and vertical segregation of the labour market. The strict definition of gender pay gap (OECD, 2020b) is "the difference between the median earnings of men and of women as a proportion of the median earnings of men". The most significant factors associated with the gender pay gap are part-time work, education and occupational segregation (less women in leading positions and in fields like STEM). The World Economic Forum provides data from 2015 that evaluates the gender pay gap in 145 countries. Their evaluations take into account also economic participation and opportunity, educational attainment, health and survival, and political empowerment scores but the data are useful only as a ranking, not in absolute values as estimates of wages disaggregated by sex. The indicator "Wage equality between men and women for similar work" was obtained from the World Economic Forum's Executive Opinion Survey, using the response to the survey question, "In your country, for similar work, to what extent are wages for women equal to those of men?" (1 = not at all, significantly below those of men; 7 = fully, equal to those of men). The data is then converted to a female-over-male ratio.

The gap is usually unadjusted (not corrected for gender differences in observable characteristics that may explain part of the earnings gap). Data on gender pay gap calculated by this formula are available from OECD (OECD, 2020b), but unfortunately only for the OECD countries. EUROSTAT uses mean instead of median to average the earnings, on an hourly base (EUROSTAT, 2020). ILO has also data on gender pay gap, however with relatively low coverage and disaggregated by occupation only. We cannot use any of these data sets to find the gender pay gap in manufacturing.

The most suitable data for calculating the gender pay gap, available from ILO, are the mean nominal monthly earnings of employees by sex and economic activity in local currency (ILO, 2020b). Data are disaggregated by economic activity according to the latest version of the *International Standard Industrial Classification of All Economic Activities (ISIC*) (United Nations, 2002, 2008) available for that year. Economic activity refers to the main activity of the establishment in which a person worked during the reference period and does not depend on the specific duties or functions of the person's job, but on the characteristics of the economic unit in which this person works. Using these data we will create a simple indicator to reflect gender pay gap – the ratio of women's average earnings to men's average earnings, expressed in percent. A ratio of 100 per cent indicates that there is no gender pay gap: women are paid the same as men while a ratio below 100 indicates that women earn less than men. From this data set we could calculate the gender pay ratio for 137 countries, but still countries like USA, India, China, and the Netherlands are missing. We were able to obtain data for some of these countries from other sources. Namely for the USA from we use data from US Department of Labor,[1] for India from UNIDO (2014), and for the Netherlands from United Nations Statistics Division (2015).

2.3 Share of female in relevant tertiary education (EDUsh)

The SDG framework has a specific goal on Education - SDG 4 adopts a lifelong learning approach to education and introduces vocational and tertiary education into the global agenda. It makes explicit reference to higher education, promising to "ensure equal access for all women and men to affordable and quality technical, vocational, and tertiary education, including university". The SDG 4 agenda provides a range of indicators to measure the participation and skills of individuals throughout their lives, encompassing levels in and outside compulsory education and considering a wide range of programmes.[2] As a most relevant to the inclusiveness in manufacturing we consider the indicator "Share of female in relevant tertiary education: Engineering, Manufacturing and Construction".

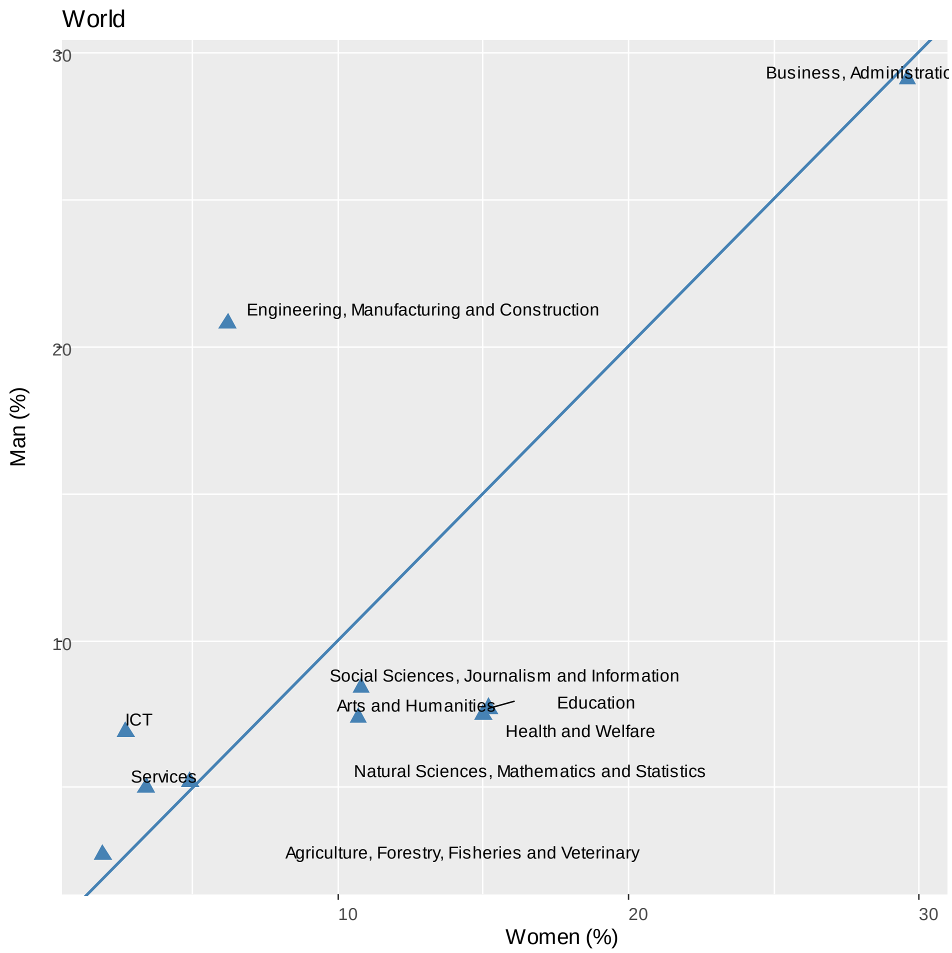
Data on this indicator is available from the UNESCO database (UIS 2020). There is already a large volume of work dedicated to measuring equity, and much of this work is founded in analysis of economic inequality. UNESCO has adapted such principles to education and has published a Handbook on Measuring Equity in Education (UNESCO, 2018). The gender gap in the participation rate of adults in formal and non-formal education varies greatly across countries, with women in some countries, and men in other countries, less likely to participate. In general, the gender gap favours girls in education, but men in the labour market (OECD, 2018).

Figure 2 presents the distribution of tertiary graduates by gender and field of study in 2016, averaged over all countries for which data were available. While some fields are on the equity line (Agriculture, Natural sciences, mathematics and statistics, Business, administration and law) others are significantly in favour of women, the field we are interested in, namely Engineering, Manufacturing and Construction, is strongly biased towards men.

Figure 2: Distribution of tertiary graduates by gender and field of study (2016) on average of all countries for which data were available in the world.

[1] https://www.dol.gov/wb/stats/NEWSTATS/facts/earn_earnings_ratio.htm#earn-genderratio

[2] A list of all the indicators and their methodologies is available at http://SDG4monitoring.uis.unesco.org.



