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Article

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DEVELOPMENT ECONOMICS | RESEARCH ARTICLE

Foreign direct investment in food manufacturing and stages of human development

Justice Gameli Djokoto^{1*}, Paragon Pomeyie² and Camillus Abawiera Wongnaa³

Abstract: The extension of the shelf life of food through processing makes food available beyond the shelf-life of fresh agricultural produce, which has implications for food and nutrition security. Food processing creates products for the specified nutritional needs of persons with special nutritional requirements, market access for products from the agricultural sector, employment for households, opportunities for trade and marketing as well as tax revenues for the state. These contribute to the standard of living (income) as well as education and health components of human development. Existing studies have focused on assessing the human development (HD) effects of foreign direct investment (FDI). However, the differences in human development could engender differences in the effect of FDI on human development. Unlike the *ex ante* literature, we focus on food manufacturing FDI, the human development stages and the contemporaneous analysis of developed and developing countries. We used panel data from 18 and 26 developing and developed countries respectively from 1991 – 2021 and fitted it to panel generalised estimation equations and the general method of moments estimators. We find that food manufacturing FDI had a significant influence on human development for all human development stages in developing but only for low-developed countries in the category of the low human development index. Not isolating the influence of FDI on human development stages could produce misleading outcomes for developed countries. Policymakers can look at food manufacturing FDI to increase HDI and in some cases to migrate from one stage to another.

Subjects: Economics and Development; Economics; Finance

Keywords: developed countries; developing countries; food production; general estimation equations

Jel Classification Codes: F21, 63; L66; O11; Q18

1. Introduction

Many nations, developed and developing, have engineered policies and expended resources to entice foreign direct investment (FDI) into various economic sectors including food manufacturing. Food manufacturing involves the conversion of rather hulking, fresh and usually uneatable input to beneficial, shelf-steady, and pleasant foodstuff and drinkables through some processes (Djokoto, 2021b; FAO, 2010; Stadler et al., 2020). Processing food promotes food safety by reducing discarding and damage enhancing obtainability and ease of food marketing. The safety and quality of food is



enhanced (Djokoto, 2023a, 2023b; Leonard et al., 2020). Aside from these, FDI in the food manufacturing sector is expected to provide resources in addition to domestic investment, employment, technology transfer, and enhance partnerships aimed at meeting the sustainable development goals (SDGs) (UN, 2015, 2017). With the year 2030 fast approaching, the urgent need to attain the SDGs is relevant within the context of this study, no hunger, optimum health and happiness, desirable learning, humanising employment, and growth of the economy, as well as industry, innovation and infrastructure. An all-encompassing measure of welfare is Human development comprising three important dimensions specifically, a long and healthy life, access to knowledge and a decent standard of living (Roser, 2014). This paper addresses two questions. First, does FDI in food manufacturing promote welfare? and second, do human development stages differentiate the influence?

De Groot (2014) investigated the human development effects of FDI and found a negative human development effect of FDI, the latter found a positive effect of FDI on human development. Studies focusing on other sections of developing countries also reported mixed findings (Ganiyu, 2016; Gohou & Soumaré, 2012). These studies used the total FDI of the economies. Only Djokoto et al. (2022a) used food manufacturing FDI and found positive effects based on data on developed and developing countries. They did not account for the human development stages, which reflect varying levels of development and consequently could elicit different responses from FDI. Although Djokoto and Wongnaa (2023) accounted for the human development stages, their study addressed the total economy. Whilst total FDI may mask the idiosyncrasies of each sector, the human development stages may be differently influenced by FDI with or without accounting for sectoral differences. Further, FDI inflows may differ with the level of development (Djokoto, 2021a; Dunning, 1981, 1986; Dunning & Narula, 1996; Narula, 1996).

We fill these gaps with two contributions. Firstly, the effects of FDI on the human development stages are modelled and secondly, developed and developing countries are associated with the human development stages and simultaneously analysed. Panel data from 44 countries (18 and 26 developing and developed, respectively) from 1991 – 2021 was employed and fitted to both panel generalised estimation equations as well as the general method of moments estimators. We found a relationship between all the human development stages and FDI in food manufacturing for all developing and developed countries with low human development. Not isolating the effects of FDI on the human development stages effects of FDI may create misleading outcomes for developed countries. Policymakers can look at food manufacturing FDI to increase HDI and in some cases to migrate from one stage to another.

In what follows, we trace the theory of development and show how food manufacturing is connected to human development. The empirical review evidences the (human) development theory. The data and methods are outlined. This is followed by the results and associated discussions. The final section is subtitled Conclusions and policy recommendations.

2. Literature review

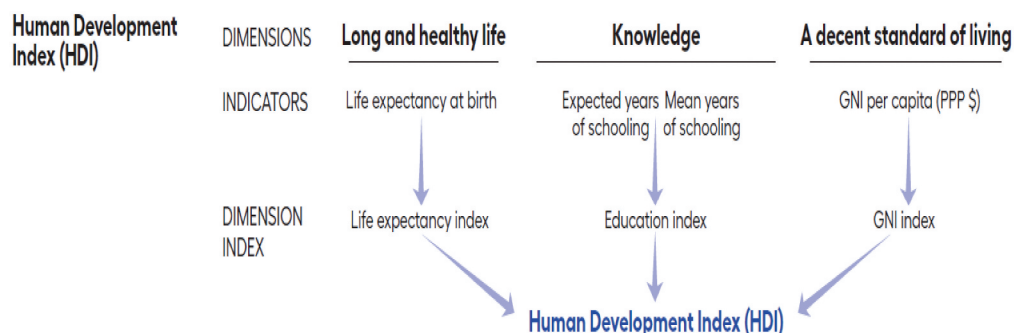
2.1. Theoretical review

Earlier, development had been considered economic growth (Lewis, 1954; Rostow, 1960). However, Morris (1978, 1980) noted that the quality of life was more important an indicator of development than income. Later, Streeten (1981) and Stewart (1985) directed attention to the delivery of rudimentary essentials. UNDP (1990) took a middle ground that money was an avenue to an end and not the finality. The position of the UNDP can be situated within the human-oriented concept. This thinking gained traction following the negative or weak growth, high poverty and debt in the 1980s – 2000s. This is crystalised in the ‘... human-oriented objectives of development such as poverty reduction, capabilities, human development, and the key role of the millennium development goals (MDGs) (Ranis, 1976; Sen, 1975; Stewart, 1985; Streeten, 1981, 1994)’ (Djokoto, 2021a, page 2).

