UNIVERSITI PUTRA MALAYSIA

ENVIRONMENTAL EFFECTS OF TRADE OPENNESS, FINANCIAL DEVELOPMENT AND AIR POLLUTION ON HEALTH OUTCOMES IN DEVELOPING COUNTRIES

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By

NOR ASMA BINTI AHMAD

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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July 2021

Chairman : Professor Normaz Wana Ismail, PhD
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The rapid economic growth across developing countries has raised concerns about possible detrimental effects on the environment as the larger material and energy inputs are required for the greater economic activities. In view of these, this thesis aims to contribute to the literature on the environmental effects of trade openness, effects of financial development on environmental quality, and finally on the effects of air pollution on the health outcomes across the developing countries. The study relies on the System-Generalized Method of Moment (GMM) estimation technique for the analysis. In the first objective, the estimation models were estimated using data from 59 developing countries between the period of 2010 to 2017. From the analyses, the environmental effects of trade openness were significantly positive, where openness to trade appears to increase $PM_{2.5}$ levels and CO_2 emissions. The findings also suggest that across the $PM_{2.5}$ estimation models, the estimated coefficients on the interactive term of trade openness with income per capita were significant, implying that higher income has the capacity to reduce environmental pollution caused by trade. In the second objective, the data covered 46 developing countries for the period of 2010 to 2017. The estimation results suggest that a country with higher domestic credit to the private sector to GDP may contribute positively to environmental quality in a country. The relationship between research and development expenditure and financial development was significantly positive, indicating that research and development expenditure was vital in enhancing environmental quality. Furthermore, improvements in environmental quality can be strengthened by the positive effects of foreign direct investment (FDI) and the inclusion of financial development in the same model. The third objective analysis establishes a significant negative effect of air pollution on health outcomes across the sample countries. The estimation of models for this objective was performed using data from 72 developing countries between the period of 2010 to 2017. Apart from that, the unfavourable effects of

air pollution ($PM_{2.5}$) on health outcomes were significantly moderated by governance quality. Evidence from the first objective showed that greater openness of trade policy could be detrimental to the environment. This study highlights the importance of considering the indirect effects because, when estimating trade openness impact on the environment, indirect negative effects compensate for a direct positive impact. In light of this, a policy that intensifies the trade-oriented development approaches to promote growth, which will bring environmental benefits at the same time, is deemed important. Developing countries should consider limiting emissions while maintaining economic growth prospects by investing more in green technologies, particularly manufacturing. Empirical evidence for the second objective endorses the policymakers to regulate policy that implements green values within the financial sectors via pertaining selective credit controls, such as a strategy that gives favoured treatments to the businesses that embrace low-emission production norms, which can contribute to environmental sustainability. On the other hand, a policy that assists firms in integrating sustainability by conducting research and development in upgrading available technologies and lowering financial barriers to technology availability is essential. The findings also suggest that policies aimed at improving the financial system will make financing more accessible to foreign businesses and investors, allowing them to start on capital projects at a lower cost. Empirical findings of the third objective emphasise the need for health authorities considering the significant health burden, as well as the need for environmental and health ministries to collaborate to address this issue. Ministries of the environment should implement clear, effective, and credible policies to reduce air pollution. Health authorities can raise public awareness on environmental issues by educating the public about the health benefits of clean air, as well as a partnership with a variety of public and private institutions. As the developing countries pursue an acceptable balance between economic development and environmental quality, growth policies need to integrate effective strategies to protect the country's health population into policymaking.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN PERSEKITARAN KETERBUKAAN PERDAGANGAN, PEMBANGUNAN KEWANGAN DAN PENCEMARAN UDARA TERHADAP KESIHATAN DI NEGARA-NEGARA MEMBANGUN

Oleh

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Pertumbuhan ekonomi yang pesat dikalangan negara membangun telah menimbulkan kebimbangan kemungkinan kesan buruk terhadap alam sekitar kerana input dan sumber tenaga yang lebih besar diperlukan untuk menampung keperluan ekonomi yang lebih besar. Oleh itu, tesis ini bertujuan untuk memberi sumbangan kepada literatur berkenaan kesan persekitaran oleh keterbukaan perdagangan, kesan pembangunan kewangan terhadap kualiti alam sekitar, dan impak pencemaran udara terhadap taraf kesihatan di kalangan negara membangun. Kajian ini menggunakan kaedah System Generalized Method of Moment (GMM). Pada objektif pertama, kajian menggunakan data dari 59 negara membangun antara tahun 2010 hingga 2017. Dari analisis, kesan persekitaran dari keterbukaan perdagangan adalah positif, di mana keterbukaan perdagangan telah meningkatkan pelepasan $PM_{2.5}$ dan CO_2. Hasil kajian juga menunjukkan pada kesemua model $PM_{2.5}$, pekali interaktif di antara keterbukaan perdagangan dengan pendapatan per kapita adalah signifikan, menunjukkan bahawa pendapatan yang lebih tinggi mempunyai keupayaan untuk mengurangkan pencemaran alam sekitar dari perdagangan. Objektif kedua merangkumi data dari 46 negara membangun untuk tempoh 2010 hingga 2017. Hasil kajian menunjukkan bahawa negara dengan kredit domestik yang lebih tinggi kepada sektor swasta kepada KDNK dapat memberikan sumbangan positif terhadap kualiti persekitaran di sebuah negara. Hubungan antara perbelanjaan penyelidikan dan pembangunan dan pembangunan kewangan adalah signifikan dan positif, menunjukkan bahawa perbelanjaan penyelidikan dan pembangunan sangat penting dalam meningkatkan pembangunan kewangan. Tambahan pula, peningkatan kualiti persekitaran dapat diperkuat dengan kesan positif pelaburan langsung asing dan kemasukan pembangunan kewangan dalam model yang sama. Analisis objektif ketiga menunjukkan kesan negatif pencemaran udara yang signifikan terhadap hasil kesihatan di seluruh sampel. Kajian model untuk objektif ini dilakukan dengan menggunakan data

