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The investment development path and human development: Is there a nexus?

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ABSTRACT

To investigate the nexus between the investment development path (IDP) and human development, we modelled the human development (human development index, HDI) using generalized estimation equations and accounted for the unit interval property using non-linear link functions. The gross domestic product per capita was used as the proxy for the IDP. Using panel data of 2,568 observations from 135 countries for 1990–2019, we found a strong and positive effect of IDP on HDI. Thus, there is a nexus between IDP and human development. The 4% elasticity of the IDP, confirms the broader scope of the HDI than the IDP in capturing development. Coupled with the 60% correlation between the IDP variable and HDI, aside from serving as a proxy for each other, these could also be instruments for each other provided they are uncorrelated with the error term in the model under consideration. Trade, infrastructure, and human capital were found to enhance human development. These offer policy options for enhancing human development.

Introduction

Measuring development and categorizing countries based on the measures of development have gained the attention of economists. Djokoto et al., (2017); Djokoto et al., (2016); Dunning (1982), Dunning (1986), Dunning (1993), Dunning and Narula (1996); Narula (1996) and Ramalho et al., (2011) have used the plot of net outward foreign direct investment (NOFDI) and gross domestic product per capita (GDPPC) or gross national product (GNP) to identify five stages of development, namely, stages I, II, III, IV and V. Described as the investment development path (IDP), stages I and II were assigned to developing countries, stage III was theorized for economies in transition and stages IV and V were linked to developed countries. Countries could move forward and backwards within these five stages of development over time (Djokoto, 2021a; Gorynia, Nowak, & Wolniak, 2010a; Gorynia, Nowak, & Wolniak, 2010b; Gorynia, Nowak, Tarka, & Wolniak, 2012; Iacovoiu & Panait, 2014a). The IDP has found application in assessing competitive advantages of countries (Djokoto, 2021a; Dunning & Narula, 1994; Duran & Ubeda, 2005; Iacovoiu & Panait, 2014b); pace and pattern of economic development (Dunning, Kim, & Lin, 2001; Tchorek, 2016; Trąpczyński, Gorynia, Nowak, & Wolniak, 2019; Voica, Panait, & Radulescu, 2020) and others. The IDP has, however, been criticized. Not only that it has two indicators, but these are also financial indicators, and it is less humanistic (Djokoto, 2021b; Sen, 1975; Stewart,

Ranis, & Samman, 2018).

A more humanistic measure of development is the human development index (HDI). Published by the UNDP, the HDI is composed of a wealth indicator, gross national income (GNI) per capita, knowledge indicators (mean years of schooling and expected years of schooling) and a long and healthy life indicator (life expectancy at birth) (Djokoto, 2021b; UNDP, 2020). The HDI is thus, the geometric mean of the normalized indices of each of the three dimensions (UNDP, 2020). The HDI, which is bounded between 0 and 1, has been classified into four categories of human development: low, medium, high, and very high. The HDI has informed industrial policy (Ferrannini, Barbieri, Biggeri, & Di Tommaso, 2021); energy policy (Acheampong, Erdiaw-Kwasie, & Abunyawah, 2021; Yumashev, Ślusarczyk, Kondrashev, & Mikhaylov, 2020); tourism policy and competitiveness (Croes, Ridderstaat, & Shapoval, 2020; Croes, Ridderstaat, Bąk, & Zientara, 2021); knowledge diffusion (Asongu & Nwachukwu, 2018); and climate justice (Alves & Mariano, 2018) among others. As the HDI measures the more intrinsic aspects of human development than the IDP, what is the direction and extent of the relationship between the IDP and the HDI?

Some studies have investigated the determinants of HDI (Afoakwa, 2016; Arisman, 2018; Butar & Rahmanta, 2021; Ganiyu, 2016; Handalani, 2018; Kolster, 2015; Sofilda, Hermiyanti, & Hamzah, 2015). Whilst the analyses in these studies did not take account of the unit interval properties of the HDI, they did not investigate the role of IDP in HDI.

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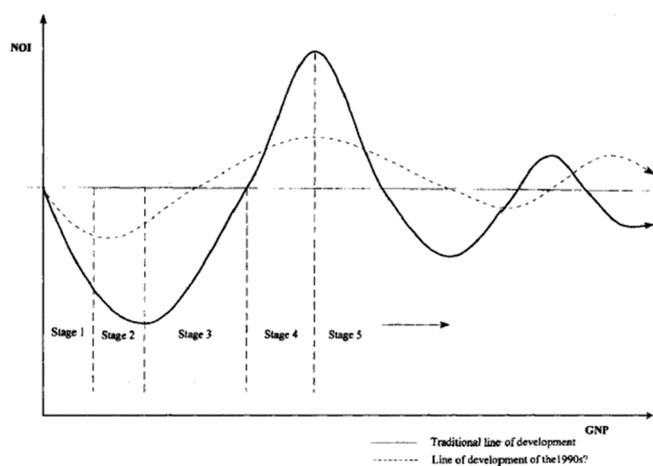


Fig. 1. Investment development path (Dunning and Narula, 1996). Note: Not drawn to scale – For illustrative purposes only.

Djokoto (2021b) however, accounted for the fractional property of the HDI as well as the effect of IDP on HDI. IDP was found to have a weak relationship with HDI. But the countries used in the study were 23 developing countries. As the IDP is established for a country over time, this limited the number of countries resulting in cross-sectional data. Further, the stages of the IDP were assigned numeric values with the highest not exceeding 5. Whilst these served the purpose of the study of Djokoto (2021b), not only did the number of countries reduce the efficiency of the estimates, but the range of the numeric values also reduced the variability in the IDP variable. The link between IDP and HDI is important because whilst the IDP and HDI measure the level of development (Djokoto, 2021b; Dunning, 1981a; Dunning, 1981b; Dunning, 1986), the GDP used in IDP is also used in the construction of the HDI through the GNI (Djokoto, 2021b; UNDP, 2020; UNDP, 2021). In this paper, whilst accounting for the fractional properties of the HDI and including IDP to explain HDI, we used a proxy of the IDP that allowed for each country to have data for each year. This made it possible to include more countries in the data and analyze the data as a panel to reap spatial and temporal benefits. This would certainly produce more efficient parameter estimates.

The outcome of this paper would provide evidence on the link between the more financial measure of development and the humanistic measure of development based on a more efficient estimate. It would also add to the indicators of measurement in the development space (Djokoto, 2021b). Further, either of the development indicators could serve as proxies and instruments for each other.

In what follows, the theoretical and empirical literature presented is followed by the data and methods of analysis. The presentation and discussion of the results are in Section “Results and discussions”. The final section is the conclusions and recommendations.

Literature review

Theoretical review

In line with the subject of the study, a review of the IDP and development theories are presented before the empirical review. The IDP relates a country’s NOFDI to gross domestic product to show the country’s level of development (Djokoto, 2021b; Dunning, 1981a; Dunning and Narula, 1996). The graphical relation, a chart or curve is marked out to show the stage of development (Fig. 1).

The basis of each of the five stages; I, II, III, IV and V lies in the levels and interaction of three factors: ownership, localization, and internationalization (Djokoto, 2021b; Dunning, 1981b). In stage I, the inward foreign direct investment (IFDI) exceeds outward foreign direct investment (OFDI). Ownership advantages such as indigenous technology and

limited created assets explain this. The location advantages are insufficient to entice IFDI. Internationalization from native firms is almost non-existent. In stage II, there is an additional rise in IFDI compared to OFDI. Ownership and location advantages move beyond the levels for stage I. The development of supportive businesses for the ownership advantage and the changes in the business setting such as comparative cost of production for the location advantage explains stage II. Developing countries are hypothesized to be in stages I and II.