Drawing on the human-oriented thinking of development, the maiden Human Development Report (UNDP, 1990) joined the capabilities with basic needs approaches (Sen, 1987, 1992;

Figure 1. Graphical representation – calculating the human development index.

Source: UNDP (2020).



Stewart, 1985; Streeten, 1981). This emphasised the requirements of the underprivileged. The foremost components “of human development are long and healthy life, being knowledgeable and having a decent standard of living” (Djokoto, 2021a, page 1). These were composed of the human development index (HDI), the geometric mean of the normalised indices for each of the three components (Djokoto, 2021a; Djokoto & Wongnaa, 2023; UNDP, 2021). Life expectancy at birth measures health. Education is considered the average annual period of schooling for persons aged 25 years and the anticipated annual period of schooling for children at the age of first school entry. The gross national income per capita captures the living standards component (Djokoto, 2021a; UNDP, 2020) (Figure 1). The HDI, which ranges from 0 to 1, is categorised as shown in Figure 2. It is worth noting that social and economic measures influence people’s lives (Djokoto et al., 2022b; Sen, 1987, 1992, 1997, 1998).

Food manufacturing is linked to the three components of the HDI. The extension of the shelf life of food through processing makes food available beyond the shelf-life of the fresh agricultural produce, which has implications for food and nutrition security (Djokoto, 2021b, Djokoto et al. 2022b; FAO, 2010; Leonard et al., 2020; Phan et al., 2020; Stadler et al., 2020). The processing also creates products for the specified nutritional needs of persons with special nutritional requirements. Food manufacturing creates market access for products from the agricultural sector (Djokoto, 2021b). The manufacturing process creates employment for households, opportunities for trade and marketing as well as tax revenues for the state (Djokoto et al. 2022b; Hine, 2015; Kosova, 2010; Primanthi, 2015; UN, 2015, 2017). Income from agriculture production and food manufacturing goes to households and the state to fund food and nutrition, education, and health among other social services. These contribute to the standard of living (income) as well as education and health components of human development (Conceição et al., 2016; De Silva et al., 2000, Djokoto et al. 2022a; Essemeyr, 1983, 1986; Verwimp, 2012). From the foregoing, investments in food manufacturing would impact the various components of HDI and ultimately, the total HDI.

Figure 2. Stages of human development.

0.800 and above	Very high human development
0.700 - 0.799	High human development
0.550 - 0.699	Medium humn development
Below 0.550	Low human development

2.2. Empirical review

Existing literature on the HDI effects of FDI covers Africa and its parts (Adegboye et al., 2021; Aloui, 2019; Ganiyu, 2016; Hamdi & Hakimi, 2021; Kolster, 2015; Tamer, 2013) as well as the Association of South-East Asian Nations (ASEAN) (Kaukab & Surwandono, 2021; Nam & Ryu, 2022). Other spatial representations include Latin America (Aloui, 2019), developing countries (Djokoto et al. 2022a; Reiter & Steensma, 2010) and the world (Djokoto & Wongnaa, 2023; Orbes Cervantes et al., 2022; Srivastava & Talwar, 2020). As the unit of analysis is countries, the panel data has the earliest year as 1970 (1970–2010, De Groot, 2014) and the latest as 2019 (1990–2019, Djokoto & Wongnaa, 2023). The structure of the data informed the estimation procedures of the studies, namely, fixed effects (FE), the general method of moments (GMM), panel vector error correction, seemingly unrelated regression, fully modified Ordinary Least Squares (FMOLS) and panel generalised estimation equations (XTGEE). All studies used HDI as the indicator for human development.

For developing countries and their sub-regions, FDI promotes human development (Aloui, 2019; Djokoto, 2021a; Djokoto & Wongnaa, 2023; Ganiyu, 2016; Gohou & Soumaré, 2012; Hamdi & Hakimi, 2021; Kaukab & Surwandono, 2021; Kolster, 2015; Reiter & Steensma, 2010; Tamer, 2013). However, De Groot (2014) and Nam and Ryu (2022) provided contrary evidence. Srivastava and Talwar (2020) also provided evidence for a neutral effect. Foreign investment generates more employment, grows local know-how, and fuels technological progress, that enhances human development (Djokoto et al. 2022b; Ganiyu, 2016). More specifically, Tamer (2013) clarified that FDI is more operative in economies possessing commercially active environments. The negative human development effect of FDI is attributable to budget constraints encountered by policymakers that instigated certain spending choices that led to the negative effect (De Groot, 2014). Disbursing resources to attract FDI may thus deprive social sectors such as health and education of resources (De Groot, 2014).

On the global stage, Orbes Cervantes et al. (2022) and Srivastava and Talwar (2020), found co-movement and neutral human development effects of FDI. FDI contributes to enhanced human development including the growth of the economy and increased income which could increase spending on education and health (Orbes Cervantes et al., 2022). Government expenditure's effect on products is positive (Djokoto, 2022; Kolster, 2015), negative (Aloui, 2019; Djokoto & Wongnaa, 2023) and neutral (De Groot, 2014; Djokoto et al. 2022a; Orbes Cervantes et al., 2022).

There is sectoral evidence of the human development effect of FDI at the sectoral level. Djokoto et al. (2022b) researched the human development effects of FDI in developing countries using data on 51 developing countries from 1990 – 2019. Agricultural FDI promoted human development. The other sectoral study specific to food manufacturing is Djokoto et al. (2022b) which used unbalanced panel data from 44 countries (18 developing and 26 developed) from 1991 to 2018 with FE and GMM estimators. Developing and developed countries' food manufacturing FDI and human development of the total economy have a positive relationship (Djokoto et al. 2022a). However, developed countries' outcome was stronger than developing countries' outcome (Djokoto et al. 2022b).

There is a mixed human development effect of inflation; positive (Aloui, 2019; Djokoto et al., 2022a; Hamdi & Hakimi, 2021; Nam & Ryu, 2022), negative (Djokoto, 2021b; Djokoto & Wongnaa, 2023; Ganiyu, 2016) and neutral effect (De Groot, 2014; Djokoto et al., 2022b; Tamer, 2013). Inflation decreases the value of money for economic agents, causing the opposite relationship (Djokoto, 2021b; Djokoto & Wongnaa, 2023).