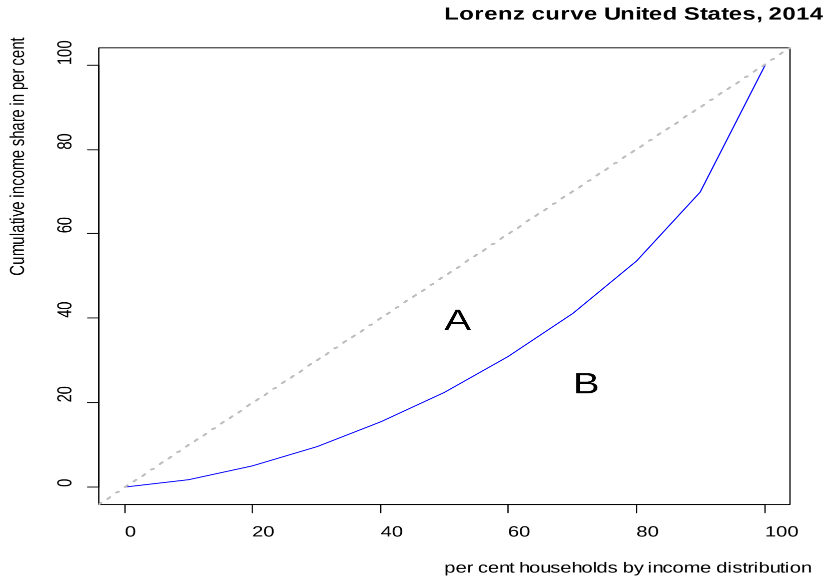
Source: UIS (2020)

2.4 Measuring inequality (GINI)

To compare and rank inequality of income distribution between countries we need an inequality measure, which could be a function that designates a value to a specific distribution of income within an economy. This mapping should be done in such a way that that allows direct and objective comparisons across different distributions. Several such measures are defined and used in the literature, starting from the simple graphical presentation through a Lorenz curve, different indices and ratios (United Nations, 2015).

The GINI index is the most widely cited measure of inequality, which measures the extent to which the distribution within an economy deviates from a perfectly equal distribution. The index can be defined graphically through the Lorenz curve, which plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. It is computed as the ratio of the area between the Lorenz curve and 45-degree line (a hypothetical line of absolute equality) to the area beneath the 45-degree line. In the example presented in Figure 3, it is equal to A/(A+B) with the dotted line presenting the line of perfect equality.

Figure 3: Example of a Lorenz curve (solid line)



The Gini coefficient yields a value between 0 and 1, with 0 signifying perfect equality and 1 signifying perfect inequality. According to World Bank data, between 1981 and 2013, the Gini index ranged between 0.3 and 0.6 worldwide. The coefficient allows direct comparison of two populations' income distribution, regardless of their sizes.

Our main data source is the World Bank (World Bank, 2020) but not all countries can be covered by these data. As a secondary data source we use the CIA World Fact Book (Central Intelligence Agency, 2020). From this data source we take China, Hong Kong SAR, Singapore, Saudi Arabia, Turkmenistan, Cambodia and New Zealand. The third source is Liberati (2015) where we found the GINI coefficient for Kuwait, Oman, and the United Arab Emirates. Several other countries come from different sources: Afghanistan and Qatar from the Human Development Report of the United Nations Development Program (2020) and New Zealand in 2014 from OECD (2020c).

2.5 Exploratory data analysis of the new indicators

Table 3 presents the descriptive statistics of the indicators. Additionally to the standard descriptive statistics (minimum, maximum, mean, median, standard deviation, first and third quartile) also the median absolute deviation (MAD), coefficient of variation (CV) and skewness are presented. The CV measures the relative variability by dividing the standard deviation by the mean and then multiplying by 100 to render a percent (in our case it makes sense to use CV since all indicators are nonnegative). The MAD, calculated as the median of the absolute deviations from the median and multiplied by a suitable consistency factor is a robust measure of scale, which differently from the standard deviation, will not be influenced by outliers in the data. The median and MAD are used to construct the boxplots shown in Figure 4, which are useful for detection of outliers. The skewness is the third standardized central moment of a distribution and if its values are far from zero, the distribution is skewed: to the left if the value of the skewness measure is negative and to the right if this value is positive.

The large gaps between the mean and median of subindicators GMVApc and GMXpc indicate that the sub-indicators have a skewed distribution with long tails. The large differences between the standard deviation (sd) and the median absolute deviation (MAD) also indicate that there are extreme values in these sub-indicators. The distribution of the four new indicators is much smoother.

Figure 4 indicates some outliers in the four new inclusiveness indicators. The outliers shown in blue colour are not that important, because these countries did not participate in the calculation of the final index (due to missing data in some of the other indicators), however the countries shown in red were included in the IGIP index.

Obviously, an obstacle in ours and in any similar research is the limited data coverage which forced us to drop a number of countries not reporting data during the considered period on particular indicators. The industrial production data has lower coverage than the international trade data. Employment and CO_2 emissions data are also missing for some countries. From the 104 countries which we analyzed on the GIP index in Moll de Alba and Todorov (2020) (reference year 2015) remained only 83 countries when we added the four new indicators on inclusiveness. It should be noted that in the meantime the GIP can be computed for two more countries (Niger and United Arab Emirates) which are already included in IGIP. Thus, there are 23 countries for which GIP can be computed but not IGIP. First of all, China was dropped out because it does not report data disaggregated by gender and thus neither GPG nor EDUsh could be computed. Similarly, data by gender is missing for Senegal and Turkmenistan. Brunei Darussalam was dropped because of missing data on GINI. For the following 11 countries data on education by gender (EDUsh) are missing: Bolivia, Botswana, Cameroon, Mauritius, Montenegro, Nigeria, Pakistan, Paraguay, Russian Federation, Tanzania and Yemen and finally, there are 8 countries without data on GPG: Iran, Iraq, Kenya, Kuwait, Lebanon, Morocco, Oman and Tunisia.

Only five African countries (Egypt, South Africa, Ethiopia, Niger and Ghana) report data on education and inequality.

2.6 Compilation of the index

Each of the ten indicators is normalized into the range [0, 1], with higher scores representing better outcomes (except for the two "negative" indicators, CO_2 emissions by manufacturing value added and GINI, for which lower values mean better performance). Normalization is carried out by the min-max method, where the minimum and maximum values of each indicator sample values are taken. This is done to enable aggregation, as the indicators have different measurement units. We do use geometric aggregation as aggregation method as under the geometric aggregation method, the index is constructed as a weighted geometric average of all sub-indicators, using equal weights for each indicator and each country.