dari 72 negara membangun antara tahun 2010 hingga 2017. Selain daripada itu, kesan pencemaran udara ($PM_{2.5}$) yang tidak baik terhadap hasil kesihatan dapat dikurangi oleh kualiti pemerintahan. Bukti dari objektif pertama menunjukkan bahawa keterbukaan dasar perdagangan boleh merugikan alam sekitar. Kajian ini menekankan pentingnya mempertimbangkan kesan tidak langsung kerana, ketika menganggarkan kesan keterbukaan perdagangan terhadap alam sekitar, kesan negatif tidak langsung mengimbangi kesan positif langsung. Sehubungan dengan itu, polisi yang menekankan pendekatan pembangunan yang berorientasikan perdagangan untuk mendorong pertumbuhan, yang akan membawa manfaat alam sekitar pada masa yang sama, dianggap penting. Negara membangun perlu mempertimbangkan untuk mengurangkan pencemaran sambil mengekalkan prospek pertumbuhan ekonomi dengan melabur lebih banyak dalam teknologi hijau, terutama dalam pembuatan. Bukti empirikal untuk objektif kedua menyokong polisi yang menerapkan aspek alam sekitar dalam sektor kewangan melalui kawalan kredit selektif, seperti strategi yang mengutamakan perniagaan yang menerapkan norma pencemaran rendah, yang dapat menyumbang kepada kelestarian alam sekitar. Selain dari itu, polisi yang mengintegrasikan kelestarian dengan melakukan penyelidikan dan pembangunan dalam meningkatkan teknologi yang ada dan menurunkan halangan kewangan terhadap penggunaan teknologi sangat penting. Hasil kajian juga menunjukkan bahawa dasar yang bertujuan meningkatkan sistem kewangan akan menjadikan pembiayaan lebih mudah diakses oleh perniagaan dan pelabur asing, yang memungkinkan mereka untuk memulakan projek modal dengan kos yang lebih rendah. Penemuan empirikal objektif ketiga menekankan perlunya pihak berkuasa kesihatan mempertimbangkan beban kesihatan, serta keperluan kementerian alam sekitar dan kesihatan untuk bekerjasama dalam menangani masalah ini. Kementerian alam sekitar perlu mengadakan polisi yang jelas, efektif, dan kukuh untuk mengurangkan pencemaran udara. Pihak berkuasa kesihatan dapat meningkatkan kesedaran masyarakat mengenai isu-isu alam sekitar dengan mendidik masyarakat tentang manfaat kesihatan udara bersih, serta kerjasama dengan pelbagai institusi awam dan swasta. Untuk negara membangun mencapai keseimbangan di antara pembangunan ekonomi dan kualiti alam sekitar, polisi pembangunan perlu mengintegrasikan strategi yang efektif untuk melindungi kesihatan populasi negara dalam merangka polisi.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

AMG	Augmented Mean Group
APEC	Asia-Pacific Economic Cooperation
ARDL	Autoregressive Distributed Lag
CIESIN	Centre for International Earth Science Information Network
CTS	Composite trade share
ECOWAS	Economic Community of West African States
EKC	Environmental Kuznets Curve
EPA	Environmental Protection Agency
EPI	Environmental Performance Index
EU	European Union
FDI	Foreign direct investment
GBD	Global Burden of Disease
GCC	Gulf Cooperation Council
GDP	Gross domestic product
GNP	Gross national product
GMM	Generalized method of moment
HDI	Human Development Index
IHME	Institute for Health Metrics and Evaluation
IEA	International Energy Agency
ITC	International Trade Centre
NAFTA	North American Free Trade Agreement
NASA	National Aeronautics and Space Administration
MENA	Middle East and North Africa

OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary least squares
PCA	Principal component analysis
PM	Particulate matter
PMG	Pesaran's Pooled Mean Group
PVAR	Panel-Vector Autoregressive
R&D	Research and development
SSA	Sub-Saharan Africa
UAE	United Arab Emirates
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
WDI	World Development Indicators
WGI	Worldwide Governance Indicators
WMO	World Meteorological Organization
WHO	World Health Organization
WTO	World Trade Organization
YCELP	Yale Centre for Environmental Law and Policy

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Environmental degradation is environmental deterioration by the depletion of resources, including air, water and soil, the exploitation of ecosystems, and wildlife loss (Choudhary, Chauhan & Kushwah, 2015). Environmental degradation has raised global concerns by many academicians, governments, policy makers, and other stakeholders after the Rio earth summit in 1992, Kyoto Protocol in 1997, preceded by the current Paris Agreement of Climate Change in 2015. Manufacturing intensification between many developing countries is an increasingly significant concern during the process of economic development, as the manufacturing process is accompanied by significant increases in pollutant discharges and the depletion of a large number of natural resources that lead to environmental degradation (Zafar, Saud & Hou, 2019; Wang et al., 2018).

Empirical evidence has suggested that industry, particularly manufacturing, has generated higher growth rates than agriculture and most services (Jiang, Kim & Woo, 2020; Felipe, 2018; Chakraborty & Mukherjee, 2013). The key feature is that activities in this sector have a higher capacity for productivity growth, increasing returns to scale and externalities (technical and financial). For this reason, the literature has referred to manufacturing as the engine of growth. In developing countries, structural change in their economies has largely moved away from primary products towards manufacturing-based production, leading to high growth rates of their GDPs (McMillan, Rodrik & Sepulveda, 2017; Collier & Venables, 2007). From Figure 1.1, manufacturing has shown to be more significant in the developing countries (indicated by the middle-income countries[1]) than high-income economies, pointing to the continued importance of manufacturing as an important engine of growth.