In the pertinent literature, infrastructure was proxied as paved roads (Kolster, 2015) and subscriptions of fixed cum mobile telephones per 100 people (Adegboye et al., 2021; Djokoto, 2021b; Djokoto et al. 2022b; Djokoto & Wongnaa, 2023). The evidence shows that irrespective of the measurement of infrastructure, the effect has been positive. Infrastructure encompasses education, health, roads, and others (Djokoto et al., 2022a,b; Djokoto & Wongnaa, 2023).

Some studies reported the effect of the growth of the population on human development (De Groot, 2014; Djokoto et al., 2022a; Djokoto & Wongnaa, 2023). Population growth and human development had a negative relationship. Health and education facilities are stressed by increases (Djokoto et al. 2022a). In the absence of appropriate expansion, competition would set in (Djokoto et al. 2022a).

Human development of trade openness is mixed; positive (Orbes Cervantes et al., 2022; Djokoto et al., 2022a; Djokoto & Wongnaa, 2023; Hamdi & Hakimi, 2021; Nam & Ryu, 2022; Tamer, 2013) and neutral (De Groot, 2014; Djokoto, 2021b, Djokoto et al. 2022b; Kolster, 2015). The pertinent literature did not adduce reasons for the effect of trade openness.

Whilst other literature related to the total economy addressed developing countries and their sub-regions as well as developed countries, the empirical review shows evidence of the relationship between agriculture and food manufacturing FDI and human development. Conspicuously missing is sectoral FDI effects on the stages of the HDI. We plug these fissures by addressing the influence of food manufacturing FDI on stages of HDI.

From the foregoing, we formulate three hypotheses:

- H1:** Foreign direct does not influence the level of human development in developing countries.
- H2:** Foreign direct does not influence the level of human development in developed countries.
- H3:** The human development effect of FDI is the same as on the stages of human development.

3. Data, methods and estimation procedure

3.1. Data

The data is made up of 609 observations constituted by 18 and 26 developing and 26 developed countries, respectively (Appendix 1), 1991 – 2021. The division is informed by the United Nations (2022). As some HDI of some countries may not correlate with their classification as developing countries, these are accounted for in the analysis. The number of developing and developed countries constituting the data is not based on statistical representativeness, but rather on the availability of data and identification of countries with the available data. The resulting observations (data) are adequate for the estimators to be used and to provide efficient estimates.

3.2. Methods

We model the determinants of human development using equation 1 which is informed by the study objectives and the relevant literature (Adegboye et al., 2021; Aloui, 2019; Djokoto & Wongnaa, 2023; Ganiyu, 2016; Gohou & Soumaré, 2012; Hamdi & Hakimi, 2021; Orbes Cervantes et al., 2022; Reiter & Steensma, 2010; Tamer, 2013).

$$\begin{aligned} HDI_{it} = & \alpha_0 + \alpha_1 FDI_{it} + \alpha_2 FDI_DVD_LHD_{it} + \alpha_3 FDI_DVD_MHD_{it} + \alpha_4 FDI_DVD_HHD_{it} \\ & + \alpha_5 FDI_DVP_LHD_{it} + \alpha_6 FDI_DVP_MHD_{it} + \alpha_7 FDI_DVP_HHD_{it} + \alpha_8 FDI_DVP_VHHD_{it} \\ & + \alpha_9 NFFDI_{it} + \alpha_{10} GE_{it} + \alpha_{11} INFLA_{it} + \alpha_{12} INFRAS_{it} + \alpha_{13} POPG_{it} + \alpha_{14} TO_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

Equation 2 is formulated without accounting for economic and human development.

$$\begin{aligned} HDI_{it} = & \beta_0 + \alpha_1 FDI_{it} + \beta_2 FDI_DVP_{it} + \beta_3 NFFDI_{it} + \beta_4 GE_{it} + \beta_5 INFLA_{it} + \beta_6 INFRAS_{it} + \beta_7 POPG_{it} \\ & + \beta_8 TO_{it} + \omega_{it} \end{aligned} \quad (2)$$

HDI ranges from 0 to 1 and is measured as the human development index. The natural logarithm of the foreign direct investment inflow in current US dollars is *FDI*. *DVD* captures developed countries whilst developing countries are represented by *DVP*. *LHD* is the low human development index and *MHD* is the medium human development index. Whilst *HHD* has a high human development index, *VHHD* represents HDIs classified as very high human development index. *FDI_DVD_LHD* is developed countries' foreign direct investment with a low human development index. *FDI_DVD_MHD* captures developed countries' foreign direct investment with an *MHD*. *FDI_DVD_HHD* connotes developed countries' foreign direct investment with *HHD*. *FDI_DVP_LHD* represents developing countries' foreign direct investment with *LHD*. Developing countries' foreign direct investment with *MHD* is captured by *FDI_DVP_MHD*. *FDI_DVP_HHD* is developing countries' foreign direct investment with an *HHD* whilst *FDI_DVP_VHHD* is developing countries' foreign direct investment with a *VHHD*. The reference is *FDI_DVD_VHHD*, developed countries' foreign direct investment with *VHHD*. *FDI_DVP* represents developing countries' foreign direct investment.

Foreign direct investment for non-food manufacturing is *NFFDI*, measured as the natural logarithm of the non-food manufacturing FDI in current US dollars. *NFFDI* takes account of possible omitted variable bias in the model. *GE*, general government expenditure is measured as final general government expenditure on products as a ratio of gross domestic product (GDP). Inflation, measured as the annual growth rate of the consumer price index is captured as *INFLA*. *INFRAS* is a proxy for infrastructure; subscriptions per 100 people for fixed and mobile telephones. The annual growth rate of the population of both sexes is *POPG*. The sum of exports and imports as a ratio of gross domestic product is *TO*, trade openness.