The gradual decrease in the IFDI and increase in OFDI precipitate a fall in the excess of IFDI over OFDI marking the beginning of stage III. This is attributable to the ownership and location advantages of indigenous firms. As a result, native firms start to invest outside their borders. This stage is proposed for emerging economies.

Stages IV and V are reserved for developed countries. In the former, OFDI exceeds IFDI, thus, NOFDI becomes greater than zero. This is because the ownership and location merits would have increased substantially. Foreign investments would, therefore, increase in volume culminating in internationalization by native firms. In the case of the latter, there is the backward and forward movement of OFDI and IFDI leading to fleeting peaks and troughs of NOFDI. This scenario is accentuated by the maturity of the ownership, location, and internationalization merits. Thus, no one economy has the overarching ownership, location, and internationalization merits. Multinationals tend to value their business interest above that of their country of origin owing to the high intensity of internationalization.

Stewart et al. (2018) traced the evolution of development thinking in their book, *Advancing Human Development: Theory and Practice*. In the 1950s and 1960s, within the context of low incomes and postcolonialism and to fulfil the development desire, the main strand of developed country thinking was Keynesianism in which development was considered as economic growth. This was to be achieved through planning and industrialization (Rostow, 1960; Lewis, 1954).

By the 1970s, the context changed to an observation of growth but high poverty and unemployment. Two other dominant strands joined Keynesianism, Marxism, and the Neoclassical revival in the 1970s. In response to the existing context, the thinking of Keynesianism was the need to increase employment (Seer, 1972), and the redistribution of the observed growth (Chenery, Ahluwalia, Bell, Duloy, & Jolly, 1979). Streeten (1981) and Stewart (1985) championed the provision of basic needs. Morris (1978) and Morris (1980) proposed the Physical Quality of Life Index (PQLI). Morris argued that for humans to flourish, money incomes - even for the poor - was a deficient indicator (Stewart et al. (2018)). Later, UNDP (United Nations Development Programme) (1990), noted that income was a means to an end. Marxism pointed out issues of dependency (*dependencia*) (Frank, 1966; Furtado, 1980). As expected of the neoclassical, they revived the role of prices/markets (Scitovsky, 1976). By the 1980s, there was an acute balance of payments and debt problems. Not to be outdone by the neoclassical, the Monetarists launched a ‘counter-revolution’ for pro-market and anti-state monetarism in macroeconomic policy (Balassa, 1969).

From the late 1980s to the middle of the 1990s and 2000, the world found itself in negative or weak growth, high poverty and debt. This called for new theories of growth and trade, informational asymmetries, alternative motivations, and the strong role of institutions. The thought marked the move towards human-oriented objectives of development such as poverty reduction, capabilities, human development, and the key role of the millennium development goals (MDGs) (Sen, 1975; Ranis, 1977; Stewart, 1985; Streeten, 1981; Streeten, 1994). In the subsequent decades, there was a global agreement on the Sustainable Development Goals (SDGs) in 2015.

In 1990, the UNDP published its first Human Development Report. The report combined the capabilities approach of Sen with the basic needs focused on the needs of the most deprived. The main dimensions of human development comprise ‘a long and healthy life, being knowledgeable and having a decent standard of living. The HDI is the geometric mean of the normalized indices for each of the three dimensions

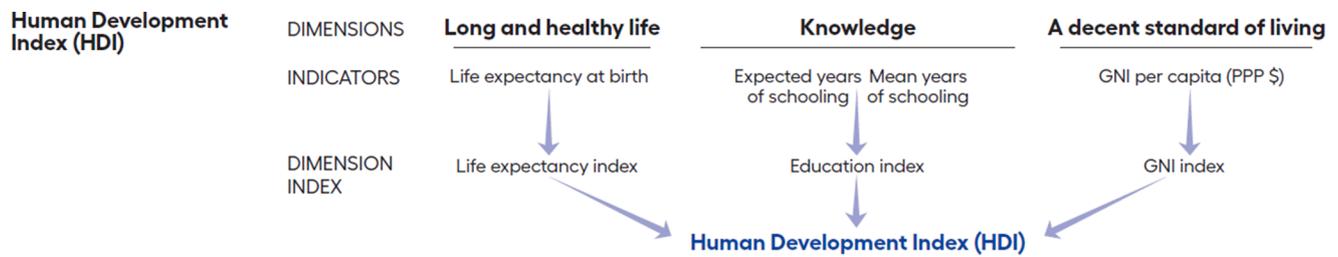


Fig. 2. Graphical representation – Calculating the human development index Source: UNDP (2020).

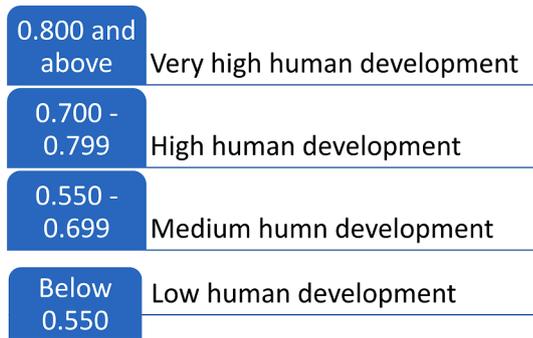


Fig. 3. Stages of human development.

(UNDP, 2021). Whilst the health is measured by life expectancy at birth, that of education dimension is assessed by mean of years of schooling for adults aged 25 years as well as the expected years of schooling for children of school entering age. The standard of living dimension is captured as the gross national income per capita (UNDP, 2020) (Fig. 2). The resulting index of human development, HDI, which ranges between 0 and 1, is categorized into four; low human development, medium human development, high human development, and very high human development (Fig. 3). In that order, countries in the very high human development group (very high HDI) have the highest human development, higher than those lower; high, medium, and low HDI. Aside from the HDI, other forms of development measurement have been published (UNDP, 2020): Inequality-adjusted HDI, Gender development index (GDI), Gender inequality index (GII) and the Multidimensional poverty index (MPI) (Fig. 4).

Beyond the three categories and four indicators, Ranis, Stewart, and Samman (2006) identified eleven categories and 39 indicators. Interestingly, they found eight indicators to be highly correlated with the HDI, hence may therefore be represented by it. Under-five mortality rates performed equally as well as the HDI, and income per capita was less representative of other dimensions of human development. Using data on OECD and developing countries, Ranis et al. (2006) found that the HDI (and the other two broad indicators) were worse indicators of the extended categories of human development for OECD countries than for developing countries.

Some similarities can be drawn from IDP and HDI. First, they are both indicators of development. Second, GDPPC contributes to both IDP and HDI. Thirdly, IDP and HDI are categorized into stages, the former into five stages and the latter into four stages. The two development indicators differ in the sense that whilst IDP is established based on the interaction of GDPPC and NOFDI, the HDI is an index. Whilst the IDP relies on financial variables only, the HDI employs financial plus non-financial variables. IDP is less humanistic than the HDI. Whilst the measure of HDI is computable annually, it is more difficult to establish the level of development using the IDP for a country on an annual basis. Whilst the similarities form the basis of a possible nexus between IDP and HDI that informed this study, the differences make the use of the HDI on the rise in recent times.

Empirical review

Recently, Djokoto (2021b) used data on 23 developing countries to assess the variability in HDI explained by the stages of the IDP. Modelling the HDI as a fraction, the results showed that the IDP had a weak relationship with human development. A 1% increase in IDP induced a 2% increase in human development. Djokoto (2021b) attributed the statistical significance to the presence of GDP in the construction of the HDI through the GNI. Further, just as IDP measured the level of development, HDI did the same. The weak significance was associated with the fact that GDP was embedded in GNI, but the GNI formed a portion of the HDI. Other results showed that human capital development was the strongest driver of human development and inflation worsened human development. Infrastructure, measured by the sum of fixed and mobile telephony subscriptions per 100 persons, also enhanced HDI.