[1] Available statistics from World Bank classification of economies by income (2018) assigns the world's economies based on income groups. Lower-middle income and upper-middle economies are the countries with per capita GNIs between $1,006 and $3,955 and between $3,956 and $12,235 are considered as developing economies.

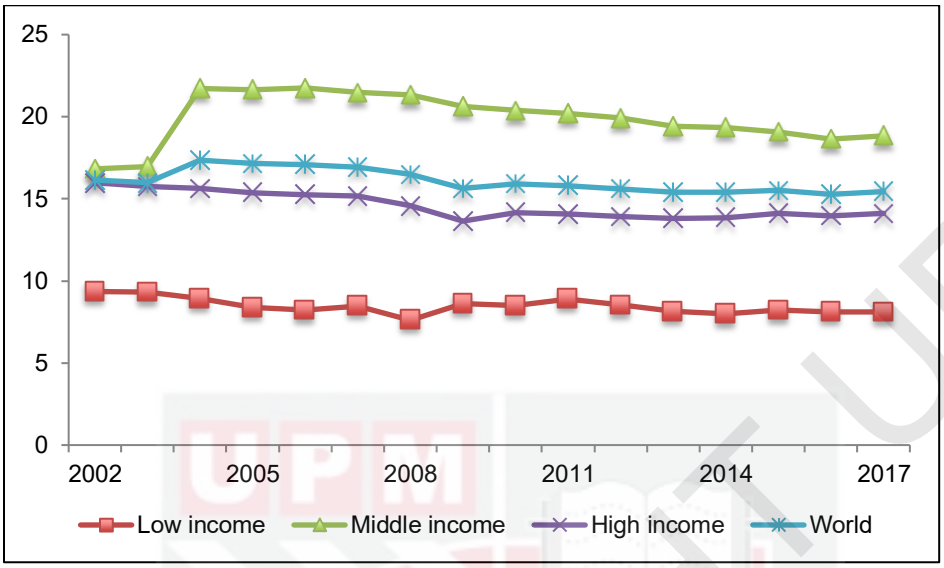

Figure 1.1 : Manufacturing, value added (% of GDP) by income group, 2002–2017
(Source: Computed based on data from world development indicators, World Bank, 2018)

The manufacturing processes in generating a product produce several waste products, including air pollutants, which is a large proportion of manufacturing pollution (Vallero, 2014; Richter & Klesta, 2011). Air pollution relates to the discharge of hazardous pollutants into the earth's atmosphere, including toxic gases, particulates, chemicals, etc., which are detrimental to human health and the planet as a whole (Manisalidis et al., 2020). According to the United States Environmental Protection Agency, the most common and harmful air pollutants are carbon monoxide (CO), lead, nitrogen dioxides (NO_2), ground-level ozone (O_3), particle pollution (often referred to as particulate matter), and sulfur dioxides (SO_2) (Figure 1.2).

Figure 1.2 : Types of air pollutants
(Source: US Environmental Protection Agency)

Based on their physical features, air pollutants can be categorised into one of three categories (Hocking, 2016). Coarse particulate matter (PM) is the first of these air pollutants, and it consists of solid particles or liquid droplets with an average diameter of more than 10 µm (known as PM10). This class of pollutants has particles or droplets large enough to be visible to the naked eye. The aerosol class, which consists of solid particles or liquid droplets, is the second group of air pollutants. These particles or droplets are small enough in size, with an average diameter of less than around 10 µm, and these are known as fine particles (regarded as PM2.5). Gases are the third major category of air pollutants, and they include any contaminant that exists in a gaseous or vapour condition. This comprises gases, such as CO, NO_2, O_3, and SO_2.

Varied pollutants have been adopted in the literature to assess air pollution; however, this study emphasises particulate matter ($PM_{2.5}$) and CO_2 emissions as air pollution measurements. $PM_{2.5}$ chosen as these particles is a by-product of goods production and is the primary form of local air pollution, which can be intensified by rapid economic development, industrialisation and urbanisation (Li et al., 2016; Wang et al., 2015). Furthermore, compared to large particles, which is PM_{10}, $PM_{2.5}$ has been posited to be more harmful to health due to its small size (Fann et al., 2017; Li et al., 2018; Wang et al., 2019). In addition, CO_2 is also included following many previous studies as it relates to air pollution in its contribution to the greenhouse effect (Alam et al., 2015; Hao et al., 2016; Wang, 2018).

The scatterplots in Figures 1.3 and 1.4 show the relationship between manufacturing, value added (% of GDP), and air pollutants ($PM_{2.5}$ and CO_2) from 2010 to 2017. Figure 1.3 indicates that many countries with greater reliance on manufacturing activities have relatively higher levels of $PM_{2.5}$. However, some countries (India, Egypt, and Bangladesh) have higher $PM_{2.5}$ levels than China, even with lower manufacturing concentrations. On average, China's income levels are comparatively higher than those countries, which may likely promote better implementation of local environmental regulations, contributing to the improved environmental efficiency of production processes.