There are i cross-sections (countries) and t periods (years). Whilst α_i and θ_i are parameters to be estimated, ε_{it} and ω_{it} are the idiosyncratic error terms. *HDI* was sourced from UNDP (2023). The source of food manufacturing *FDI* was FAOSTAT (2023).¹ The control variables were obtained from the World Bank (2023).²

3.3. Estimation procedure

Since the cross-section dimension (42 countries) exceeds the time dimension (31 years) the former rather than the latter preponderates in the panel. Hence, the cross-section properties dive into the data. In the existing literature, *HDI* was linearly related to the explanatory variables (Adegboye et al., 2021; Aloui, 2019; Ganiyu, 2016; Gohou & Soumaré, 2012; Hamdi & Hakimi, 2021; Orbes Cervantes et al., 2022; Reiter & Steensma, 2010; Tamer, 2013). However, the *HDI* was observed within the unit interval (0 and 1), indicating the distribution of *HDI* could be non-linear (Ramalho et al., 2018). We considered that the *HDI* could follow a logit, probit, loglog or cloglog distribution. Thus, we performed a back transformation to a linear form. In the first step of our estimation, the transformed *HDI* were fitted to linear regression as well as the untransformed *HDI*. The Akaike (AIC) cum Bayesian (AIC, BIC) information criteria (Akaike, 1974; Schwarz, 1978) were estimated for all five models to help select the appropriate model.

Given that *FDI* interacts with the level of development, there is an endogeneity problem. That is, some of the variables influencing the level of development also impact the human development index. Indeed, unobserved confounding factors simultaneously influence human development and the level of development and create an endogeneity bias. The explanatory variables could no longer be treated as exogenous. The situation is resolved by employing the GMM estimator. The second step involved the estimation of the selected model using the GMM to consider endogeneity. We assessed the robustness.

Using the estimates from Equation 1, the stages of human development effects of food manufacturing *FDI* are outlined in Table 1. These were evaluated as the Wald and at the means of the development categorisation and stage of human development except for very high human development for developed countries. A chi-square test is employed for the Wald.

Table 1. Foreign direct investment effects on levels of development and stages of human development as the Wald

Low human development	Medium human development	High human development	Very high human development
Developed countries			
$\alpha_1 + \alpha_2 * \overline{DVD_LHD}$	$\alpha_1 + \alpha_3 * \overline{DVD_MHD}$	$\alpha_1 + \alpha_4 * \overline{DVD_HHD}$	α_1
Developing countries			
$\alpha_1 + \alpha_5 * \overline{DVP_LHD}$	$\alpha_1 + \alpha_6 * \overline{DVP_MHD}$	$\alpha_1 + \alpha_7 * \overline{DVP_HHD}$	$\alpha_1 + \alpha_8 * \overline{DVP_VHHD}$

4. Results and discussions

4.1. Results

The number of observations of each general development and human development group is presented in Appendix 2. The minimum HDI of 0.039 was recorded by Iceland in 1993 and the maximum of 0.947 for Sweden in 2021 (Table 2). The mean HDI is 0.7667 which coincides with

Table 2. Descriptive statistics

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
HDI	609	0.7667	0.1457	0.0394	0.9470
LNFMFDI	609	18.6183	2.4449	2.3026	24.4765
FFDI_DVP	609	7.7930	9.0922	0	23.5314
FFDI_DVD	609	10.7947	9.6121	0	24.4765
FFDI_DVD_LHD	609	0.2601	1.9596	0	19.2802
FFDI_DVD_MHD	609	0.0449	0.7869	0	15.1238
FFDI_DVD_HHD	609	1.5637	5.0908	0	21.5584
FFDI_DVD_VHHD	609	8.8907	9.8121	0	24.4765
FFDI_DVP_LHD	609	1.6132	4.9652	0	20.0904
FFDI_DVP_MHD	609	2.0169	5.7120	0	21.8064
FFDI_DVP_HHD	609	2.9768	6.9770	0	23.5314
FFDI_DVP_VHHD	609	1.1562	4.4834	0	20.6384
DVP_LHD	609	0.0969	0.2960	0	1
DVP_MHD	609	0.1117	0.3152	0	1
DVP_HHD	609	0.1560	0.3631	0	1
DVP_VHHD	609	0.0657	0.2479	0	1
DVD_LHD	609	0.0181	0.1333	0	1
DVD_MHD	609	0.0870	0.2821	0	1
DVD_HHD	609	0.0870	0.2821	0	1
DVD_VHHD	609	0.4581	0.4987	0	1
LNNFFDI	609	29.2232	12.1641	-16.3877	54.8412
INFLA	609	7.10635	60.9309	-1.7360	1500
POPG	609	0.7758	0.9197	-3.8477	3.2256
TO	609	78.134	38.8450	19.7865	290.9025
INFRAS	609	98.8613	57.5735	0.2123	199.5712
GE	609	16.7656	5.4553	4.0701	27.3765

Brazil, in 2019 and Mexico in 2015. The mean falls within the high human development band (0.700–0.799).

The correlation matrix reported in Appendix 3 suggests no significant correlation among the key variables. In Table 3, model 1 has the lowest AIC (–2105) and BIC (–2039) across models 1–5. This implies a linear relationship between HDI and the explanatory variables. Consequently, we fitted the data to a GMM estimator and performed robustness checks as shown in Table 4. The estimates of the first lag of HDI are statistically significant suggesting the endogeneity has been accounted for. The statistical insignificance of the AR(2) and the Sargan statistics suggest respectively, that there is no order-two serial correlation and that the overidentifying restrictions are valid. Across models 7–13, the key variables’ estimates are similar in magnitude, sign, and statistical significance. This suggests the estimates are robust to the control variables.