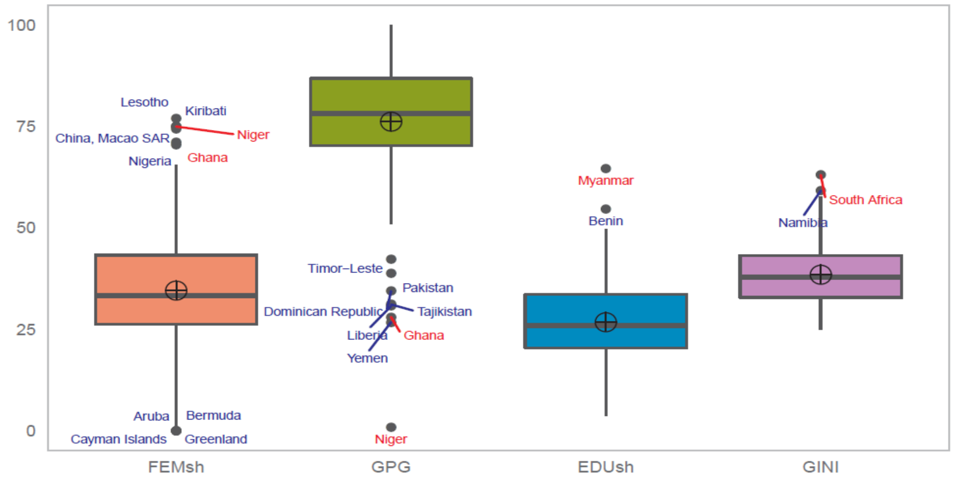
Table 3: Descriptive statistics of the indicators

Indicator	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	sd	MAD	CV	skewness
GMVApc	0.00	8.84	50.30	176.69	216.18	2310.08	0.17	0.03	1.81	3.97
GMVAsh	0.00	0.02	0.05	0.05	0.08	0.18	0.24	0.25	0.74	0.48
GEMPsh	0.00	0.02	0.06	0.06	0.08	0.21	0.24	0.25	0.73	0.64
GMXsh	0.00	0.03	0.07	0.07	0.10	0.40	0.17	0.15	0.78	2.82
GMXpc	0.08	25.32	179.62	581.78	709.19	4472.58	0.21	0.05	1.48	2.03
CO2VA	0.04	0.17	0.31	0.60	0.75	3.53	0.18	0.09	1.18	2.18
FEMsh	1.39	27.68	32.99	34.20	39.93	74.94	0.18	0.14	0.38	0.31
GPG	0.87	74.44	79.41	78.62	85.43	100.00	0.13	0.09	0.16	-2.67
EDUsh	6.02	21.72	27.04	27.61	32.68	64.59	0.16	0.14	0.33	0.71
GINI	25.00	30.88	34.60	35.73	39.72	63.00	0.20	0.24	0.20	0.99

Source: Authors' calculations based on the sources listed in **Table 1 and Table 2.**

Note: MAD is the median absolute deviation from the median and CV is the coefficient of variation.

Figure 4: Outliers in the four new inclusiveness indicators



Source: Authors' calculations based on the sources listed in Table 2.

3. Analysis of inclusive and green industrial performance of economies using IGIP index

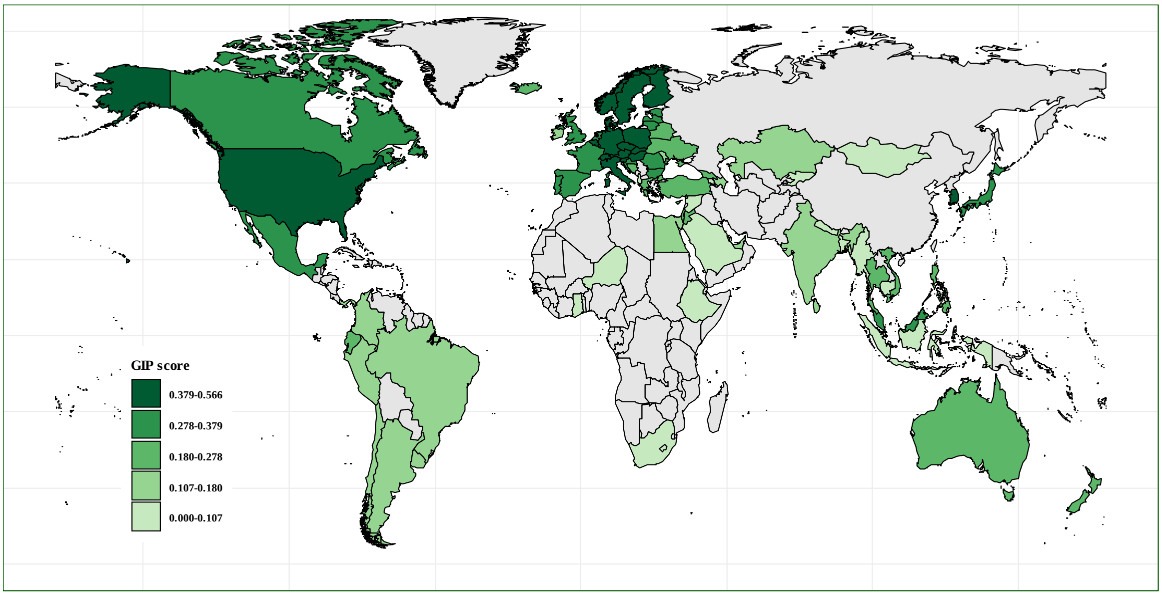
The ultimate objective of the IGIP index is to enable gaining a comparative overview of the inclusive and green industrial performance at the economy level. Having already introduced the IGIP index and its components as well as the methodological approach, we proceed to calculate it. In this section, we undertake an analysis of the inclusive and green industrial performance and progress over time of those economies. Due to data availability, we can compute the IGIP index and its components for as many as 83 economies in 2016. Readers can find the 2016 IGIP index and its components in Annex, Table A1.

Figure 5 serves to illustrate graphically the significant differences among economies in terms of the IGIP values in 2016. The darker an economy is shadowed, the higher its IGIP index is. The index ranges as widely as from 0.566 in Switzerland to almost nil in Niger. The below map also serves to underline the very limited coverage of African economies due to the lack of the necessary data to compute the IGIP index. Out of 54 African economies only five, namely, Egypt, Ethiopia, Ghana, Niger and South Africa, are included in our analysis. Moreover, it is also worth noting that, unfortunately, Russia and China are missing from our sample. In both cases, data on education by gender was missing. Moreover, China provides data on salaries by gender only at the aggregate level with data for manufacturing not been available.

Our future research extension will endeavour to find alternative ways to estimate the IGIP index for additional African economies and thus enlarge the IGIP index population.

Figure 5: Distribution of IGIP index worldwide in 2016

Distribution of the IGIP index score on the world map, 2016.



Source: Annex, Table A1

It is worth noticing that in 2016, industrialized economies top the IGIP ranking. Switzerland, Denmark, Germany, the Czech Republic and Austria hold the five first IGIP positions in 2016 with values that range from 0.566 to 0.466. It is also interesting to see that a similar pattern emerged from our earlier research (Moll de Alba and Todorov, 2020) contained in the latest version of the Green Industrial Performance index which did not consider inclusiveness, and for which Denmark, Singapore, the Republic of Korea, Germany and the Czech Republic were the top five GIP performers in 2015.