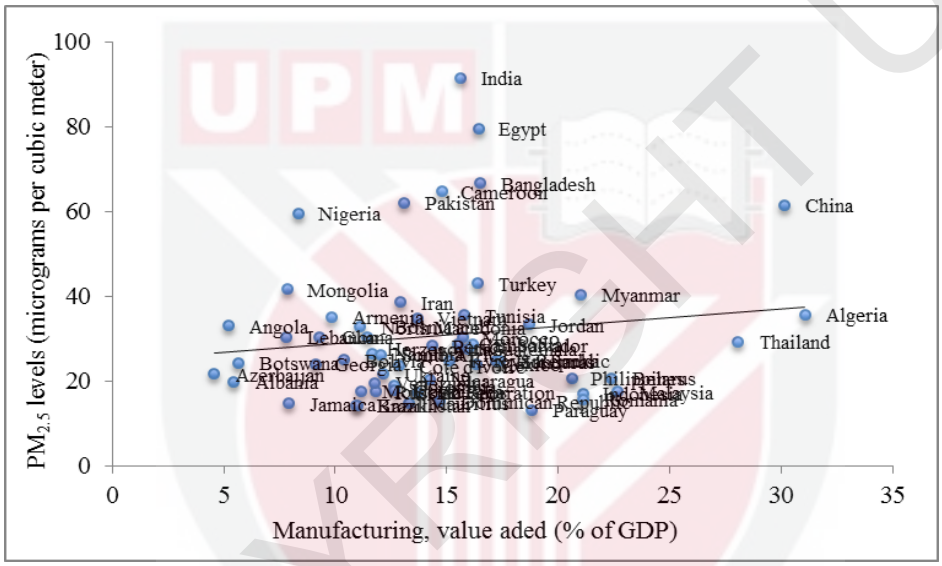

Figure 1.3 : Manufacturing, value added (% of GDP) and $PM_{2.5}$ levels, average 2010–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018)

The same pattern linked to manufacturing concentration can be observed for CO_2 emissions (Figure 1.4). CO_2 is, however, a global pollutant and is categorised as a global pollutant with a global impact (Frankel & Rose, 2005). It has been well recognised that CO_2 emission has a global occurrence; there is a vertical and horizontal pathway for the airborne CO_2 concentration at least in a certain region (Sohag et al., 2017). Therefore, in one country, it is likely that CO_2 emissions may affect another country. Thus, even Kazakhstan and Russia have a comparatively higher income than China, such domestic efforts (local environmental regulations) are likely to be insufficient to reduce overall air pollutant emissions from a global context.

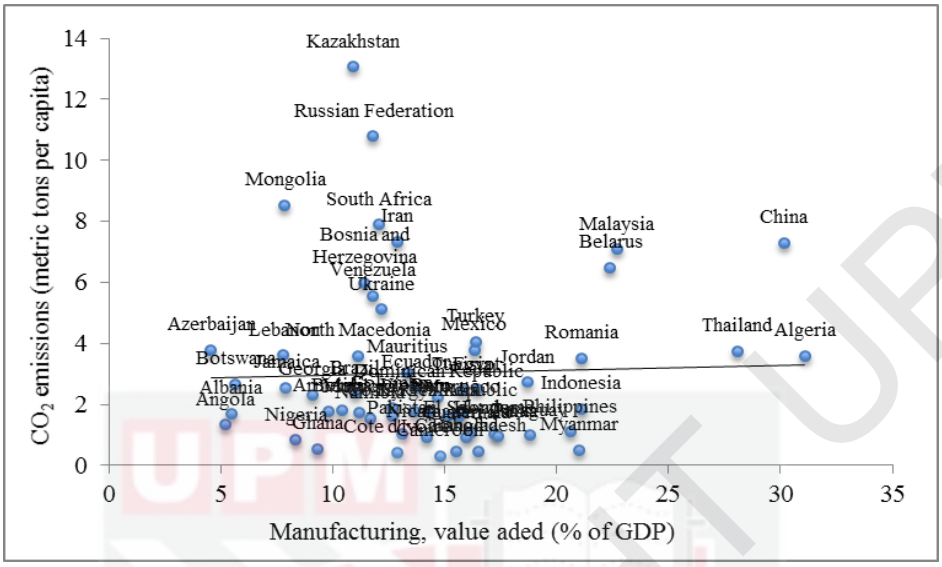

Figure 1.4 : Manufacturing, value added (% of GDP) and CO_2 emissions, average 2010–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018)

The influence of disclosure on environmental pollution is much larger in developing regions, in which population growth (nearly 70 per cent of the global population resides in middle-income countries), urbanisation, and accelerated industrialisation lead to a reduction in environmental quality (Mannucci & Franchini, 2017; Pena & Rollins, 2017). Consequently, the present study included three independent but related issues. It was anticipated that the investigation of these issues would lead to a new understanding of the major sources of environmental pollution and, therefore, the quality of the environment, along with the effects of such pollution on health outcomes. The first issue investigated the effects of trade openness on the environment, while the second issue analysed the effects of financial development on environmental quality. Finally, the third issue pinpointed the possible effects on health outcomes from air pollution.

1.2 Trade Openness and Environment in Developing Countries

Trade openness can be described as the extent to which an economy's outward orientation towards trade is maintained (Fujii, 2019). The degree to which countries are open to international trade has facilitated the participation of the developing countries in the global economy and made a progressively important contribution to economic growth (Keho, 2016; Sun & Heshmati, 2010). The argument that trade openness improves specialisation and division of labour, thereby enhancing productivity and export capability, along with economic

performance, explains the beneficial contribution of trade openness to growth (Chandran, 2009). This study concentrated on developing nations as, since the 1980s, these governments have been aggressively adopting increased trade openness in comparison to developed ones (Tee et al., 2018). The manufacturing sector has long been recognised as the primary driver of export performance and spectacular economic growth in developing countries (Figure 1.1). It demonstrates the importance of openness for manufacturing sectors in developing countries.

Developing economies have seen a notable rise in their share of world trade in the last two decades, whereby they now account for one-third of such trade, up from about a quarter in the early 1980s. This upsurge in trade has led to greater trade intensity in these countries, measured as the share of exports and imports to GDP (Figure 1.5). Specifically, developing countries' share of global trade of goods and services has increased notably since the 1990s, but this growth rarely outpaced the developed world (the high-income countries).