Table 3. Selection models

	(1)	(2)	(3)	(4)	(5)
VARIABLES	HDI	lyLOGIT	lyPROBIT	lyLOGLOG	lyCLOGLOG
LNFMDI	0.0067*** (0.0009)	0.0466*** (0.0059)	0.0258*** (0.0032)	0.0408*** (0.0048)	0.0233*** (0.0035)
FFDI_DVD_LHD	–0.0351*** (0.0009)	–0.1896*** (0.0063)	–0.1109*** (0.0035)	–0.1439*** (0.0052)	–0.1226*** (0.0038)
FFDI_DVD_MHD	–0.0100*** (0.0022)	–0.0621*** (0.0149)	–0.0355*** (0.0082)	–0.0578*** (0.0123)	–0.0288*** (0.0090)
FFDI_DVD_HHD	–0.0028*** (0.0004)	–0.0197*** (0.0028)	–0.0110*** (0.0015)	–0.0188*** (0.0023)	–0.0085*** (0.0017)
FFDI_DVP_LHD	–0.0172*** (0.0006)	–0.0874*** (0.0043)	–0.0519*** (0.0024)	–0.0741*** (0.0035)	–0.0495*** (0.0026)
FFDI_DVP_MHD	–0.0086*** (0.0005)	–0.0516*** (0.0033)	–0.0297*** (0.0018)	–0.0464*** (0.0028)	–0.0258*** (0.0020)
FFDI_DVP_HHD	–0.0046*** (0.0003)	–0.0350*** (0.0023)	–0.0192*** (0.0013)	–0.0326*** (0.0019)	–0.0155*** (0.0014)
FFDI_DVP_VHHD	–0.0007* (0.0004)	–0.0108*** (0.0029)	–0.0054*** (0.0016)	–0.0107*** (0.0024)	–0.0036** (0.0018)
LNNFFDI	0.0004** (0.0002)	0.0011 (0.0011)	0.0008 (0.0006)	0.0001 (0.0009)	0.0016** (0.0007)
INFLA	–0.0000 (0.0000)	–0.0002 (0.0002)	–0.0001 (0.0001)	–0.0002 (0.0002)	–0.0001 (0.0001)
POPG	0.0034 (0.0029)	0.0900*** (0.0191)	0.0429*** (0.0105)	0.0904*** (0.0158)	0.0273** (0.0116)
TO	0.0000 (0.0001)	0.0003 (0.0004)	0.0002 (0.0002)	0.0001 (0.0003)	0.0003 (0.0002)
INFRAS	0.0005*** (0.0000)	0.0036*** (0.0003)	0.0020*** (0.0002)	0.0032*** (0.0003)	0.0017*** (0.0002)
GE	0.0023*** (0.0005)	0.0146*** (0.0035)	0.0083*** (0.0019)	0.0135*** (0.0029)	0.0068*** (0.0021)
CONSTANT	0.6113*** (0.0192)	0.1856 (0.1282)	0.1668** (0.0707)	0.4955*** (0.1060)	–0.1819** (0.0776)
Model diagnostics					
Observations	608	608	608	608	608
R-squared	0.9176	0.8835	0.8939	0.8873	0.8693
F	471***	321***	357***	333***	282***
AIC	–2105	204	–519	–27	–406
BIC	–2039	271	–453	39	–340

Notes: 1. Standard errors in parenthesis. 2. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 4. Robustness of estimates of key variables to the control variables

VARIABLES	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	HDI	HDI	HDI	HDI	HDI	HDI	HDI
L.HDI	0.0741*** (0.0115)	0.0770*** (0.0079)	0.0890*** (0.0270)	0.0263 (0.0187)	0.0661*** (0.0175)	0.0927*** (0.0204)	0.0643*** (0.0200)
LNFMFDI	0.0114*** (0.0010)	0.0120*** (0.0009)	0.0112*** (0.0010)	0.0096*** (0.0012)	0.0087*** (0.0009)	0.0099*** (0.0009)	0.0037** (0.0017)
FFDI_DVD_LHD	-0.0351*** (0.0004)	-0.0350*** (0.0003)	-0.0354*** (0.0009)	-0.0338*** (0.0003)	-0.0355*** (0.0006)	-0.0358*** (0.0008)	-0.0364*** (0.0010)
FFDI_DVD_MHD	-0.0057*** (0.0008)	-0.0057*** (0.0004)	-0.0059*** (0.0006)	-0.0063*** (0.0008)	-0.0068*** (0.0004)	-0.0059*** (0.0008)	-0.0073*** (0.0009)
FFDI_DVD_HHD	-0.0062*** (0.0005)	-0.0056*** (0.0006)	-0.0054*** (0.0005)	-0.0043*** (0.0007)	-0.0015*** (0.0003)	-0.0051*** (0.0006)	-0.0015*** (0.0003)
FFDI_DVP_LHD	-0.0117*** (0.0025)	-0.0140*** (0.0017)	-0.0164*** (0.0011)	-0.0141*** (0.0018)	-0.0119*** (0.0018)	-0.0096*** (0.0017)	-0.0034 (0.0024)
FFDI_DVP_MHD	-0.0091*** (0.0019)	-0.0096*** (0.0018)	-0.0101*** (0.0018)	-0.0089*** (0.0012)	-0.0090*** (0.0016)	-0.0057*** (0.0008)	-0.0005 (0.0024)
FFDI_DVP_HHD	-0.0070*** (0.0011)	-0.0072*** (0.0016)	-0.0064*** (0.0014)	-0.0059*** (0.0011)	-0.0086*** (0.0015)	-0.0032*** (0.0006)	-0.0008 (0.0023)
FFDI_DVP_VHHD	-0.0053*** (0.0012)	-0.0054*** (0.0018)	-0.0040** (0.0016)	-0.0036*** (0.0010)	-0.0073*** (0.0016)	-0.0007 (0.0007)	-0.0002 (0.0022)
LNFFDI	-0.0001 (0.0000)						-0.0001 (0.0001)
INFLA		-0.0002*** (0.0001)					-0.0001 (0.0001)
POPG			0.0020** (0.0009)				-0.0014** (0.0007)
TO				0.0012*** (0.0001)			0.0004*** (0.0001)
INFRAS					0.0007*** (0.0000)		0.0006*** (0.0000)

(Continued)

Table 4. (Continued)							
VARIABLES	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	HDI	HDI	HDI	HDI	HDI	HDI	HDI
GE						0.0090*** (0.0006)	0.0049*** (0.0010)
CONSTANT	0.5771*** (0.0180)	0.5685*** (0.0121)	0.5734*** (0.0215)	0.5520*** (0.0223)	0.5626*** (0.0166)	0.4118*** (0.0222)	0.4978*** (0.0360)
Model diagnostics							
Observations	466	466	466	466	466	466	466
Countries	43	43	43	43	43	43	43
Wald	3.33E+05***	2.23E+05***	1.74E+05***	1.19E+05***	4.11E+05***	6.49E+04***	5.03E+05***
Probability of AR(2)	0.3471	0.3327	0.3139	0.2941	0.3376	0.3020	0.4040
Probability of Sargan	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Notes: 1. Standard errors in parenthesis. 2. ***p<0.01, **p<0.05, *p<0.10.

4.2. Discussion of control variables

We first discuss the control variables as the estimates occur in Table 4. The positive coefficient of GE implies as GE increases by one unit, HDI will increase by 0.56%. Government expenditure on goods and services would lead to an increase in HDI if these are channelled into a welfare-inducing area such as health and education. Further, GE is an additive variable in the national income equation, thus an increase would lead to an increase in GDP. This would increase the standard of living component of the HDI. This finding coincides with that of Kolster (2015) but diverges with Aloui (2019) and Djokoto and Wongnaa (2023) who reported negative effects. Most studies, however, found neutral effects (De Groot, 2014; Djokoto, 2021b; Djokoto et al. 2022a; Ganiyu, 2016; Orbes Cervantes et al., 2022).