Some studies provided empirical evidence on the effect of the GDPPC and the control variables on HDI. These focused on provinces of Indonesia (Butar & Rahmanta, 2021; Sofilda et al., 2015), the Association of South-East Asian Nations (ASEAN) (Arisman, 2018; Handalani, 2018), North Africa (Kolster, 2015), sub-Saharan Africa (Aloui, 2019; Ganiyu, 2016; Ranjkeshan, 2021), Africa (Gohou & Soumaré, 2012), developing countries (De Groot, 2014) and the world (Oladapo & Abdul, 2016). The data structure used in all the studies was a panel, which ranged from 1990 (Kolster, 2015; Ranjkeshan, 2021) to 2019 (Ranjekeshan, 2021). The estimation methods have largely been fixed effects (FE) (Arisman, 2018; Butar & Rahmanta, 2021; Ganiyu, 2016; Handalani, 2018; Sofilda et al., 2015). Three studies employed the general method of moments (GMM) (De Groot, 2014; Kolster, 2015; Ranjkeshan, 2021).

Without specifically addressing IDP, Arisman (2018) assessed the effect of GDP growth rate on HDI whilst De Groot (2014), Handalani (2018) and Ranjkeshan (2021) used GDPPC as a determinant (control variable) of HDI. All four studies found a strong positive effect of GDP growth rate and GDPPC on HDI. These results encompass ASEAN nations, sub-Saharan Africa and developing countries. Recognizing these countries are all developing states, the results appear to be consistent for developing countries. Our results will provide evidence on all this plus transition and developed countries.

De Groot (2014), Kolster (2015) and Ranjkeshan (2021) reported a neutral effect of trade openness on HDI. Inflation measured as the growth rate of the consumer price index (CPI) had a mixed effect on HDI. Aloui (2019) reported positive effects whilst Arisman (2018), Ganiyu (2016) and Handalani (2018) found negative effects. De Groot (2014), Gohou and Soumaré (2012), Kolster (2015) and Ranjkeshan (2021) reported a neutral effect of inflation on HDI.

Regarding the effect of population on HDI, the population had been measured as the number of males and females (quantum) (Arisman, 2018) and the annual growth rate of the number of males and females (De Groot, 2014; Sofilda et al., 2015). Arisman (2018) and De Groot (2014) found an inverse relationship between the population indicators and HDI. A neutral effect was found by Sofilda et al. (2015).

Human capital had also been measured in two ways in the literature; education expenditure (Butar & Rahmanta, 2021; Oladapo & Abdul, 2016; Sofilda et al., 2015) and secondary school enrolment as a percentage of gross enrolment (Ganiyu, 2016; De Groot, 2014). Ganiyu

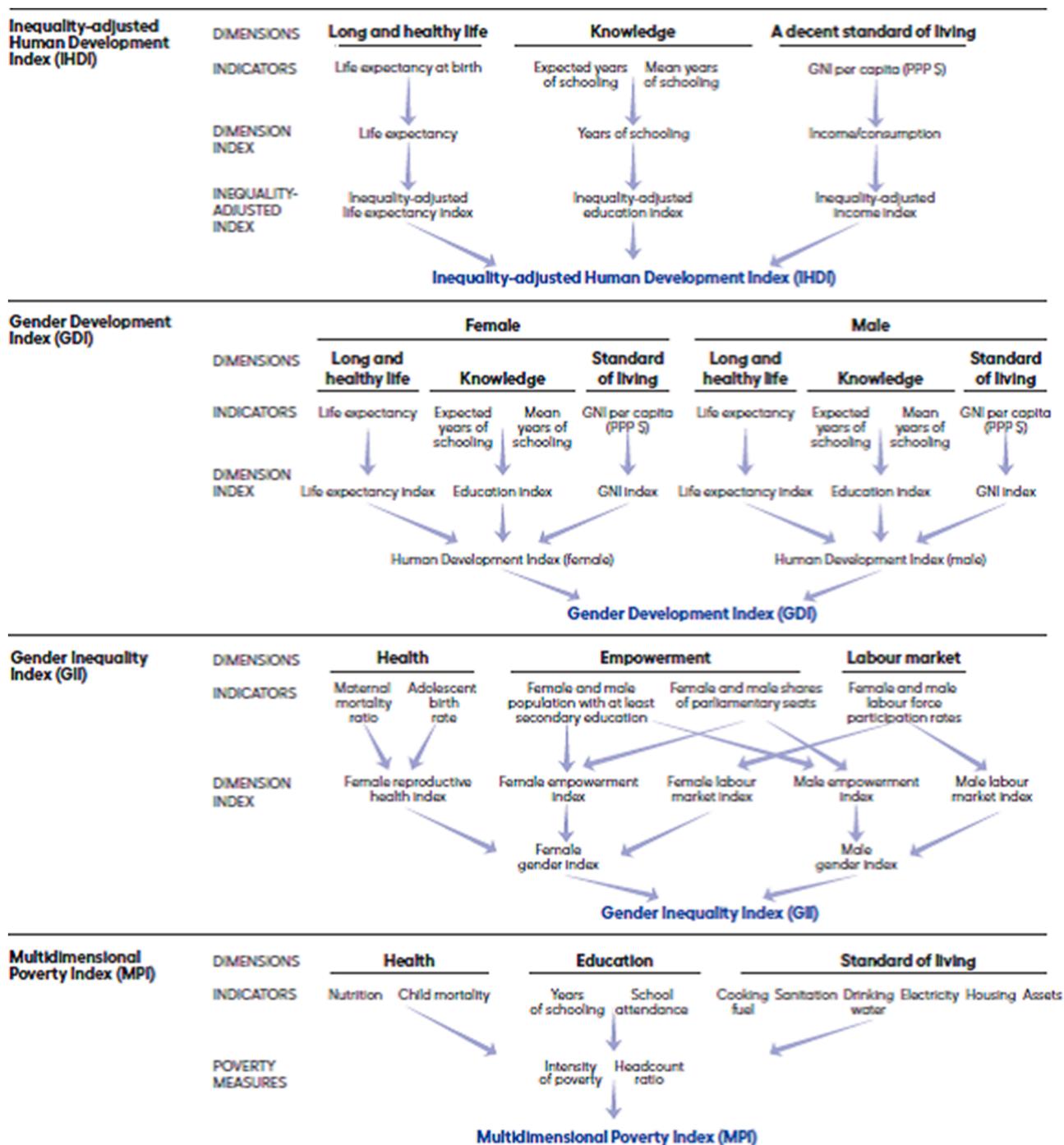


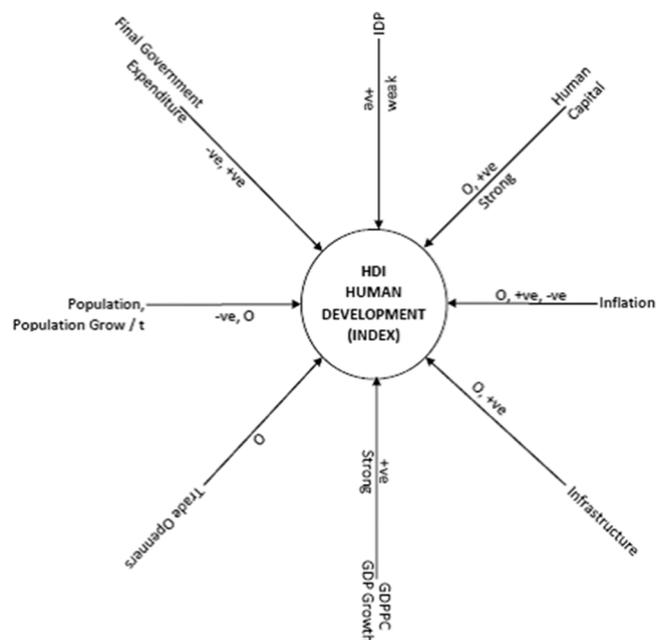
Fig. 4. Other human development indices (UNDP, 2020).