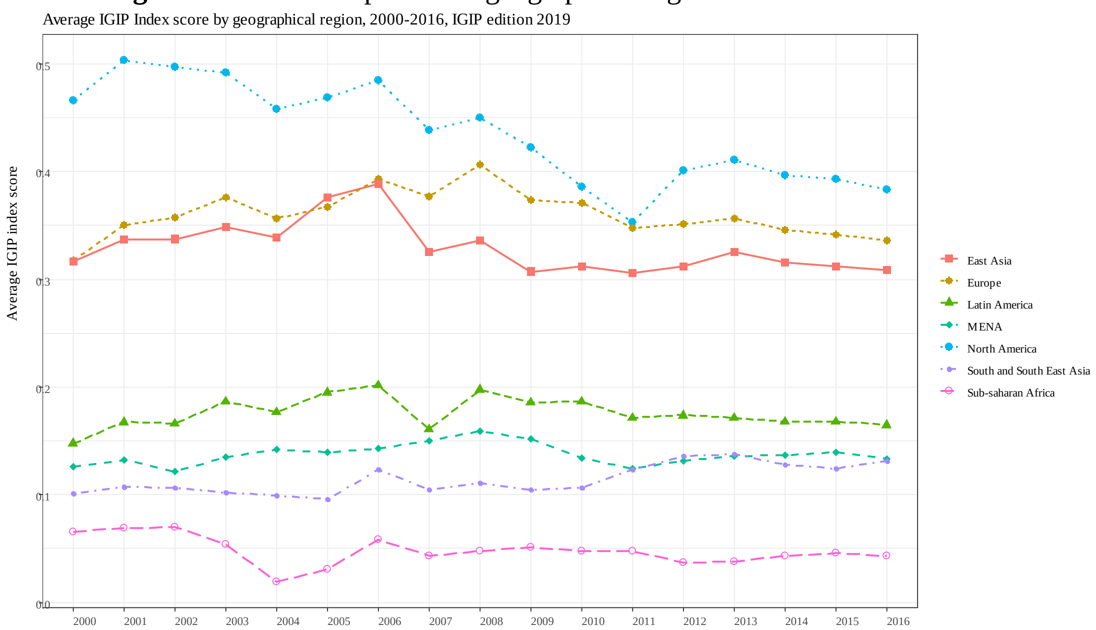
Coming back to our IGIP index, it is worth stressing that 25 industrialized economies rank among the 26 IGIP index performers in 2016 with the sole exception of Poland, an emerging industrial economy that ranks 16th. It is also noticeable that the best-ranked developing economies top the bottom half of our IGIP population with Bosnia Herzegovina, Vietnam, Ecuador, Georgia and Jordan in positions 43 to 47. All seven LDCs included in our population are in the bottom quintile starting with Myanmar and Bangladesh in ranks 68 and 69, respectively. Turkey (36), Thailand (37), and Ghana (70) top the rankings within the MENA region, South and Southeast Asia and Sub-Saharan Africa, respectively.

We are interested in analysing and presenting the changes of our index per quintile as well as those economies that experienced significant changes over time in their rankings. Whereas, during the period from 2013 to 2016, we observe overall stability in the rankings of economies, a limited number of economies moved from one quintile to one other. All in all, 16 economies out of 83 changed quintiles in that period. Poland moved up from the upper middle to the top quintile while Norway, France and Canada experienced the opposite move. Mexico, the best performer in the LAC region, and Japan moved to the upper-middle quintile whereas Australia and Luxembourg dropped to the middle quintile. Indonesia and Kyrgyzstan dropped from the lower-middle to the bottom quintile.

Moreover, some economies made remarkable progress in terms of IGIP ranking including Iceland, which moved from the bottom to the middle quintile, Vietnam and Malta gaining 38, 10 and 9 positions, respectively. One can look at the various components of the IGIP index and seek to understand what has led the changes of a given economy. In the case of Iceland, for instance, the significant move, i.e. 38 positions in the ranking, was led by a very significant increase in green MVA and manufactured exports per capita that reached US$ 289.62 and US$ 208.09 in 2016 compared to US$120.95 US$ 146.65 in 2013, respectively. The shares of both indicators increased significantly to reach 4.55% (GMVAsh) and 2.45% (GMXsh) Iceland also experienced a significant increase of its green employment share that reached 4.73% in 2016. On the other hand, the emissions per unit of MVA increased during the same period from 0.198 to 0.245 kg, which leads us to think that there is room for improvement on this particular area.

At the same time, other economies experienced a significant drop including Ukraine, Indonesia and Kyrgyzstan that lost 11 positions, as well as Ireland and Albania, which dropped by 15 and 51 positions, respectively. When looking at the IGIP components of Albania, one can conclude that its decline in terms of IGIP ranking over the period 2013-2016 is explained mainly by the vanishing of its 2013 US$19.20 green MVA per capita and 4.93% green employment share. Figure 6 provides us an analysis of the IGIP index per world geographical region.

Figure 6: IGIP index per world geographical region

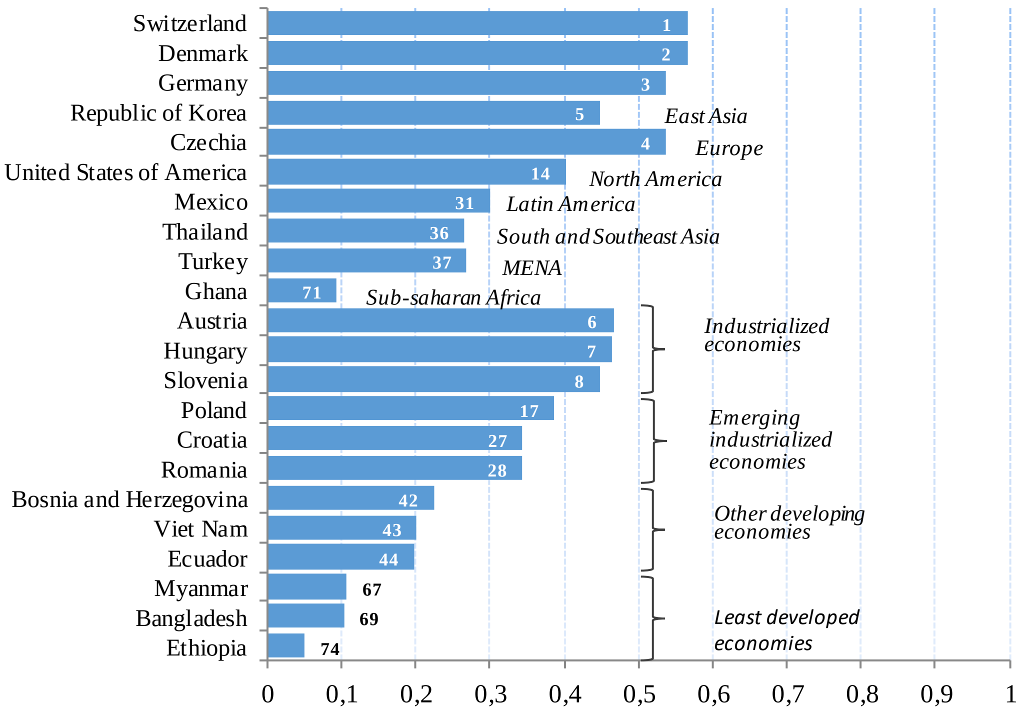


Source: Authors' calculations based on the sources listed in Table 1 and Table 2.