The negative sign of inflation is expected because inflation decreases the value of money of consumers. However, the magnitude is statistically not different from zero. The finding disagrees with Djokoto (2021b) and Ganiyu (2016). Whilst Aloui (2019) reported a positive effect for SSA, similar effects were reported by Hamdi and Hakimi (2021) for MENA countries in the short run, Aloui (2019) for Latin America, De Groot (2014) for developing countries, Gohou and Soumaré (2012) and Tamer (2013) for Africa as well as Kolster (2015) for North Africa. Djokoto et al. (2022b) reported positive effects for both developing and developed countries.

Infrastructure can be considered the backbone of the economy. It is the “hardware” on which the economy operates. Roads, telecommunications, and physical facilities, among others, are essential for welfare. The use of these produces income and renders services that enhance education and health. An increase in INFRAS increases human development. The findings of the current study are in line with Adegboye et al. (2021), Djokoto (2021b), Djokoto et al. (2022b), Djokoto and Wongnaa (2023), Kolster (2015) and Tamer (2013).

Table 5. The Wald of the effects of foreign direct investment on the stages of HDI

(I) Low human development	(II) Medium human development	(III) High human development	(IV) Very high human development
Developed countries			
Stages effects			
0.0030	0.0033	0.0030	0.0033
(0.0017)	(0.0045)	(0.0047)	(0.0045)
[3.06]*	[0.53]	[0.44]	[0.53]
Common effect			
0.0034			
(0.0020)			
[3.02]*			
Developing			
Stages effects			
0.0034	0.0036	0.0036	0.0037
(0.0016)	(0.0015)	(0.0014)	(0.0016)
[4.66]**	[5.87]**	[6.27]***	[5.22]**
Common effect			
0.0051			
(0.0024)			
[4.33]**			

Notes: 1. Standard errors in parenthesis. 2. Chi-square statistics in square brackets. 3. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Growth in population by 1% decreases HDI by 0.14%. An increase in population could create competition for welfare services thereby decreasing human development. However, an increase in population in countries experiencing declining populations or slow growth could help in human development as this would provide the needed labour resources among others. This finding is in line with that of De Groot (2014) and Djokoto et al. (2022a) which reported negative effects respectively. Djokoto and Wongnaa (2023) however reported a positive association between developed and developing countries.

Previous papers have shown a co-movement of trade and human development (Djokoto & Wongnaa, 2023; Hamdi & Hakimi, 2021; Orbes Cervantes et al., 2022). Access to products and services from other countries would allow households to acquire and consume goods and services not produced in the resident country. Firms would also acquire resources and market their products that are not consumed locally. As firms' activities would contribute to increasing GDP, consumption of goods and services by households would increase welfare. Contrary to the findings of the current study, Adegboye et al. (2021) reported negative effects of trade on HDI whilst other studies reported neutral effects (De Groot, 2014; Djokoto, 2022; Kolster, 2015).

4.3. Discussion of main effects

The effects of foreign direct investment in the food manufacturing sector on stages of human development are positive (Table 5). For developed countries, the FDI effect is significant for only stage I, albeit weakly. This coincides with the estimation for all four stages jointly. That is, failing to recognise the stages, the result is like that of stage I. This is the case for 3 countries, Hungary, Iceland, and Malta, making up 11 observations out of 346 for developed countries and 70 for countries with low human development index. However, those of stages II, III and IV are statistically insignificant and hence depart from that of the common effect. Failure to estimate the human development stages' effects would provide misleading results for 29 (more than 90%) out of the 32 developed countries, and more than 50% of the observations. The human development stages must be recognised in estimating the effects of food manufacturing FDI. This lends credence to modelling the stages of HDI, one of the contributions of this paper. Our findings for stages I (low human development), II (medium human development), III (high human development) and IV (very high human development) regarding developed countries are consistent with that of the total economy (Djokoto & Wongnaa, 2023).

Regarding developing countries, the magnitudes of the effects are statistically distinguishable from zero. Although there is a rise in the effect size from stage I towards stage IV, the rise is infinitesimal. Unlike the case for developed countries, where the joint effect departed from most of the stages, for developing countries, the human development stages' effects of FDI are congruent with that of the joint effect. Thus, failure to recognise the stages of human development in assessing the effect of food manufacturing FDI will not lead to misleading results for developing countries. This congruence is beneficial to about 40% of the countries in the sample and less than 44% of the observations in the sample. The conclusions of Djokoto and Wongnaa (2023) are consistent with those of this study for stages II, III and IV. Djokoto and Wongnaa (2023) found a relationship for developing countries. Further, our result is unlike the finding of Djokoto (2022b) in which the effect for developed countries was found to be statistically bigger than that of developing countries. This implies similar policy recommendations within the context of each development group (developed and developing) regarding the effect of FDI on HDI would be apt. In developing countries, one USD rise in FDI in food processing would induce at least 0.34% (0.003) and at most 0.37% (0.004) in HDI. The 0.003 is also three times the difference as one moves from lower human development to a higher index category. The margin of change induced in the HDI is greater than the 0.001 required in moving from one stage to another. For example, the upper limit for medium human development is 0.699 whilst the lower limit for high human development is 0.700. Also, the upper limit for very high human development is 0.799 whilst the lower limit for very high human development is 0.800. The boundary value between low human development and medium human development is 0.550. Thus, for countries on the boundary values of the upper and

lower limits, a change of 0.003 or 0.004 is about three and four times capable of moving a country from one stage of human development to the other.

The results for both developed and developing countries show that the extension of the shelf life of food through processing makes food available beyond the shelf-life of the fresh agricultural produce, which has implications for food and nutrition security (Djokoto, 2021b, 2022; FAO, 2010; Leonard et al., 2020; Phan et al., 2020; Stadler et al., 2020). Also, the processing creates products for the specified nutritional needs of persons with special nutritional requirements. Food manufacturing creates market access for products from the agricultural sector (Djokoto, 2021b). Further, the manufacturing process creates employment for households, opportunities for trade and marketing as well as tax revenues for the state (Djokoto, 2022; Hine, 2015; Kosova, 2010; Pramanthi, 2015; UN, 2015, 2017). Regarding the income component of human development, income from agriculture production and food manufacturing goes to households and the state to fund food and nutrition, education, and health among other social services. These contribute to the standard of living (income) as well as education and health components of human development (Conceição et al., 2016; De Silva et al., 2000; Djokoto, 2022; Essemyr, 1983, 1986; Verwimp, 2012).