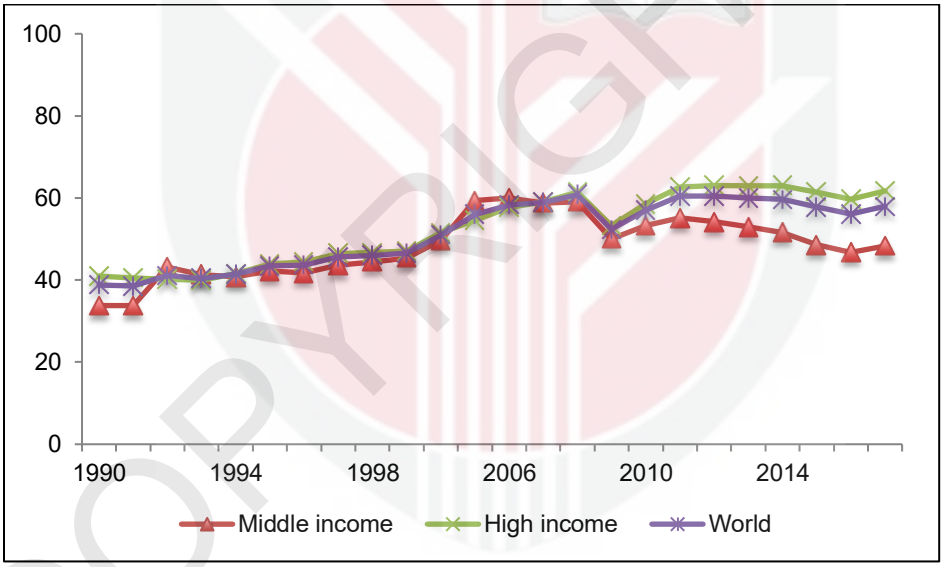

Figure 1.5 : Trade (% of GDP) by income group, 1990–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018)

According to Cherniwchan (2017), high-income countries tend to outsource production to lesser income countries in the dirty segment of such a value chain. Consequently, they will import dirty, unfinished goods from the lesser income countries, which are less likely to incur environmental regulatory costs for domestic processing within that clean segment of the value chain. Empirical studies also suggest that pollution stabilisation in developed countries is also

due to rising imports from the developing countries, the use of low-cost labour and resources as well as weak environmental regulation to upsurge capital returns (Xu, Dietzenbacher & Los, 2020a; Sato, 2014; Frankel, 2009). This will put pressure on adverse environmental effects on the lesser income countries. Thus, economic consequences of trade openness may lead to environmental degradation due to the relocation of developed countries air emissions to other developing countries.

International trade is defined as trade in goods (merchandise) and services. Merchandise is the products that have completed the manufacturing process. Feng et al. (2013) indicated that the utilisation of machinery and other massive equipment in the manufacturing of merchandise products brought the use of fuels as a source of energy, which could harm the environment. This will put pressure on adverse environmental effects on these countries. Growth in the manufacturing sector in producing merchandise goods could make the developing countries specialise in the dirty segment of the value chain, which are more likely to incur environmental costs.

In the context of global merchandise trade volume, it recorded a growth of about 32% between 2006 and 2016 (WTO, 2018). Among developing countries, there was a threefold increase in the growth of merchandise trade (% of GDP) in the last three decades, of which the growth increased from 16% in the 1990s to 47% recently (Table 1.1). Currently, middle-income countries' shares of $PM_{2.5}$ levels and CO_2 emission are increasing, as indicated in Table 1.1. Considering the relationship between industrialisation and air quality, many studies have argued that the increase in manufacturing activities has contributed to the increase in $PM_{2.5}$ levels (Hao & Liu, 2016). CO_2, on the other hand, is undeniably a contributor to global warming, where CO_2 concentrations have risen gradually from the beginning of the industrial era.

Table 1.1 : Average share of middle-income countries in $PM_{2.5}$, CO_2, merchandise trade, GDP per capita, energy use, and population

Variables	1990–1999	2000–2009	2010–2017
$PM_{2.5}$ levels (micrograms per cubic meter)	51.88	54.92	55.21
CO_2 emissions (metric tons per capita)	2.36	2.77	3.75
Merchandise trade (% of GDP)	15.91%	63.33%	47.01%
GDP per capita	2185.25	3001.70	4430.64
Energy use (per capita)	910.52	1055.33	1344.36
Urban population	38.61	44.09	49.64

(Source: Computed based on data from World Development Indicators, World Bank, 2018)

The scatterplots in Figures 1.6 and 1.7 show the nexus between merchandise trade (% of GDP) and air pollutants ($PM_{2.5}$ and CO_2) from 2010 to 2017. The trendline of $PM_{2.5}$ and merchandise trade are showing a decreasing trend (Figure 1.6). This could be related to the decreased amount of merchandise trade in the current period compared to the previous period (2000–2009, in Table 1.2), coupled with the fact that many countries have begun to adopt and enforce environmental policies concerning air pollution to reduce the intensity of local environmental degradation. In addition, this graph explains only a bivariate relationship between merchandise trade and air pollutants but other factors such as energy use and urban population have not been incorporated to explain this relationship. Thus, the direction of drawing a meaningful association between trade openness and environmental pollution in developing countries required further empirical analysis.