Despite remaining on the top region in terms of IGIP, North America lost ground compared to other world regions and its index dropped significantly from 0.466 to 0.383 during 2000-2016. Europe experienced some improvement as proven by its index that increased from 0.317 to 0.336 while East Asia declined slightly to reach 0.308 in 2016. With significant lower values, Latin America, MENA and South and South East Asia displayed a moderate improvement in their IGIP to reach 0.165, 0.133 and 0.131 in 2016, respectively. Sub-Saharan Africa remained at the bottom and its IGIP index fell further during the period to reach a low value of 0.0433 in 2016.

Figure 7 presents the scores and ranks of the top performers in the whole sample, as well as per region and development grouping (see Upadhyaya 2013 for the industrial development groupings we use in this article). In its three sections, the figure shows (a) the top three countries; (b) the leaders in the geographical regions and (c) the top three countries leading each of the four development groups. If a country is already listed in the top three, then the runner-up is highlighted in the group of regional leaders. Similarly, if a country is included in the group of regional leader, the runner-up will come in first among the development group leaders. For example for industrialized economies, six countries perform better than Republic of Korea, but these have already been listed above, namely Denmark, Switzerland, Germany and Singapore as they all perform better than Republic of Korea. In each bar is shown the rank of the country and the slider on the right shows the change of the rank in 2016 compared to 2013.

Figure 7. Scores and ranks of the top performing countries in the IGIP Index



Source: Authors' calculations based on the sources listed in Table 1 and Table 2.

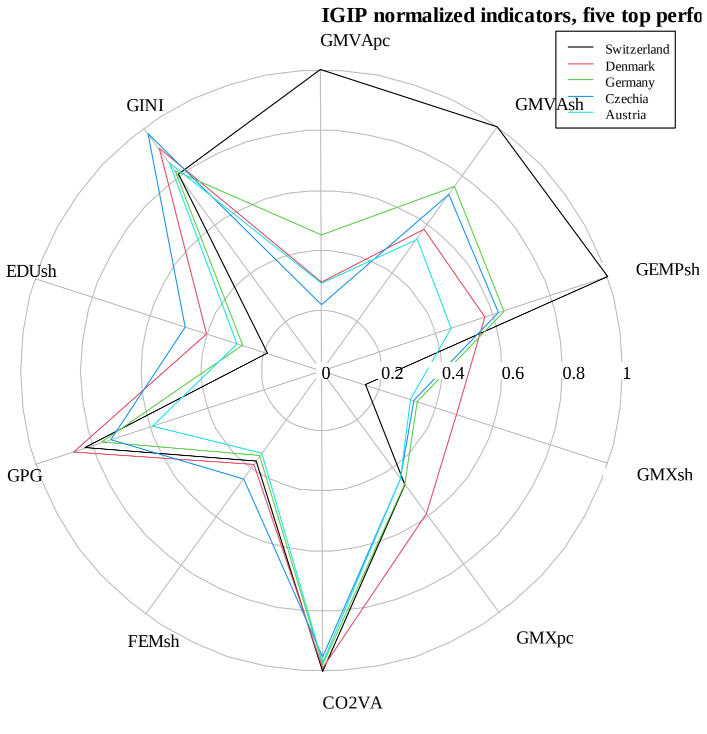
We are particularly interested in looking at the performance of countries in each of the ten IGIP components in 2016. The IGIP top ranking economy, Switzerland with US$ 2,293.49 MVA per capita more than doubled the value per capita of Germany with US$ 1,033.93, second economy in this IGIP component and almost tripled that of the third economy, the Republic of Korea with US$774.26. Similarly, Switzerland with 17.8% GMVA share significantly outperformed Germany with 13.4% and the Republic of Korea with 12.9%. Switzerland also tops the sample when looking at the green manufacturing employment share with 21 followed by, once more, Germany with 13.4% and, surprisingly, by Azerbaijan with 13.23%. A radically different picture emerges when looking at the value of green manufactured exports per capita. Singapore tops our sample with US$4,322.55 with a significant lead over China, Hong Kong SAR and Denmark with US$2,882.85 and US$2,552.18, respectively.

If one focuses on the share of green manufactured exports and in line with our previous research, one notices that Trinidad and Tobago with 40.3% tops the sample, probably due to the limited size of its manufacturing sector and concentration in a limited number of products, followed by Denmark and Hungary with 19.1% and 14.4%, respectively. Also consistent with our previous research, Ireland and Switzerland outperform other countries when looking at their emissions in kg per unit of MVA with 0.038 and 0.041, respectively. In the following paragraphs, we focus on the inclusiveness indicators comprised in the IGIP index. In terms of labour force participation of women in manufacturing, Niger, Ghana, Cambodia and Ethiopia led our sample with more than 60% in 2016. When looking at the gender pay gap in manufacturing, Panama jointly with some Gulf countries, likely due to the limited number of female working in the manufacturing sector and focusing on high-end activities, topped our sample in 2016. Myanmar and Uruguay topped the EDU sh whereas Ukraine, Belarus, Slovenia and Czechia displayed the lowest inequality measured with the GINI coefficient.

We further analyse the performance of Switzerland, Denmark, Germany, Czechia and Austria, the top five performers in 2016 in terms of the ten IGIP components. For that purpose, Figure 8 seeks to summarise such performance by making use of a radar-type chart that presents the normalised scores of the ten IGIP components.

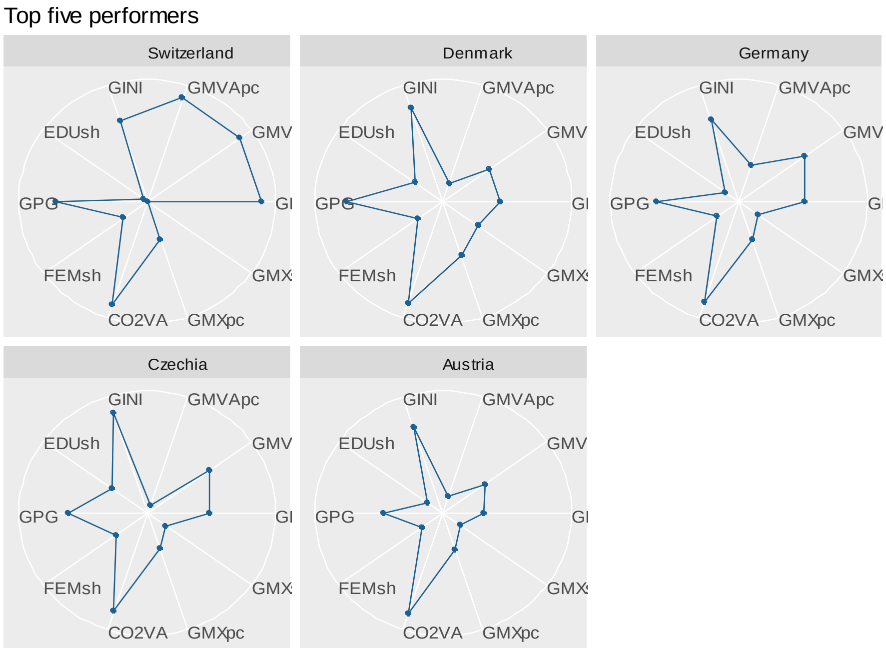
The first conclusion that one can draw from the below figure is the diverse performance of the top ranking economies when focusing on different IGIP indicators. Switzerland, IGIP top performer in 2016, outperforms other economies in both per capita and share terms of GMVA, as well as in terms of GEMP share. While Switzerland performs well in terms of CO_2 emissions, the country displays significant room for improvement in terms of green manufactured exports share –as well as per capita–, EDUsh and inequality. Denmark outperforms this group in GMX pc and GPG and has potential to improve in green MVA and green employment share. Germany shows room for improvement in inequality and EDUsh. Czechia performs comparatively poorly in green MVA per capita while Austria could improve in most components, particularly in GMVAsh, GEMPsh and GPG.