The positive and statistically significant effect of food manufacturing FDI on the human development index for developing countries aligns with the previous findings of Aloui (2019), Djokoto and Wongnaa (2023), Ganiyu (2016), Gohou and Soumaré (2012), Hamdi and Hakimi (2021), Kaukab and Surwandono (2021), Kolster (2015), Reiter and Steensma (2010), Tamer (2013). However, De Groot (2014) and Nam and Ryu (2022) provided contrary evidence. Srivastava and Talwar (2020) also provided evidence for a neutral effect.

The positive effects imply that attracting FDI into the food manufacturing sector enhances HDI. Although food manufacturing is a sub-sector within the main manufacturing sector, it has induced a significant change in human development for the total economy. This can be attributable to the fact that households in the economy consume manufactured food. Also, food manufacturing is integrated into the agriculture, manufacturing, and services sectors. In the case of agriculture, food manufacturing provides market access and complementary demand for other factors of production such as labour. The services sector such as marketing (sales, distribution, warehousing, transport, etc.) also provides market access to manufactured food products. Consumption of manufactured food provides nutrition that can improve health and contribute to longevity. Manufactured food products increase the shelf life of agricultural products (Djokoto, 2021a; FAO, 2010; Leonard et al., 2020; Phan et al., 2020; Stadler et al., 2020), thereby improving food quality, food safety and food security (Djokoto, 2021a; FAO, 2010; Leonard et al., 2020; Phan et al., 2020; Stadler et al., 2020). The value addition created by the manufacturing of agricultural produce into manufactured food creates employment and profit for entrepreneurs. Together, these would increase income for economic agents. This would reflect an increased GDP that is a constituent of GNI (Rossana, 2011; Sikdar, 2020; Thomas, 2021) which is, one of the three components of HDI (UNDP, 2020).

From the discussions, hypotheses; H1, H2 and H3 have been disproved. That is, firstly, foreign direct significantly affects the level of human development in developing countries. Secondly, foreign direct significantly affects the level of human development in developed countries. Thirdly, the human development stages' effects of foreign direct investment are different from the human development effects of foreign direct investment.

5. Conclusion and policy recommendations

The extension of the shelf life of food through processing makes food available beyond the shelf-life of fresh agricultural produce, which has implications for food and nutrition security. Food processing creates products for the specified nutritional needs of persons with special nutritional requirements, market access for products from the agricultural sector, employment for households, opportunities for trade and marketing as well as tax revenues for the state. The income from agriculture production and

food manufacturing goes to households and the state to fund food and nutrition, education, and health among other social services. These contribute to the standard of living (income) as well as education and health components of human development. This study departs from the ex-ante literature in two ways. First, the focus of the effect of food manufacturing is on the stages of the HDI. Second, the effects of food manufacturing FDI on the stages of HDI were studied for developed and developing countries contemporaneously. Food manufacturing FDI had a significant effect on human development for all the stages of human development in developing countries. The effect of the size of food manufacturing FDI on the stages of human development is three to four times the margin required to move from one stage of human development to the other. The weak statistically significant developed countries' human development effects of FDI conform to only stage I. Consequently, the joint weak effect is inconsistent with that of most of the data and most countries in the sample.

Consequently, it is worth accounting for human development stages in analysing HDI. The effect of food manufacturing FDI can move a country from one stage of human development to the other, especially those around the boundary values. The opposite is also true, that is, a decrease in food manufacturing FDI could make a country slip to a lower stage of human development.

Policymakers can look at food manufacturing FDI as a way not only to increase HDI within the specific band or stage of human development but also to migrate from one level of human development to another. Although food manufacturing is a subsector of the economy, the products of food manufacturing benefit both firms and households. Thus, food manufacturing FDI deserves to be promoted. Whilst economic managers must pay attention to final government expenditure on goods and services and direct these into human development-inducing activities, attention must not be shifted from population growth.

The study is limited to food manufacturing. Further research can focus on the agricultural sector, a sector with which food manufacturing integrates backwards and provides food for humankind just as food manufacturing. In this, the stages of HDI must be modelled. Additional attention can be on a superlative analysis of the size of the effects for each stage. These would be important for policy formulation. The effect of trade, the other twin of economic openness to FDI can be assessed on the stages of human development.

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Notes

1. The URL is included as part of the reference.
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Appendices

Appendix 1. List of countries in the data

Developing countries				
Bangladesh	Costa Rica	Mexico	Republic of Korea	Turkey
Brazil	India	Pakistan	Saudi Arabia	Uruguay
Cambodia	Israel	Paraguay	Thailand	
Chile	Malawi	Philippines	Tunisia	
Developed countries				
Austria	Estonia	Italy	Portugal	UK
Belgium	France	Latvia	Romania	US
Bulgaria	Germany	Lithuania	Slovakia	
Croatia	Greece	Malta	Slovenia	
Cyprus	Hungary	Netherlands	Spain	
Czechia	Iceland	Poland	Sweden	

Appendix 2. Observations of the general development and human development group

General development and human development group (Variable)	Observations
Low human development (LHD)	70
Medium human development (MHD)	70
High human development (HHD)	148
Very high human development (VHHD)	319
Developed countries with LHD (DVD_LHD)	11
Developed countries with MHD (DVD_MHD)	53
Developed countries with HHD (DVD_HHD)	53
Developed countries with VHHD (DVD_VHHD)	279
Developing countries with LHD (DVP_LHD)	59
Developing countries with MHD (DVP_MHD)	68
Developing countries with HHD (DVP_HHD)	95
Developing countries with VHHD (DVP_VHHD)	40