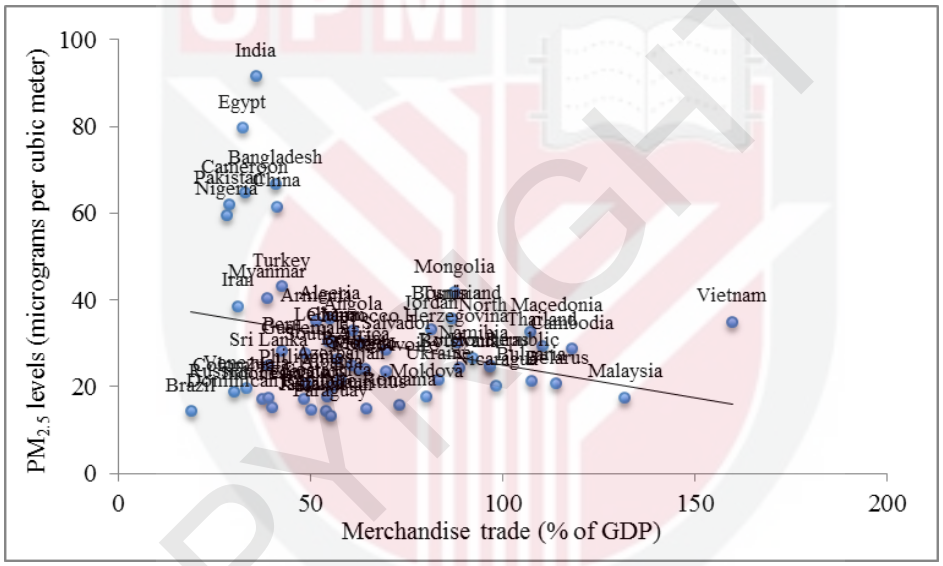

Figure 1.6 : Merchandise trade (% of GDP) and PM.5$_2$ levels, average 2010–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018)

Figure 1.7, on the other hand, shows that there is a growing trend in CO_2 and merchandise trade trends. It has been observed that increased merchandise trade contributes to greater carbon emissions, at least for some countries (for example, in the case of Iran, Russia, and Kazakhstan). The climate change issues have been clarified by the fact that energy usage is growing with trade openness, contributing to higher carbon emissions (Sun et al., 2019; Yu et al., 2019; Yoshida & Honma, 2011). In addition to direct trade impact, Cristea et al. (2013) suggests that increasing CO_2 emissions are also rising in line with merchandise trade activities from enhanced international freight transport.

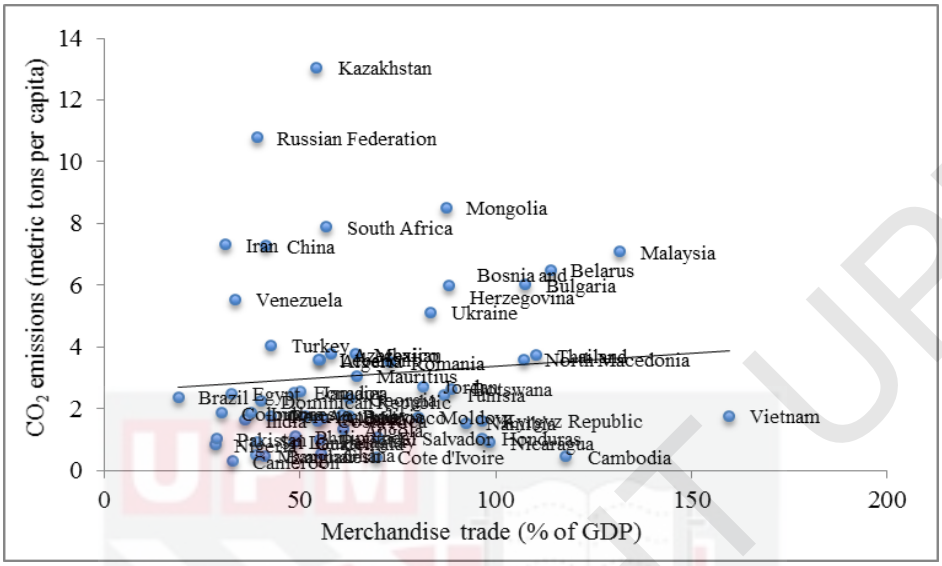

Figure 1.7 : Merchandise trade (% of GDP) and CO_2 levels, average 2010–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018)

In addition, energy use and urban population are also showing increasing trends (Table 1.1). The world's urban population is projected to double to over five billion in the next 30 years, with nearly all growth in less economically developed countries. Moreover, many developing countries are projected to undergo more extensive urbanisation in the coming decades than most other countries (UN, 2019). In developing countries, urbanisation takes place at an unparalleled speed and scale, which is generally characterised by unplanned growth, sprawl, and growing reliance on transport that could relate to the rise in harmful pollutants. Energy has a major role in the economic growth of a country, so it is referred to as a catalyst in most service and production sectors. Moreover, the economic activities of developing countries have mainly been fuelled by coal use, which is a less sophisticated production and pollution mitigation technologies (Tran, 2020; Minx et al., 2011). Thus, the increased usage of energy (and the severity of that use) may have a negative effect on air quality and environmental conditions (Salim, Rafiq & Shafiei, 2017).

On the other hand, Dean (2002) and Yu et. (2019) indicate that trade openness has a detrimental direct impact on the environment, but it can be mitigated by a favourable indirect impact through income. It could be argued that higher economic growth may likely promote better implementation of local environmental regulations, contributing to the improved environmental efficiency of production processes. Furthermore, higher income causes a country's populace to value the environment and, as a result, to demand higher environmental quality (Frankel & Rose, 2005). As a result, the government is

encouraged to design and implement various pollution-reduction initiatives. In turn, the industrial sector is encouraged to develop and implement multiple pollution-reduction efforts in their manufacturing processes. Consequently, this situation might be described by economic structural changes and the technique effect, which could be explained by income-induced demand for better environmental conditions and more stringent environmental protections (Grossman & Krueger, 1995). Thus, it demonstrates the importance of understanding the association between trade openness and the environment by bringing in income levels, which can influence not only trade openness but also the state of the environment.

Considering that trade between and among countries is ever-increasing, there is a growing concern about whether openness to trade is being promoted at the expense of the environment, particularly in developing nations. Therefore, understanding the in-depth association of trade openness and environmental pollution was one of the objectives of the present study. This study is necessary for the effective formulation and implementation of environmental policies that will realise the region's growth potential.