Figure 8: Radar-type chart presentation of the IGIP normalized scores



Source: Authors' calculations based on the sources listed in Table 1 and Table 2.

Figure 9: Radar-type charts of the IGIP normalized scores for the top five performs

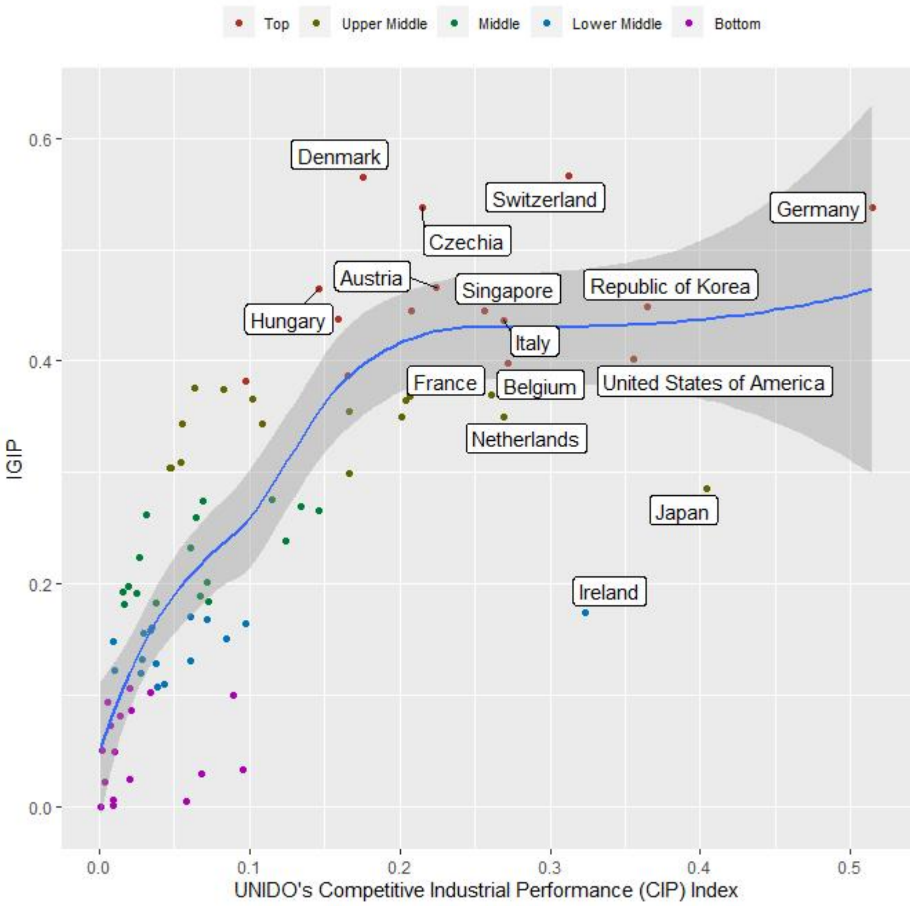


Source: Authors' calculations based on the sources listed in Table 1 and Table 2.

To illustrate the different performance of the top five performers in each IGIP indicator and underline areas that might offer room for potential improvement, we also produce individual radar-type charts for each of those countries (see Figure 9).

Making use of a Pearson correlation (0.69), we compare the IGIP scores with UNIDO's competitive industrial performance index CIP index scores for countries for which both indices are computed. The CIP serves to assess and benchmark national industrial competitiveness. In figure 10, which shows a scatterplot of IGIP scores against CIP scores, three groups of countries seem to emerge. We can first identify a group of countries such as Denmark, Czechia and Switzerland that outperform in terms of IGIP compared to their CIP performance. Then we see a cluster of countries that perform very well in terms of both the IGIP and CIP including Germany, the Republic of Korea and Singapore. Finally, we notice a group of countries such as Japan and Ireland that perform better in terms of the CIP index than on the IGIP index. Further research including an in-depth analysis of the existing national policy frameworks related to industrial, environmental and inclusiveness issues would be helpful to shed light on the above different patterns of performance.

Figure 10: Correlation of the IGIP index with UNIDO's Competitive Industrial Performance (CIP) index



Source: Authors' calculations based on the sources listed in Table 1 and Table 2 as well as UNIDO 2020(c).

4. Conclusions

In this paper, we compute the new proposed IGIP index and calculate the indicators it comprises for 83 economies for the period 2013–2016. Our analysis underlines the significant differences among economies in terms of their inclusive and green industrial performance as measured by the IGIP index. It is worth underlining that industrialised economies top the IGIP ranking. Switzerland, Denmark, Germany, the Czech Republic and Austria, which are the top performers in 2016, show different patterns of performance when one analyses how they do in terms of each IGIP indicator. It is also noticeable that despite a general stability, a restricted number of economies experienced significant changes in their rankings, e.g. Iceland moved up by 38 places during 2013-2016. Finally, while Europe managed to reduce the gap with North America, the IGIP top region whose performance declined over the period 2013-2016.

The IGIP index offers an evidence-based tool, which builds upon data produced by international sources ensuring their comparability and reliability, to monitor over time and benchmark the inclusive and green industrial performance of the economies of the world. Compared to our earlier GIP index, which focused exclusively on green industrial performance, the IGIP index fills a gap in the existing body of knowledge as it equips policy-makers and scholars with a sound tool to gain an understanding of the status of green and inclusiveness dimensions of industry at the country level.

A limitation of the study (and in any similar research) is the limited data coverage which forced us to drop a number of countries not reporting data during the considered period on particular indicators. Details on the difference in coverage between GIP (Moll de Alba and Todorov, 2020) and IGIP are given in Section 2.5. One approach is to look for alternative sources in such cases, but we investigated also other methods for imputation of missing data, particularly multiple imputations that draw many different estimates for each missing observation and the final result is obtained as average of all trials. One avenue to study is the multiple imputation with state space model proposed by Lin et al. 2019 which extends the multiple imputation by chain equations (MICE) of Buuren and Groothuis-Oudshoor (2011) to time series data. Another method that worth studying is AMELIA, developed by Honaker and King (2010) specifically to deal specifically with time-series cross-section data at the country-level (see also Castellacci and Natera, 2011). The preliminary results look promising, and we intend to follow and further explore this approach in our future research. When applying such novel imputation methods it will be of prime importance to study how these methods as well as other modelling choices contributing to uncertainty, affect the final IGIP index.

Another important issue are the rank shifts caused by extreme observations in sub-indicators, which can be investigated using the distribution-driven winsorisation approach as proposed recently by Boudt et al. (2019).