(2016), Oladapo and Abdul (2016) and Sofilda et al. (2015) found a positive effect on HDI whilst a neutral relationship was reported for the effect of education on HDI (Butar & Rahmanta, 2021; De Groot, 2014).

The effect of final government expenditure on goods and services as a percentage of GDP had a mixed effect. These were positive effects (Kolster, 2015), negative effects (Aloui, 2019) and neutral effects (Ganiyu, 2016; De Groot, 2014; Gohou & Soumaré, 2012; Sofilda et al., 2015).

Measuring infrastructure as internet subscription per 100 persons, Ganiyu (2016) found no effect of infrastructure on HDI for sub-Saharan African countries. In the case of Kolster (2015), infrastructure was found to have a positive effect on HDI. In the case of the latter, the proxy for infrastructure was paved roads.

In the literature reviewed and summarized in Fig. 5, except income and trade, all other determinants of HDI showed mixed effects. Whilst this observation calls for further study on the effect of these factors on HDI, review studies, either qualitative or quantitative would also be useful. From the foregoing, the role of IDP in HDI was unexplored by many studies that also failed to appropriately account for the unit interval properties of the HDI. Only Djokoto (2021b) considered the role of IDP in HDI. Whilst accounting for the unit interval properties of the HDI by non-linear modelling; fractional regression with a probit link function, the data was limited in size and the IDP measure was constrained to range from 1 to 5. To fill these gaps, we modelled the HDI using generalized estimation equations and accounting for the unit interval property using non-linear link functions. Also, a more flexible proxy for



o: no effect; -ve: negative effect; +ve: positive effect

Fig. 5. Summary of empirical review.

Table 1
Variables, definitions, and measurement.

Variable	Definitions	Measurement
HDI	Human development index	Ranges between 0 and 1
IDP	Either <i>IDP_GD</i> or <i>IDP_NOFDI</i>	International US dollars per person or International US dollars
<i>IDP_NOFDI</i>	Net outward foreign direct investment as Investment development path	International US dollars
<i>IDP_GD</i>	Gross domestic product per capita as Investment development path	International US dollars per person
<i>INFLA</i>	Inflation	Annual growth rate
<i>TO</i>	Trade openness	Sum of exports and imports divided by GDP
<i>INFRAS</i>	Infrastructure	Sum of fixed and mobile phone lines per 100 persons
<i>HC</i>	Human capital	Secondary school enrolment as percentage of gross enrolment
<i>GE</i>	Government expenditure	Final government expenditure on goods and services to GDP ratio
<i>POPG</i>	Population growth	Annual growth rate

IDP and a larger data set with many countries over many years was employed in this study.

Data and methods

Data

All the data was drawn from the World Development Indicators (WDI) of the World Bank except the HDI which was obtained from the United Nations Development Programme (UNDP) website. The data consisted of an unbalanced panel of 135 countries (Appendix) from 1990 to 2019 making up 2,573 observations. The countries are modelled together without distinctions into levels of development because although these countries could be classified into stages of IDP, in practice, the countries within the development groups do move across the

IDP stages over time (Djokoto, 2021a; Gorynia et al., 2010a; Gorynia et al., 2010b; Gorynia et al., 2012; Iacovoitu & Panait, 2014b). Moreover, the goal of the paper is to assess the relationship between IDP and HDI irrespective of the stage of IDP or HDI. Owing to the unbalanced nature of the panel, many countries had few years, with some as low as 2. As the number of countries far exceeded the number of years, we did not anticipate problems with the time-series properties of the panel (Baltagi, 2021; Greene, 2003; Mátyás & Sevestre, 2013; Pesaran, 2015; Tsionas, 2019).

Models and modelling

The base model is

$$HDI = f(IDP) \tag{1}$$

Based on the empirical review (Aloui, 2019; Arisman, 2018; Butar & Rahmanta, 2021; De Groot, 2014; Djokoto, 2021b; Ganiyu, 2016; Gohou & Soumaré, 2012; Handalani, 2018; Kolster, 2015; Oladapo & Abdul, 2016; Ranjakeshan, 2021; Sofilda et al., 2015), other variables explain HDI. Incorporating these into Eq. (1) yields Eq. (2).

$$HDI = f(IDP, INFLA, TO, INFRAS, HC, GE, POPG) \tag{2}$$

The variables are described in Table 1.

Eq. (2) can be specified as

$$HDI_{i,t} = \alpha_0 + \alpha_1 IDP_{i,t} + \alpha_2 INFLA_{i,t} + \alpha_3 TO_{i,t} + \alpha_4 INFRAS_{i,t} + \alpha_5 HC_{i,t} + \alpha_6 GE_{i,t} + \alpha_7 POPG_{i,t} + \epsilon_{i,t} \tag{3}$$

where α_k are parameters to be estimated whilst $\epsilon_{i,t}$ is the idiosyncratic error term. There are i cross-sections and t periods (years). Based on the literature (Djokoto, 2021a; Dunning, 1982; Dunning, 1986; Dunning, 1993; Dunning and Narula, 1996; Narula, 1996) two variables represented IDP, *IDP_GD* and *IDP_NOFDI*. The choice of the appropriate one was accomplished by the information criteria; Akaike information criterion (AIC) (Akaike, 1974) and Bayesian information criterion (BIC) (Schwarz, 1978).

Estimation procedure

Earlier studies have often modelled the HDI as a linear variable (Afoakwa, 2016; Arisman, 2018; Butar & Rahmanta, 2021; Ganiyu, 2016; Handalani, 2018; Kilimova, 2016; Kolster, 2015; Nakouwo, 2019; Šimanová, 2013; Sofilda et al., 2015; Tamer, 2013),

$$E(y|x) = x\theta \tag{4}$$

With the marginal effect as

$$\frac{\partial E(y|x)}{\partial x_j} = \theta_j \tag{5}$$

which is constant over the range of y . However, by construction, HDI is bounded between 0 and 1, hence the plausible link functions are logit, probit, loglog, cloglog and cauchit (Djokoto, 2021b; Papke & Wooldridge, 1996; Ramalho, Ramalho, & Henriques, 2010). With this characteristic, three options can be considered to model HDI. 1. Transform the HDI by the family of link functions to linear data (Ramalho, Ramalho, & Coelho, 2018). 2. Model the HDI directly as a fraction using fractional regression (Djokoto, 2015; Djokoto & Gidiglo, 2016; Djokoto, 2021b; Papke & Wooldridge, 1996; Ramalho et al., 2010). 3. Apply the generalized estimation equations (GEE) (Gyimah, Kwansa, Kyiu, & Sikochi, 2021; Papke & Wooldridge, 2008; Xu, Solanki, & Fink, 2021).

The generalised estimation equations (GEE) is a powerful tool for analyzing a variety of non-normally distributed data with correlations (Hardin & Hilbe, 2013; Liang, 1987; Pekár & Brabec, 2018; Zeger & Liang, 1986; Zeger, Liang, & Albert, 1988). Whilst GEE provides correct estimates and inferences, it is often based on fewer assumptions and its

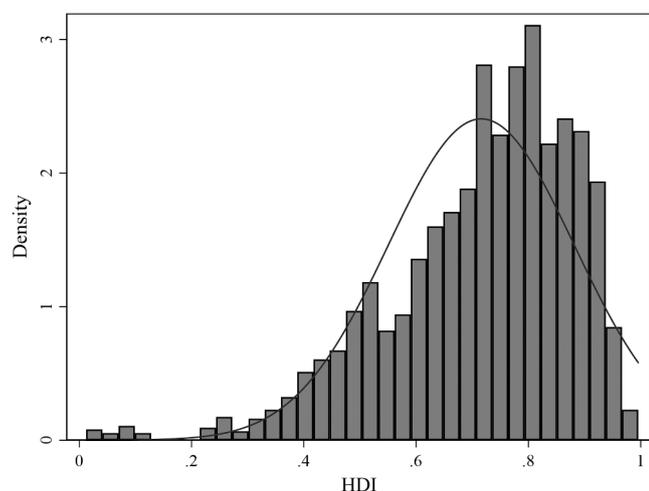


Fig. 6. Distribution of HDI.