1.3 Financial Development and Environmental Quality in Developing Countries

Financial development corresponds to a country's decisions to promote the activities of financial institutions such as the stock market, banking, and foreign and domestic investment (Zafar et al., 2019). The development of the financial sector has become vital that it is now recognised as an important connection to ensuring the proper functioning of an economy, given its role in the acquisition of reserves, the easing of business deals and the channelling of resources to effective sectors (Moghadam & Dehbashi, 2017; Zhuang et al., 2009). Nevertheless, while the financial sector's significance to fostering economic growth is indisputable, environmental implications have increasingly become an area of concern.

With the advent of financial growth, Lanoie, Laplante, and Roy (1998) and Dasgupta et al. (2002) have highlighted its importance in terms of environmental quality, arguing that a functioning financial sector would provide substantial inducements for companies in developing countries to reduce their emissions. Other studies, such as Jalil and Feridun (2011), Shahbaz et al. (2016) and Seetanah et al. (2018), have recognised that when evaluating environmental quality, financial development is a crucial factor that needs to be addressed. Stronger financial development provides quick access to external finance for local businesses with inadequate internal resources to undertake appealing investment prospects that require huge fixed and variable costs early in the production cycle (Desbordes & Wei, 2014). Therefore, if businesses gain access to external financing at a lower cost, the adoption of environmentally friendly technology would be promoted.

Because of the global sustainable development agenda, the emphasis has been on green economics and finance (Ntow-Gyamfi et al., 2020). Over the years, interest has grown in developing indicators to measure sustainability, which tends to be a mixture of economic, environmental and social indicators. In addition to growing economic and financial sector growth, green economics and finance are also concerned with the effective utilisation of natural resources to promote economic and financial development while lowering pollution and other types of environmental devastation. According to the International Trade Centre (ITC), they are essential to support the flow of financial instruments and associated services concerning the development and application of sustainable business models, investments, economic, environmental, and social projects and policies. Therefore, green economics and finance may have higher environmental quality by being free of certain environmental stressors.

While some think that financial development is beneficial to the environment, others claim that it damages the environment. According to Sadorsky (2011) and Sehrawat et al. (2015), financial development would promote industrialisation, leading to industrial pollution and a decline in environmental quality. Financial development may also harm the environment by making it easier for consumers and businesses to obtain low-cost credit to purchase large-ticket items and expand or start new businesses, all of which increase energy consumption and thus carbon emissions (Ganda, 2019). In addition, given the increase in the level of credit availability, financial access in a range of environmentally sensitive sectors can have significant implications, involving greenhouse gas emissions and irreversible harm to the environment and natural resources that reduce the quality of the environment. Therefore, recognising the effect of financial development in developing countries on the environment will have repercussions for sustainable development.

Since the previous studies focused heavily on CO_2 as the measurement of environmental impact, the current study combines ecological and environmental policy components to reflect environmental quality. The study incorporates the Environmental Performance Index (EPI) to evaluate the countries' environmental quality and, thus, overall progress towards environmental sustainability as this index rules out the aspect of the economy, society, and environment that are the basis of sustainable development. From the report, the EPI score comprises two major components, namely environmental health and ecosystem vitality (Table 1.2). This measure represents appropriate weights of the national-level environmental performance of a country as it covers the country’s performance in important environmental issues as a measurement of its quality, offering directives for countries aspiring to promote environmental sustainability.

Table 1.2 : Environmental Performance Index framework

Environmental health	**Contribution (%)**
Child mortality	15
Indoor air contamination	3.75
Particulate matter	3.75
Drinking water accessibility	3.75
Sanitation accessibility	3.75
SO_2 pollution per capita	4.38
SO_2 emissions per GDP	4.38
Water quantity changes	8.75
Total	**47.51**
Ecosystem vitality	**Contribution (%)**
Biome protection	8.75
Marine protection	4.38
Critical habitat protection	4.38
Agricultural subsidies	3.89
Pesticide rule	1.94
Raising stock change (forest)	1.94
Loss of forest	1.94
Difference of forest cover	1.94
Fishing stocks desecrated	2.92
Coastal shelf fishing density	2.92
CO_2 emissions per capita	6.13
CO_2 emissions per GDP	6.13
CO_2 emissions per electricity generation	2.6
Renewable electricity	2.6
Total	**52.46**

(Source: Environmental Performance Index (EPI), 2016)

Figure 1.8 presents the relationship of domestic credit to the private sector (% of GDP) and the Environmental Performance Index. In the period 2010–2017 (average), the trendline shows a fairly positive association of domestic credit to the private sector with Environmental Performance Index scores in the developing countries. This implies that more credit availability is correlated with better environmental quality in the region but relatively minimal. Particularly, Malaysia, Thailand, South Africa and China showed the highest levels of credit provided to the private sector. On the contrary, Lesotho, Pakistan and Papua New Guinea exhibited the lowest levels of credit extended to the private sector as well as the levels of environmental performance.