Future research to enhance the IGIP index underlying methodology and to enlarge its geographical coverage will certainly provide policy-makers and practitioners with a sound mechanism to measure and benchmark the status and progress of inclusive and green industrial performance of the world economies. This will, in turn, make a substantial contribution to the ongoing policy debate about the most appropriate tools and mechanism to achieve the objectives set up by the international community in the framework of the 2030 agenda for Sustainable Development and which are encapsulated in the Sustainable Development Goals (SDGs).

References

Aksoy, T., & Gonel, F. (2015) How green is my industry? The case of Turkey. *World Journal of Science, Technology and Sustainable Development*.

Boudt, K., Todorov, V., & Wang, W. (2020) Robust Distribution-Based Winsorization in Composite Indicators Construction, Social Indicators Research, [online] https://doi.org/10.1007/s11205-019-02259-w

Buuren, S., & Groothuis-Oudshoor, K. (2011) MICE: Multivariate imputation by chained equations in R. *Journal of Statistical Software,* 45(3), 1–67.

Castellacci, F., & Natera J. M. (2011). A new panel dataset for cross-country analyses of national systems, growth and development (CANA). Innovation and development, 1, 205-226.

Central Intelligence Agency (2020) The World Factbook [online] https://www.cia.gov/library/publications/the-world-factbook/rankorder/rawdata_2172.txt (Accessed May 2020)

Chen, W., Chen, J., Xu, D., Liu, J., & Niu, N. (2017) Assessment of the practices and contributions of China's green industry to the socio-economic development. *Journal of Cleaner Production*, 153, 648-656.

Eurostat (2020) Gender pay gap in unadjusted form [online] https://ec.europa.eu/eurostat/web/products-datasets/product?code=tesem180 (accessed May 2020)

Honaker, J., King, G. & Blackwell, M. (2011) Amelia II: A Program for Missing Data. *Journal of Statistical Software*, 45(7), 1–47. http://www.jstatsoft.org/v45/i07/

Höök, M., & Tang, X. (2013) Depletion of fossil fuels and anthropogenic climate change—A review. *Energy policy*, 52, 797-809.
IEA. (2020) *Data and statistics*. Retrieved from https://www.iea.org
ILO (2020a) Employment by sex and age (thousands) – Annual. *ILOSTAT database*, [online] https://ilostat.ilo.org/data. Accessed 14-02-2020.
ILO (2020b) Mean nominal monthly earnings of employees, by sex and economic activity. *ILOSTAT database*, [online] https://ilostat.ilo.org/data. Accessed 14-02-2020.
IPCC. (2018) Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate. In Press.
Liberati P. (2015) The World Distribution of Income and its Inequality, 1970–2009, Review of Income and Wealth, Vol. 61, Issue 2, pp. 248-273
Lin, J., Monga, C. & Standaert, S. (2019) The Inclusive Sustainable Transformation Index. *Social Indicators Research*, 143 47-80
Meena, R. (2013) Green banking: As initiative for sustainable development. *Global Journal of Management and Business Studies*, 3(10), 1181-1186.
Moll de Alba, J., & Todorov, V. (2018) Green industrial performance: the GIP index. World Review of Science, *Technology and Sustainable Development*, 14(2-3), 266-293.
Moll de Alba, J., & Todorov, V. (2020) Measurement of green industrial performance: An enhanced GIP index, Int. J. Environment and Sustainable Development, Vol. 19, No 4, 343-366
OECD (2018) Education at a Glance 2018: OECD Indicators, OECD Publishing, Paris, https://doi.org/10.1787/eag-2018-en.

OECD (2020a) *CO2 Emissions from Fuel Combustion Statistics*, OECD: Paris [online] https://www.oecd-ilibrary.org/energy/data/iea-co2-emissions-from-fuel-combustion-statistics_co2-data-en (accessed April 2020)
OECD (2020b) "Gender wage gap" (indicator), https://doi.org/10.1787/7cee77aa-en (Accessed on 27 May 2020).
OECD (2020c) Income Distribution Database (IDD): Gini, poverty, income, Methods and Concepts [database] https://stats.oecd.org/Index.aspx?DataSetCode=IDD (Accessed may 2020)
Sarkar, A. N. (2013) Promoting eco-innovations to leverage sustainable development of eco-industry and green growth. *European Journal of Sustainable Development*, 2(1), 171-171.
UNGA (2015) Transforming our world: the 2030 Agenda for Sustainable Development, United Nations General Assembly available at [accessed 24 May 2020]: https://www.refworld.org/docid/57b6e3e44.ht ml
UNGA) (2015) *Resolution Transforming our world: the 2030 Agenda for Sustainable Development*, A/RES/70/1, United Nations General Assembly (, New York.
United Nations (2002) *International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3.1*, Statistical Papers Series M NO. 4/REV.3.1, New York
United Nations (2008) *International Standard Industrial Classification of All Economic Activities Revision 4*, Statistical Papers Series M NO. 4/REV.4, New York
United Nations Development Program (2020) Human Development Reports: Income Gini coefficient [online] http://hdr.undp.org/en/content/income-gini-coefficient (Accessed May 2020)
United Nations (2015) Development Issues No. 2: Inequality Measurement. Department of Economic and Social Affairs [online] https://www.un.org/en/development/desa/policy/wess/wess_dev_issues/dsp_policy_02.pdf (accessed May 2020)
United Nations Statistics Division (2015) The World's Women 2015 Trends and Statistics [online] https://unstats.un.org/unsd/gender/downloads/WorldsWomen2015_report.pdf (Accessed May 2020)

United Nations Statistics Division (2020) *UN COMTRADE*. New York [online] https://comtrade.un.org/ (accessed April 2020)
UNIDO. (2011) *UNIDO Green Industry Initiative for Sustainable Development*. Vienna, Austria.
UNIDO (2014) Proceedings of the International Seminar on Industrial Statistics "20 years in Service of the Nations for Industrialization, Vienna 2014" [online] https://stat.unido.org/content/publications/proceedings-of-the-international-seminar-on-industrial-statistics-%252220-years-in-service-of-the-nations-for-industrialization%252c-vienna-2014%2522 (Accessed may 2020)
UNIDO (2015) *Introduction to UNIDO – Inclusive and Sustainable Industrial Development*. Vienna, Austria.
UNIDO (2017) Competitive Industrial Performance Report 2016, Vols. 1–2, Vienna [online] http://stat.unido.org (accessed February 2018)
UNIDO (2020a) *MVA Manufacturing Value Added Database*, Vienna, Austria [online] http://stat.unido.org (accessed April 2019)
UNIDO (2020b) INDSTAT 4 Industrial Statistics Database at 3- and 4-digit level of ISIC Revision 3 and 4. Vienna, [online] http://stat.unido.org (accessed April 2019)
UNIDO (2020c) Competitive Industrial performance (CIP) Index, edition 2019. Vienna, [online] http://stat.unido.org (accessed April 2019)
Upadhyaya, S. (2013) *Country Grouping in UNIDO Statistics*, Development Policy, Statistics and Research Branch Working Paper 1/2013, Statistics Unit UNIDO, Vienna.
UIS (2018) Handbook on Measuring Equity in Education, UNESCO Institute for Statistics, Montreal, http://uis.unesco.org/sites/default/files/documents/handbook-measuring-equity-education-2018-en.pdf (accessed on 30 March 2020).
UIS (2020) Education: Distribution of tertiary graduates by field of study [database] http://data.uis.unesco.org/ (Accessed May 2020).
United Nations. (2019) Sustainable Development Goal 9. Retrieved from Sustainable Development Goals Knowledge Platform: https://sustainabledevelopment.un.org/sdg9
Yuan, Q., Cheng, C. F. C., Wang, J., Zhu, T. T., & Wang, K. (2020) Inclusive and sustainable industrial development in China: An efficiency-based analysis for current status and improving potentials. *Applied Energy*, 268, 114876.
World Bank (2020) GINI index (World Bank estimate) [indicator] https://data.worldbank.org/indicator/SI.POV.GINI (Accessed April 2020)