Table 2
Descriptive statistics.

Variable	N	Mean	Standard Deviation	Minimum	Maximum
HDI	2,569	0.7161	0.1658	0.0122	0.9956
IDP_NOFDI	2,570	-2,143	17,584	-310,229	144,111
IDP_GD	2,573	14,696	18,873	86.1872	11,9211
INFLA	2,573	22.2657	501.2533	-9.7976	23,773
TO	2,573	86.7743	52.8581	18.9665	442.62
INFRAS	2,573	87.8800	61.5983	0.0000	342.722
HC	2,572	82.9586	28.9053	5.2208	163.9347
GE	2,573	16.7076	6.2850	0.9517	103.1732
POPG	2,573	1.2102	1.3358	-3.8477	16.7002

parameters have a more straightforward interpretation when population-level inferences are desired (Wang, Chen, & Yan, 2011; Zarei, Shabani, & Mahmoudi, 2020; Yang, Tang, & Deng, 2009). This property is particularly useful for our study as all the countries are modelled jointly. Theoretically, GEE could be used to analyze data with any number of random effects. GEE can be limited by the number of pre-programmed working correlation structures (Pekár & Brabec, 2018; Wang et al., 2011). The use of GEE is very efficient when the design of a study can be modelled using any of the predefined structures (Pekár & Brabec, 2018; Wang et al., 2011; Yang et al., 2009; Zarei et al., 2020). GEE accounts for correlations within the data and can handle heteroscedasticity.

Three of the papers reviewed used GMM *a priori* (De Groot, 2014; Kolster, 2015; Ranjkeshan, 2021). However, not accounting for endogeneity is preponderated in the pertinent literature (Arisman, 2018; Butar & Rahmanta, 2021; Ganiyu, 2016; De Groot, 2014; Handalani, 2018; Sofilda et al., 2015). Moreover, the results of the effect of GDPPC on HDI has been consistent for models estimated with the GMM estimator (De Groot, 2014; Ranjkeshan, 2021) and those estimated without the GMM estimator (Arisman, 2018; Djokoto, 2021b; Handalani, 2018).

Table 3
Correlation matrix.

	HDI	IDP_GD	INFLA	TO	INFRAS	HC	GE	POPG
HDI	1.0000							
IDP_GD	0.5641	1.0000						
INFLA	-0.0445	-0.0282	1.0000					
TO	0.3072	0.3054	-0.0285	1.0000				
INFRAS	0.6646	0.5537	-0.0494	0.3738	1.0000			
HC	0.8576	0.5263	-0.0424	0.2353	0.6137	1.0000		
GE	0.2271	0.2252	-0.0493	0.1368	0.1698	0.3038	1.0000	
POPG	-0.4089	-0.0735	0.0306	-0.0800	-0.2544	-0.4594	-0.1421	1.0000

Table 4
Information criteria assessment for choice between IDP_NOFDI and ID_GD.

IDP variable	AIC	BIC
IDP_NOFDI	-5,711	-5,665
IDP_GD	-5,792	-5,745

Thus, we did not suspect endogeneity hence, we did not specifically account for it.

Eq. (3) was estimated by Stata’s *xtgee* code. The family of distribution used in the GEE model was binomial, informed by the distribution of HDI (Fig. 6). The link functions included logit, probit and cloglog (Djokoto, 2015; Djokoto & Gidiglo, 2016; Papke & Wooldridge, 1996; Ramalho et al., 2010).

Results and discussions

The mean HDI ranged from 0.0122 to 0.9956 (Table 2). Whilst this confirms the unit interval property of the HDI, it also shows that some countries fall within the low human development category and others fall within the very high human development category. On average, however, the mean HDI is 0.7161 which falls within the high human development stage. With the standard deviation less than 1, the square, which is the variance would be closer to 0 than 1. As the variance is less than the mean, the HDI is under dispersed. Similarly, *TO*, *INFRAS*, *HC* and *GE* also show under dispersion around their respective means. The exceptions are *IDP_NOFDI*, *IDP_GD*, *INFLA* and *POPG*. Except for *INFLA* and *GE*, the correlation coefficients exceed 0.30 (Table 3). The size of the linear correlation coefficients is in order of *HC*, *INFRAS*, *IDP_GD*, *POPG*, *TO*, *GE* and *INFLA*. It is left to be seen if these would reflect in the size of the elasticities.

As the basic IDP model relates the *GDPPC* to the *NOFDI*, either of these could be the indicator for IDP in equation (4). To choose between the two, equation (4) was estimated with an OLS estimator, one with *NOFDI* (*IDP_NOFDI*) and the other with *GDPPC* (*IDP_GD*). The AIC and BIC were computed (Table 4). The model with the *GDPPC* showed the lowest AIC and BIC. Hence, the *IDP_GD* was selected to proxy the IDP.

The estimates of the GEE are presented in Table 5. As these may not be useful, the elasticities have been computed as shown in Table 6. The elasticities for the total sample are models 1, 5 and 9 respectively, for the logit, probit and complementary loglog link functions. Five layers of robustness were attained. The first was to obtain heteroscedasticity robust estimates of the coefficients from the GEE. The second was to obtain semi-robust elasticities from the coefficients of the GEE estimations. Third, was to compare the robust elasticities obtained for the total sample without observations from sub-sample without low human development (HDI below 0.550), medium human development ($0.550 \leq HDI \leq 0.699$) and high human development ($0.700 \leq HDI \leq 0.799$), respectively. The sub-sample had respectively, 2,139, 2,025 and 1,893 observations. For the logit link function, the elasticities are in models 2–4, models 6–8 for the probit link function and models 10–12 for the cloglog link function. Our elasticity of interest is that for the *IDP_GD*.

For models with each link function, the elasticities of the sub-samples are generally like those of the total sample in sign, size, and statistical

Table 6
Elasticities of the GEE estimates.