Appendix 3. Correlation matrix

F-P_VHHD	HDI	LNFMFI	FFDI_DVP	FFDI_DVD	FFDI_DVD_LHD	FFDI_DVD_MHD	FF-D_HHD	F-D_VHHD	FF-P_LHD	FF-P_MHD	FF-P_HHD	F-P_VHHD
HDI	1.0000											
LNFMFI	0.4948	1.0000										
FFDI_DVP	-0.5070	-0.1200	1.0000									
FFDI_DVD	0.5961	0.3519	-0.9715	1.0000								
FFDI_DVD_LHD	-0.4200	-0.2198	-0.1207	0.0613	1.0000							
FFDI_DVD_MHD	-0.0416	-0.1249	-0.0518	0.0190	-0.0082	1.0000						
FFDI_DVD_HHD	0.0238	-0.0155	-0.2404	0.2230	-0.0382	-0.0164	1.0000					
FFDI_DVD_V-D	0.6603	0.4376	-0.7585	0.8196	-0.1206	-0.0518	-0.2403	1.0000				
FFDI_DVP_LHD	-0.6361	-0.2665	0.3235	-0.3687	-0.0458	-0.0197	-0.0912	-0.2878	1.0000			
FFDI_DVP_MHD	-0.3067	-0.0814	0.4062	-0.4024	-0.0500	-0.0215	-0.0996	-0.3142	-0.1193	1.0000		
FFDI_DVP_HHD	-0.0501	0.0669	0.4725	-0.4295	-0.0648	-0.0278	-0.1291	-0.4074	-0.1547	-0.1688	1.0000	
FFDI_DVP_V-D	0.1654	-0.0201	0.2544	-0.2447	-0.0372	-0.0160	-0.0742	-0.2341	-0.0889	-0.0970	-0.1258	1.0000
DVP_LHD	-0.6472	-0.3006	0.3178	-0.3714	-0.0461	-0.0198	-0.0919	-0.2900	0.9927	-0.1201	-0.1558	-0.0895
DVP_MHD	-0.3105	-0.0984	0.4033	-0.4037	-0.0501	-0.0215	-0.0999	-0.3152	-0.1197	0.9967	-0.1694	-0.0973
DVP_HHD	-0.0483	0.0198	0.4521	-0.4215	-0.0653	-0.0280	-0.1301	-0.4105	-0.1558	-0.1701	0.9925	-0.1267
DVP_VHHD	0.1678	-0.0312	0.2530	-0.2460	-0.0373	-0.0160	-0.0744	-0.2347	-0.0891	-0.0973	-0.1261	0.9973
DVD_LHD	-0.4298	-0.2615	-0.1232	0.0538	0.9794	-0.0084	-0.0390	-0.1231	-0.0467	-0.0510	-0.0662	-0.0380
DVD_MHD	-0.0430	-0.1297	-0.0521	0.0182	-0.0083	0.9943	-0.0165	-0.0521	-0.0198	-0.0216	-0.0280	-0.0161
DVD_HHD	0.0232	-0.0326	-0.2414	0.2198	-0.0384	-0.0165	0.9959	-0.2413	-0.0916	-0.1000	-0.1296	-0.0745
DVD_VHHD	0.6579	0.3473	-0.7670	0.8061	-0.1220	-0.0524	-0.2430	0.9889	-0.2911	-0.3177	-0.4120	-0.2367
INFLA	-0.0483	-0.0671	-0.0077	-0.0087	-0.0078	-0.0043	-0.0016	-0.0742	-0.0011	0.0110	0.0846	-0.0155

(Continued)

(Continued)													
F~P_VHHD	HDI	LNFMFI	FFDI_DVP	FFDI_DVD	FFDI_DVD_LHD	FFDI_DVD_MHD	FF~D_HHD	F~D_VHHD	FF~P_LHD	FF~P_MHD	FF~P_HHD	F~P_VHHD	F~P_VHHD
PORG	-0.5333	-0.1952	0.6207	-0.6318	0.1079	0.0131	-0.2733	-0.4317	0.4624	0.2684	0.0653	0.1108	0.1108
HC	0.7426	0.3430	-0.5590	0.6089	0.0760	0.0274	0.0311	0.5695	-0.6684	-0.3770	-0.0055	0.0981	0.0981
TO	0.2178	-0.1512	-0.2771	0.2252	0.0910	-0.0176	-0.0099	0.2112	-0.2704	-0.0191	-0.1013	-0.0613	-0.0613
INFRAS	0.6484	0.3140	-0.4378	0.4877	0.0891	-0.0227	-0.1956	0.5728	-0.4373	-0.3878	-0.0931	0.2190	0.2190
GE	0.6002	0.2055	-0.6861	0.6960	0.1124	0.0420	0.1538	0.5361	-0.4893	-0.3847	-0.2015	0.0796	0.0796

	DVP_LHD	DVP_MHD	DVP_HHD	DVP_VHHD	DVD_LHD	DVD_MHD	DVD_HHD	DVD_VHHD	INFLA	POPG	HC	TO	INFRAS	GE
DVP_LHD	1.0000													
DVP_MHD	-0.1205	1.0000												
DVP_HHD	-0.1570	-0.1707	1.0000											
DVP_VHHD	-0.0898	-0.0976	-0.1271	1.0000										
DVD_LHD	-0.0471	-0.0512	-0.0667	-0.0381	1.0000									
DVD_MHD	-0.0199	-0.0217	-0.0282	-0.0161	-0.0085	1.0000								
DVD_HHD	-0.0923	-0.1003	-0.1306	-0.0747	-0.0392	-0.0166	1.0000							
DVD_VHHD	-0.2932	-0.3188	-0.4151	-0.2373	-0.1245	-0.0527	-0.2440	1.0000						
INFLA	-0.0008	0.0105	0.1042	-0.0160	-0.0084	-0.0043	-0.0024	-0.0750	1.0000					
POPG	0.4726	0.2721	0.0486	0.1176	0.1051	0.0147	-0.2686	-0.4503	0.0160	1.0000				
HC	-0.6767	-0.3793	-0.0045	0.0988	0.0734	0.0271	0.0329	0.5674	-0.0489	-0.5298	1.0000			
TO	-0.2633	-0.0122	-0.0957	-0.0609	0.1185	-0.0186	-0.0005	0.2474	-0.0440	-0.2702	0.3122	1.0000		
INFRAS	-0.4464	-0.3933	-0.1022	0.2206	0.0807	-0.0242	-0.1913	0.5740	-0.0939	-0.3804	0.6503	0.3271	1.0000	
GE	-0.4972	-0.3842	-0.1942	0.0909	0.1023	0.0421	0.1531	0.5412	0.0416	-0.4708	0.7511	0.2800	0.5477	1.0000