ANNEX

Table A1: Green Industrial Performance Index and its rankings with country groups by industrialization level, quintile and change during 2013-2016

Quintile	Rank 2016	Country group	Country	Score 2016	Rank 2013	Score 2013	Change in rank 2013-2016
TOP	1	IND	Switzerland	0.566	2	0.592	1
TOP	2	IND	Denmark	0.566	1	0.631	-1
TOP	3	IND	Germany	0.538	4	0.562	1
TOP	4	IND	Czechia	0.538	3	0.587	-1
TOP	5	IND	Austria	0.466	6	0.510	1
TOP	6	IND	Hungary	0.465	5	0.512	-1
TOP	7	IND	Republic of Korea	0.449	8	0.480	1
TOP	8	IND	Slovenia	0.449	7	0.496	-1
TOP	9	IND	Singapore	0.445	11	0.456	2
TOP	10	IND	Sweden	0.445	10	0.463	0

TOP	11	IND	Slovakia	0.438	13	0.443	2
TOP	12	IND	Italy	0.436	9	0.479	-3
TOP	13	IND	Finland	0.429	12	0.454	-1
TOP	14	IND	United States of America	0.401	14	0.422	0
TOP	15	IND	Belgium	0.398	15	0.414	0
TOP	16	EIE	Poland	0.386	19	0.394	3
TOP	17	IND	Norway	0.382	18	0.399	1
U-MID	18	IND	Estonia	0.375	24	0.357	6
U-MID	19	IND	Lithuania	0.374	25	0.355	6
U-MID	20	IND	France	0.370	16	0.404	-4
U-MID	21	IND	United Kingdom	0.368	20	0.371	-1
U-MID	22	IND	Portugal	0.365	26	0.354	4
U-MID	23	IND	Canada	0.365	17	0.400	-6
U-MID	24	IND	Malaysia	0.355	27	0.353	3
U-MID	25	IND	Spain	0.350	21	0.367	-4
U-MID	26	IND	Netherlands	0.350	22	0.365	-4
U-MID	27	EIE	Croatia	0.344	23	0.363	-4
U-MID	28	EIE	Romania	0.343	29	0.326	1
U-MID	29	EIE	Bulgaria	0.309	30	0.322	1
U-MID	30	IND	Trinidad and Tobago	0.304	33	0.313	3
U-MID	31	EIE	Latvia	0.303	28	0.335	-3
U-MID	32	EIE	Mexico	0.299	34	0.308	2
U-MID	33	IND	Japan	0.285	35	0.292	2
MID	34	IND	Australia	0.276	31	0.317	-3
MID	35	IND	Luxembourg	0.274	32	0.315	-3
MID	36	EIE	Turkey	0.269	39	0.271	3
MID	37	EIE	Thailand	0.265	40	0.263	3
MID	38	IND	Iceland	0.262	76	0.040	38
MID	39	IND	New Zealand	0.259	37	0.283	-2
MID	40	IND	Israel	0.239	44	0.234	4
MID	41	EIE	Greece	0.232	42	0.253	1
MID	42	DEV	Bosnia and Herzegovina	0.224	43	0.235	1
MID	43	DEV	Viet Nam	0.202	53	0.175	10
MID	44	DEV	Ecuador	0.197	45	0.209	1
MID	45	DEV	Georgia	0.192	41	0.253	-4
MID	46	DEV	Jordan	0.192	46	0.203	0
MID	47	IND	Belarus	0.189	52	0.176	5
MID	48	DEV	Philippines	0.184	48	0.189	0
MID	49	EIE	Ukraine	0.183	38	0.283	-11
MID	50	EIE	Cyprus	0.181	47	0.197	-3
L-MID	51	IND	Ireland	0.174	36	0.286	-15
L-MID	52	EIE	Argentina	0.170	50	0.182	-2
L-MID	53	IND	United Arab Emirates	0.168	54	0.174	1

L-MID	54	EIE	Brazil	0.164	49	0.186	-5
L-MID	55	EIE	Colombia	0.160	57	0.156	2
L-MID	56	EIE	Egypt	0.158	55	0.166	-1
L-MID	57	DEV	Sri Lanka	0.156	56	0.162	-1
L-MID	58	EIE	India	0.151	59	0.146	1
L-MID	59	DEV	Azerbaijan	0.148	65	0.116	6
L-MID	60	DEV	Panama	0.132	64	0.120	4
L-MID	61	EIE	Chile	0.131	61	0.138	0
L-MID	62	EIE	Kazakhstan	0.128	67	0.106	5
L-MID	63	DEV	Republic of Moldova	0.122	60	0.142	-3
L-MID	64	EIE	Uruguay	0.120	63	0.129	-1
L-MID	65	EIE	Peru	0.110	66	0.114	1
L-MID	66	IND	Malta	0.107	75	0.060	9
BOTTOM	67	LDC	Myanmar	0.106	69	0.098	2
BOTTOM	68	LDC	Bangladesh	0.102	70	0.098	2
BOTTOM	69	EIE	Indonesia	0.100	58	0.150	-11
BOTTOM	70	DEV	Ghana	0.094	71	0.093	1
BOTTOM	71	IND	China, Hong Kong SAR	0.087	68	0.100	-3
BOTTOM	72	DEV	Armenia	0.081	72	0.088	0
BOTTOM	73	DEV	Kyrgyzstan	0.073	62	0.134	-11
BOTTOM	74	LDC	Ethiopia	0.050	79	0.028	5
BOTTOM	75	DEV	Mongolia	0.050	73	0.071	-2
BOTTOM	76	EIE	Saudi Arabia	0.033	77	0.032	1
BOTTOM	77	EIE	South Africa	0.029	78	0.031	1
BOTTOM	78	LDC	Cambodia	0.024	80	0.022	2
BOTTOM	79	LDC	Nepal	0.022	74	0.070	-5
BOTTOM	80	DEV	Syrian Arab Republic	0.005	81	0.006	1
BOTTOM	81	IND	Qatar	0.004	82	0.003	1
BOTTOM	82	DEV	Albania	0.001	51	0.180	-31
BOTTOM	83	LDC	Niger	0.000	83	0.000	0

Source: Authors' calculations based on the sources listed in Table 1 and Table 2.

Note: The country group codes in column "Country Group" (based on the industrial country groupings put forward in Upadhyaya 2013) are as follows: IND=Industrialized economies, EIE=Emerging industrialized economies, DEV=Other developing economies, LDC=Least developed countries.