Link	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
	Logit					Probit					Cloglog		
Sample	Total sample	No low HD	No medium HD	No high HD	Total sample	No low HD	No medium HD	No high HD	Total sample	No low HD	No medium HD	No high HD	
<i>IDP_GD</i>	0.0401*** (0.0076)	0.0451*** (0.0045)	0.0407*** (0.0112)	0.0415*** (0.0085)	0.0388*** (0.0061)	0.0415*** (0.0040)	0.0395*** (0.0097)	0.0402*** (0.0069)	0.0356*** (0.0042)	0.0365*** (0.0034)	0.0368*** (0.0075)	0.0368*** (0.0049)	
<i>INFLA</i>	1.72E-05 (2.48E-05)	1.11E-05 (8.26E-05)	4.56E-05 (3.11E-05)	8.80E-06 (2.01E-05)	1.31E-05 (2.50E-05)	5.78E-06 (8.44E-05)	3.86E-05 (3.12E-05)	3.88E-06 (2.00E-05)	-2.32E-06 (2.81E-05)	-4.21E-06 (0.0001)	1.73E-05 (3.49E-05)	-1.90E-05 (1.95E-05)	
<i>TO</i>	0.0377*** (0.0119)	0.0252*** (0.0068)	0.0432*** (0.0132)	0.0506*** (0.0173)	0.0355*** (0.0119)	0.0240*** (0.0068)	0.0410*** (0.0130)	0.0468*** (0.0174)	0.0284** (0.0118)	0.0199*** (0.0072)	0.0344*** (0.0129)	0.0351** (0.0177)	
<i>INFRAS</i>	0.0360*** (0.0070)	0.0414*** (0.0049)	0.0389*** (0.0111)	0.0335*** (0.0100)	0.0376*** (0.0060)	0.0451*** (0.0048)	0.0413*** (0.0102)	0.0353*** (0.0090)	0.0421*** (0.0053)	0.0506*** (0.0048)	0.0471*** (0.0091)	0.0413*** (0.0084)	
<i>HC</i>	0.2135*** (0.0300)	0.1235*** (0.0185)	0.2395*** (0.0261)	0.2283*** (0.0323)	0.2194*** (0.0306)	0.1256*** (0.0187)	0.2428*** (0.0270)	0.2334*** (0.0328)	0.2230*** (0.0338)	0.1277*** (0.0192)	0.2344*** (0.0314)	0.2339*** (0.0377)	
<i>GE</i>	-0.0017 (0.0124)	0.0068 (0.0049)	0.0008 (0.0135)	-0.0107 (0.0191)	-0.0011 (0.0122)	0.0072 (0.0050)	0.0032 (0.0130)	-0.0087 (0.0191)	0.0003 (0.0116)	0.0074 (0.0055)	0.0084 (0.0111)	-0.0046 (0.0185)	
<i>POPG</i>	-0.0070 (0.0065)	-0.0026 (0.0034)	-0.0082 (0.0068)	-0.0020 (0.0116)	-0.0074 (0.0060)	-0.0024 (0.0032)	-0.0077 (0.0064)	-0.0041 (0.0106)	-0.0072 (0.0051)	-0.0022 (0.0029)	-0.0056 (0.0052)	-0.0060 (0.0086)	
Model properties													
N	2,568	2,139	2,025	1,893	2,568	2,139	2,025	1,893	2,568	2,139	2,025	1,893	

1. HDI – Human development index. 2. *** and ** are 1% and 5% levels of statistical significance respectively. 3. Robust standard errors.

Table 7
Two step System GMM.

Variables	Estimates
HDI	Coefficients (Robust standard errors)
<i>HDI_1</i>	0.8077 (0.0024)
<i>HDI_2</i>	-0.0047 (0.0001)
<i>HDI_3</i>	-0.0046 (0.0002)
<i>HDI_4</i>	0.0279 (0.0003)
<i>GDPPC</i>	2.63e-07*** (7.80e-09)
<i>INFLA</i>	2.23e-06*** (1.41e-07)
<i>TO</i>	3.05e-05*** (2.15e-06)
<i>INFRAS</i>	-2.58e-05*** (1.54e-06)
<i>HC</i>	0.0006*** (1.97e-05)
<i>GE</i>	0.0004*** (1.13e-06)
<i>POPG</i>	0.0005** (0.0002)
Constant	0.0687*** (0.0006)
Model diagnostics	
Observations	1,049
Countries	96
Wald chi2(11)	2.14e + 06***
Probability of Sargan statistics	0.3698
Probability of second order serial correlation	0.6645

1. HDI – Human development index. 2. *** and ** are 1% and 5% levels of statistical significance respectively. 3. Robust standard errors.

This estimation accounts for endogeneity by using the general method moments. This inherently accounts for heteroscedasticity and serial correlation. The fourth lag is the the Sargan test and second order serial correlation test statistics are acceptable. The positive and statistical significance of the *GDPPC* suggests the GMM results are robust to estimation procedure and accounting for endogeneity.

(Ganiyu, 2016; Kolster, 2015). However, the coefficient reported by Ganiyu (2016) was not statistically significant whilst that reported by Kolster (2015) was significant.

The coefficient for *HC* is positive and statistically significant. Thus, a 1% rise in *HC* (secondary school enrolment as a percentage of gross enrolment) will induce a 21% rise in HDI. This is a relatively high elasticity and indeed, the highest elasticity among the estimated elasticities which shows that human capital is the most potent driver of HDI. The result shows that human resource remains the most potent factor in improving human development. The proxy has also been used in other studies to represent education. It must, however, be noted that the education variable in the HDI is mean years of schooling and expected years of schooling which differs from the gross secondary school enrolment. Our finding is consistent with that of Ganiyu (2016), Oladapo and Abdul (2016) and Sofilda et al. (2015). De Groot (2014) reported a positive but statistically insignificant effect.

The elasticity of *GE* is statistically indistinguishable from zero. Thus, *GE* has no discernible effect on *HDI*. This finding is consistent with the previous studies (Ganiyu, 2016; De Groot, 2014; Gohou & Soumaré, 2012; Sofilda et al., 2015). Whilst Aloui (2019) reported a significant negative effect, Kolster (2015) found a significant positive effect.

An increase in population increases competition for health, education, and financial resources. This tends to be pronounced in resource-poor environments such as developing countries. Thus, Arisman (2018) and De Groot (2014) reported significant negative effects of population growth on HDI in developing countries. This explains the negative sign of the elasticity of *POPG*. However, the current study includes data on transition and developed economies where the competition effect may be less pronounced. Thus, the competition effect is not strong enough to induce a discernible effect on HDI. Although Sofilda et al. (2015) reported a neutral effect of *POPG* on HDI, nevertheless, the sign of the coefficient was negative.

Conclusions and recommendations

In this study, the nexus between the investment development path and the human development index was examined. HDI was modelled using generalized estimation equations and accounting for the unit interval property using non-linear link functions. Also, a more flexible proxy for IDP, gross domestic product per capita and a larger data set with many countries over many years was employed in this study. A

strong and positive effect of IDP on HDI was found. Thus, there is a nexus between IDP and human development. Although the IDP explained 4% of the HDI, nevertheless, the outcome showed that IDP has a strong relationship with HDI. Further, the extent of the explanation of the HDI confirms the broader scope of the HDI than the IDP in capturing development. Coupled with about 60% linear correlation between *IDP_GD* and *HDI*, aside from serving as a proxy for each other, these could also be instruments for each other provided they are uncorrelated with the error term in the model under consideration. To move a country from a lower to a higher IDP and HDI, Governments should seek to improve GDP with expenditure on social services such as education and health.

Following the strong positive effect of trade on HDI, whilst current efforts at promoting trade are desirable, increased trade among nations would promote human development. Therefore, obstacles to international trade must be removed or ameliorated whilst existing trade policies must be revised to attain the goal of increased trade.

Infrastructure promotes human development. Thus, increased investment in infrastructure is recommended. Countries with infrastructure deficits should be supported to improve human development. As human capital development is the greatest driver of human

development, whilst more resources must be directed into education, attention must be paid to the quality dimension of education.

As the GEE and GMM were used as the modelling methodology, subsequent studies can consider the use of other linear transformations of the HDI as well as panel fractional regression in modelling the HDI. Further, proxies for human capital other than 'Secondary school enrolment as percentage of gross enrolment' can be considered in future research.

CRedit authorship contribution statement

Justice Gameli Djokoto: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix. List of countries in the panel

Albania	Chad	Hong Kong	Malta	Rwanda
Algeria	Chile	Hungary	Mauritius	Saudi Arabia
Angola	China	Guyana	Mexico	Senegal
Antigua and Barbuda	Colombia	Honduras	Moldova	Serbia
Armenia	Congo	Iceland	Mongolia	Seychelles
Australia	Congo DR	India	Montenegro	Singapore
Austria	Costa Rica	Indonesia	Morocco	Slovakia
Azerbaijan	Croatia	Iran	Mozambique	Slovenia
Bahamas	Cyprus	Ireland	Namibia	South Africa
Bahrain	Czechia	Israel	Netherlands	Spain
Bangladesh	Côte d'Ivoire	Italy	New Zealand	Sri Lanka
Barbados	Denmark	Jamaica	Nicaragua	Sweden
Belarus	Egypt	Jordan	Niger	Switzerland
Belgium	El Salvador	Kazakhstan	Nigeria	Syrian
Benin	Estonia	Kenya	North Macedonia	Thailand
Bhutan	Eswatini	Korea, Republic	Norway	Timor-Leste
Bolivia	Fiji	Kuwait	Oman	Togo
Botswana	Finland	Kyrgyzstan	Pakistan	Tonga
Brazil	France	Lao PDR	Panama	Tunisia
Bulgaria	Gabon	Latvia	Papua New Guinea	Turkey
Burkina Faso	Georgia	Lesotho	Peru	Ukraine
Burundi	Germany	Liberia	Philippines	UAE
Cabo Verde	Ghana	Libya	Poland	UK
Cambodia	Greece	Luxembourg	Portugal	USA
Cameroon	Guatemala	Madagascar	Qatar	Uruguay
Canada	Guinea	Malaysia	Romania	Venezuela
Central African Republic	Guinea-Bissau	Mali	Russian Federation	Zimbabwe

References

- Acheampong, A. O., Erdiaw-Kwasie, M. O., & Abunyewah, M. (2021). Does energy accessibility improve human development? Evidence from energy-poor regions. *Energy Economics*, 96, Article 105165.
- Afoakwa, L. (2016). *A Study on the impact of official development assistance and foreign direct investment on human development in Sub Saharan Africa (SSA)*. Doctoral dissertation. KDI School.
- Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control*, 19(6), 716–723.
- Aloui, Z. (2019). *The impact of foreign direct investment and the institutional quality on welfare in Latin America and Sub-saharan Africa*. MPRA Paper No. 95484, Online at <<https://mpra.ub.uni-muenchen.de/95484/>>.
- Alves, M. W. F. M., & Mariano, E. B. (2018). Climate justice and human development: A systematic literature review. *Journal of Cleaner Production*, 202, 360–375.
- Arisman, A. (2018). Determinant of human development index in ASEAN countries. *Signifikan: Jurnal Ilmu Ekonomi*, 7(1), 113–122.
- Asongu, S. A., & Nwachukwu, J. C. (2018). Educational quality thresholds in the diffusion of knowledge with mobile phones for inclusive human development in sub-Saharan Africa. *Technological Forecasting and Social Change*, 129, 164–172.
- Balassa, B. (1969). Industrial development in an open economy: The case of Norway. *Oxford Economic Papers*, 21(3), 344–359.
- Baltagi, B. H. (2021). *Econometric Analysis of Panel Data*. Springer International Publishing.
- Butar, R. S. B., & Rahmanta, M. (2021). Determinant analysis of human development index in of north Sumatra Province. *Quantitative Economics Journal*, 8(1), 83–98.
- Chenery, H., Ahluwalia, M. S., Bell, C. L. G., Duly, J. H., & Jolly, R. (1979). *Redistribution with growth*. World Bank, Center and the Institute of Development Studies at The University of Sussex, Oxford University Press.
- Croes, R., Ridderstaat, J., & Shapoval, V. (2020). Extending tourism competitiveness to human development. *Annals of Tourism Research*, 80, Article 102825.
- Croes, R., Ridderstaat, J., Bak, M., & Zientara, P. (2021). Tourism specialization, economic growth, human development and transition economies: The case of Poland. *Tourism Management*, 82, Article 104181.
- De Groot O. 2014. *Foreign direct investment and welfare*. *Production Development Series* (Vol. 196). United Nations.

- Djokoto, J. G. (2015). Technical efficiency of organic agriculture: A quantitative review. *Studies in Agricultural Economics*, 117(2), 67–71.
- Djokoto, J. G. (2021a). The investment development path theory and small states. *Research in Globalization*, 3, Article 100048.
- Djokoto, J. G. (2021b). *Do the stages of the investment development path explain the stages of human development?* Academia Letters.
- Djokoto, J. G., & Gidiglo, K. F. (2016). Technical efficiency in agribusiness: A meta-analysis on Ghana. *Agribusiness*, 32(3), 397–415.
- Djokoto, J. G., Obeng-Sarkodie, K., & Dauda, T. (2017). Livelihoods diversification of fair trade cocoa farmers: Portfolio, extent, reasons and drivers. *Central Inquiry*, 3(1), 46–75.
- Djokoto, J. G., Srofenyo, F. Y., & Arthur, A. A. A. (2016). Technical inefficiency effects in agriculture—a meta-regression. *Journal of Agricultural Science*, 8(2), 109–121.
- Dunning, D. H., Kim, C., & Lin, J. (2001). Incorporating trade into the investment development path: A case study of Korea and Taiwan. *Oxford Development Studies*, 29(2), 145–154.
- Dunning, J. H., & Narula, R. (1994). *Transpacific foreign direct investment and the investment development path: The record assessed. Essays in International Business*, 10, March. Columbia, South Carolina: University of South Carolina.
- Dunning, J. H. (1981a). Explaining the international direct investment position of countries: Towards a dynamic or developmental approach. *Weltwirtschaftliches Archiv*, 117(1), 30–64.
- Dunning, J. H. (1981b). *International Production and the Multinational Enterprise*. London: George Allen and Unwin.
- Dunning, J. H. (1982). Explaining the international direct investment position of countries: Towards a dynamic or developmental approach. In *International Capital Movements* (pp. 84–121). London: Palgrave Macmillan.
- Dunning, J. H. (1986). The investment development cycle revisited. *World Economic Archives*, 122(4), 667–676.
- Dunning, J. H. (1993). *Global Business: The Challenge of 1990*. London and New York: Routledge.
- Dunning, J. H., & Narula, N. (Eds.). (1996). *Foreign Direct Investment and Governments*. London and New York: Routledge.
- Duran, J. J., & Ubeda, F. (2005). The investment development path of newly developed countries. *International Journal of the Economics of Business*, 12(1), 123–137.
- Ferrannini, A., Barbieri, E., Biggeri, M., & Di Tommaso, M. R. (2021). Industrial policy for sustainable human development in the post-Covid19 era. *World Development*, 137, Article 105215.
- Frank, A. G. (1966). *The development of underdevelopment*. New York.
- Furtado, C. (1980). Development: Theoretical and conceptual considerations. In *The Relevance of Economic Theories* (pp. 200–222). London: Palgrave Macmillan.
- Ganiyu, I. A. (2016). *Foreign Direct Investment and Welfare: Evidence from Sub-Saharan Africa*. Doctoral dissertation. University of Ghana.
- Gohou, G., & Soumaré, I. (2012). Does foreign direct investment reduce poverty in Africa and are there regional differences? *World Development*, 40(1), 75–95.
- Gorynia, M., Nowak, J., & Wolniak, R. (2010a). Investment development paths of Central European countries: A comparative analysis. *Argumenta Oeconomica*, 24(1), 65–87.
- Gorynia, M., Nowak, J., & Wolniak, R. (2010b). Foreign direct investment of Central and Eastern European countries, and the investment development path revisited. *Eastern Journal of European Studies*, 1(2), 21.
- Gorynia, M., Nowak, J., Tarka, P., & Wolniak, R. (2012). In *Internationalization of emerging economies and Firms* (pp. 64–86). London: Palgrave Macmillan UK.
- Greene, W. H. (2003). *Econometric Analysis* (p. 07458). Upper Saddle River, New Jersey: Prentice Hall.
- Gyimah, D., Kwansa, N. A., Kyiu, A. K., & Sikochi, A. S. (2021). Multinationality and capital structure dynamics: A corporate governance explanation. *International Review of Financial Analysis*, 76, Article 101758.
- Handalani, R. T. (2018). Determinant of human development index in southeast Asia. *Jurnal Kebijakan Pembangunan Daerah*, 2(2), 118–137.
- Hardin, J. W., & Hilbe, J. M. (2013). *Generalized Estimating Equations* (2nd ed). Boca Raton, FL: Chapman Hall/CRC.
- Iacovoitu, V. B., & Panait, M. (2014b). The limitation of investment development path theory. European Union Case. *Petroleum-Gas University of Ploiesti Bulletin, Technical Series*, 66(4).
- Iacovoitu, V. B., & Panait, M. (2014a). The limitation of IDP theory. European Union case. *Economic Insights – Trends and Challenges*, 3(4), 33–40.
- Kilimova, L. (2016). Quality of life as a human development determinant in the context of economic instability. *Економiчний часопис-XXI*, 157(3–4 (1)), 59–61.
- Kolster, J. (2015). Does foreign direct investment improve welfare in North African countries. *Working Paper, North Africa Policy Series*.
- Lewis, W. A. (1954). Economic development with unlimited supplies of labour. *The Manchester School of Economic and Social Studies*, 22, 139–191.
- Liang, K.-Y. (1987). Estimating functions and approximate conditional likelihood. *Biometrika*, 4, 695–702.
- Mátyás, L., & Sevestre, P. (2013). *The Econometrics of Panel data. Handbook of Theory and Applications*. Kluwer Academic Publishers.
- Morris, M. D. (1978). A physical quality of life index. *Urban Ecology*, 3(3), 225–240.
- Morris, M. D. (1980). The Physical Quality of Life Index (PQLI). *Development Digest*, 18(1), 95–109.
- Nakouwo, S. N. (2019). *Foreign Direct Investment (FDI) and Sustainable Human Development in Africa*. Doctoral dissertation. University of Ghana.
- Narula, R. (1996). *Multinational Investment and Economic Structure. Globalisation and Competitiveness*. London and New York: Routledge.
- Oladapo, I. A., & Abdul, R. A. (2016). Re-counting the determinant factors of human development: A review of the literature. *Humanomics*, 32(2), 205–226.
- Papke, L. E., & Wooldridge, J. M. (1996). Econometric methods for fractional response variables with an application to 401 (k) plan participation rates. *Journal of Applied Econometrics*, 11(6), 619–632.
- Papke, L. E., & Wooldridge, J. M. (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics*, 145(1–2), 121–133.
- Pekár, S., & Brabec, M. (2018). Generalized estimating equations: A pragmatic and flexible approach to the marginal GLM modelling of correlated data in the behavioural sciences. *Ethology*, 124(2), 86–93.
- Pesaran, M. H. (2015). *Time Series and Panel data Econometrics*. Great Clarendon Street OX2 6DP: Oxford University Press.
- Ramvalho, E. A., Ramalho, J. J., & Coelho, L. M. (2018). Exponential regression of fractional-response fixed-effects models with an application to firm capital structure. *Journal of Econometric Methods*, 7(1).
- Ramvalho, E. A., Ramalho, J. J., & Henriques, P. D. (2010). Fractional regression models for second stage DEA efficiency analyses. *Journal of Productivity Analysis*, 34(3), 239–255.
- Ramvalho, E. A., Ramalho, J. J., & Murteira, J. M. (2011). Alternative estimating and testing empirical strategies for fractional regression models. *Journal of Economic Surveys*, 25(1), 19–68.
- Ranis, G. (1977). Development theory at three-quarters century. *Economic Development and Cultural Change*, 25, 254.
- Ranis, G., Stewart, F., & Samman, E. (2006). Human development: Beyond the human development index. *Journal of Human Development*, 7(3), 323–358.
- Ranjekshan, A. (2021). *Foreign Direct Investment and Welfare: Is Sub-Saharan Africa Different?* School of Economics and Management, Lund University.
- Rostow, W. W. (1960). 'Take-Off into Economic Growth. *Challenge*, 8(8), 29–37.
- Schwarz, G. E. (1978). Estimating the dimension of a model. *Annals of Statistics*, 6(2), 461–464.
- Scitovsky, T. (1976). *The Joyless Economy: An Inquiry into Human Satisfaction and Consumer Dissatisfaction*. Oxford University Press.
- Sen, A. (1975). *Poverty and Economic Development*. India: Ahmedabad.
- Šimanová, A. K. J. (2013). In *Pace of globalization as a determinant of human development in the developed market and transition economies*. Prague: Statistics and Economics.
- Sofilda, E., Hermiyanti, P., & Hamzah, M. (2015). Determinant variable analysis of human development index in Indonesia (Case for high and low index at period 2004–2013). *OIDA International Journal of Sustainable Development*, 8(09), 11–28.
- Stewart, F. (1985). A basic needs approach to development. In *Planning to Meet Basic Needs* (pp. 1–13). London: Palgrave Macmillan.
- Stewart, F., Ranis, G., & Samman, E. (2018). *Advancing Human Development: Theory and Practice*. Oxford University Press.
- Streeten, P. (1981). Development ideas in historical perspective. In *Development Perspectives* (pp. 100–132). London: Palgrave Macmillan.
- Streeten, P. (1994). Human development: Means and ends. *American Economic Review*, 84(2), 232–237.
- Tamer, C. R. (2013). *The effects of foreign direct investment and official development assistance on the Human Development Index in Africa*. University of Massachusetts Boston.
- Tchorek, G. (2016). Foreign direct investment and investment development path. The case of visegrad countries. *Studia i Materiały*, (2/2016 (22): cz. 2), 201–212.
- Trapczyński, P., Gorynia, M., Nowak, J., & Wolniak, R. (2019). EU countries from central and Eastern Europe, and the investment development path model: A new assessment. *Argumenta Oeconomica*, 2(43), 385–406.
- Tsionas, M. (2019). *Panel Data Econometrics: Empirical Applications*. Elsevier Science.
- UNDP. (2020). *Human Development Report. Technical Notes*. <http://hdr.undp.org/site/default/files/hdr2020_technical_notes.pdf>.
- UNDP. (2021). *United Nations Development Programme. Human Development Reports*. <<http://hdr.undp.org/en/content/human-development-index-hdi>>.
- UNDP (United Nations Development Programme). (1990). *Human development report 1990*.
- Voica, M. C., Panait, M. C., & Radulescu, I. G. (2020). The paradigm of the investment development path: The applicability for the European Union members for 1990–2014 period. In *Foreign Direct Investments: Concepts, Methodologies, Tools, and Applications* (pp. 1379–1391). IGI Global.
- Wang, J. F., Chen, S. L., & Yan, L. (2011). Strong consistency of generalized estimation equation root. *Journal of Chongqing University of Technology (Natural Science)*, 08.
- Xu, D., Solanki, S., & Fink, J. (2021). College acceleration for all? Mapping racial gaps in Advanced Placement and dual enrolment participation. *American Educational Research Journal*, 0002831221991138.
- Yang, F., Tang, Z., & Deng, H. (2009). Bivariate association analysis for quantitative traits using generalized estimation equation. *Journal of Genetics and Genomics*, 36(12), 733–743.
- Yumashev, A., Ślusarczyk, B., Kondrashev, S., & Mikhaylov, A. (2020). Global indicators of sustainable development: Evaluation of the influence of the human development index on consumption and quality of energy. *Energies*, 13(11), 2768.
- Zarei, A. R., Shabani, A., & Mahmoudi, M. R. (2020). Evaluation of the influence of occurrence time of drought on the annual yield of rain-fed winter wheat using backward multiple generalized estimation equation. *Water Resources Management*, 34, 2911–2931.
- Zeger, S. L., & Liang, K.-Y. (1986). Longitudinal data analysis for discrete and continuous outcomes. *Biometrics*, 42, 121–130.
- Zeger, S. L., Liang, K.-Y., & Albert, P. S. (1988). Models for longitudinal data: A generalized estimating equation approach. *Biometrics*, 44, 1049–1060.