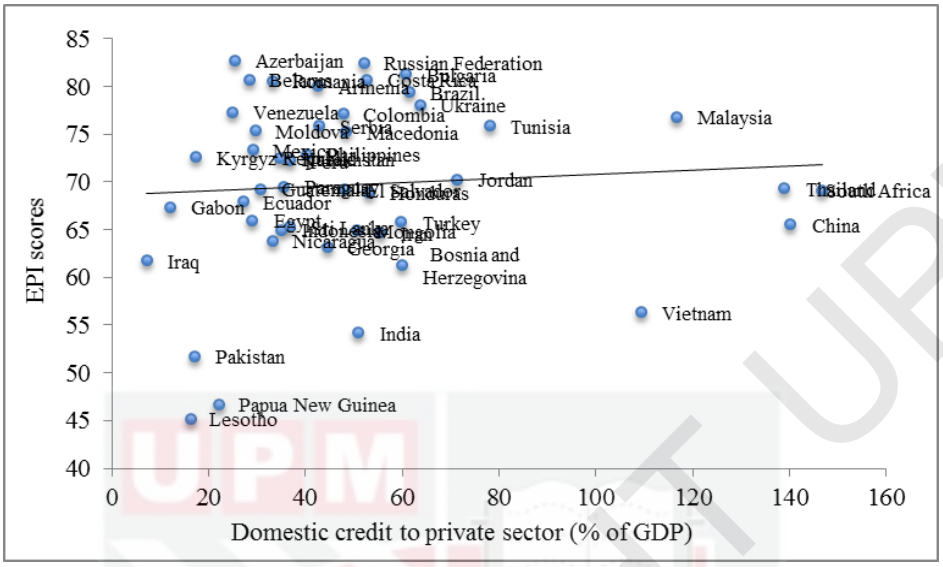

Figure 1.8 : Domestic credit to private sector (% of GDP) and Environmental Performance Index scores, average 2010–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018 and Environmental Performance Index, 2018)

This further suggested that EPI showed a positive association with per capita GDP (country wealth), suggesting that pursuing sustainability goals needs material prosperity to reinvest in the infrastructure required to preserve human health and ecosystems. Thus, developing countries may face the inherent tension of sustainable development to maintain their environmental quality in that income growth can be at the expense of the environment, particularly through the extraction of natural resources and unregulated industrialisation.

Foreign direct investment (FDI) inflows are a significant source of external financing to many developing countries and provide important ways to achieve sustainable development goals and private sector growth (UNCTAD, 2018). Nevertheless, one crucial and frequently posed concern regarding FDI is its potentially deleterious environmental impact (Demena & Afesorgbor, 2020; Cole, Elliott & Zhang, 2017; Zhu et al., 2016). It is feasible that the economic gains relating to a rise in FDI could be outweighed by conceivable environmental costs, as FDI will occur at the same time as increased environmental pollution. For instance, Pao and Tsai (2011) argue that, because of the growth-promoting direction of FDI, environmental emissions related to FDI may easily be neglected.

Recognising the prospective environmental costs related to FDI, many countries are now restrictive in FDI entering their country. Numerous countries are now encouraging the so-called 'green' FDI, which focuses on FDIs that can stimulate economic growth and internalise the negative environmental externalities generated from industrial production (Golub, Kauffmann & Yeres, 2011). From Table 1.3, middle-income countries share of FDI inflows to GDP decreased slightly from 2.87% in 2000–2009 to 2.46% in 2010–2017. With this decrease in FDI, it is also plausible that FDI contributes to a cleaner environment. FDI can help promote environmental and social standards in the host country, particularly if greener or cleaner technologies are used for foreign investment. There is also an indication that foreign firms in developing countries are more environmentally friendly compared to domestic firms because they use better management practices and advanced technologies than their domestic counterparts (Demena, & Afesorgbor, 2020; Zhu et al., 2016).

Table 1.3 : Average share of middle-income countries in foreign direct investment and research and development expenditure

Variables	2000–2009	2010–2017
Foreign direct investment, net inflows (% of GDP)	2.87	2.46
Research and development expenditure (% of GDP)	0.83	1.26

(Source: Computed based on data from World Development Indicators, World Bank, 2018)

On the other hand, research and development (R&D) efforts encourage innovation in green products and promote green process innovation, contributing to the discrepancy between environmental regulations and energy conservation and reducing emissions (Guo et al., 2018). Both in developed and developing countries, R&D is an important catalyst for economic growth and industrial development. In particular, according to the United Nations Industrial Development Organisation (UNIDO), it is a crucial factor in improving the technical competitiveness of developing countries. It thus helps to avoid being stuck in a vicious loop occupying the lowest-value-added sections within global value chains.

For a long time, large multinational companies in developed countries have firmly occupied the high end of the value chain, which are associated with clean production methods and apparently better environmental quality (Feng, Xin & Cui, 2020). Therefore, by emphasising R&D, it represents the transition from the traditional comprehensive method, which relies on greater energy consumption and increases emissions, to an intensive method, which focuses on quality and efficiency. Throughout 2010–2017, the allocation of government expenditure on R&D activities in the middle-income countries has shown an improvement of 51.8% than the previous period (Table 1.3). This suggests that higher domestic research and development allocation may enhance new, environmentally friendly technological innovation.

Financial development can influence the environment through the technology effect channel by luring FDI and increasing R&D investments, driving economic expansion and altering environmental performance dynamics (Frankel & Romer, 1999). Jensen (1996) revealed that foreign direct investment was encouraged by the presence of the well-developed financial sector, which could facilitate the transfer of foreign technology. According to Tamazian and Rao (2010), a well-developed financial sector provides lower-cost finance that might encourage governments to invest in domestic research efforts, leading to environmental protection initiatives. This means that financially developed economies draw foreign direct investment and stimulate research and development initiatives, hence improving environmental quality.

In developing countries, financial development can have both positive and negative consequences on environmental performance. Therefore, it is apparent that financial development imposes an imperative role in assessing a country's environmental quality. This fact revealed the necessity to undertake empirical analysis in the present study to analyse the results in particular circumstances.

1.4 Air Pollution and Health Outcomes in Developing Countries

Rapid economic development in developing countries may be accompanied by a massive overuse of natural resources and tremendous increases in pollutant discharges, which can cause great damage to ecosystem sustainability and may severely affect human health. Therefore, pollution is one of the most detrimental environmental challenges facing the world today. Notably, air pollution is an important issue that has been shown to be worse in rapidly developing countries than in wealthy or very poor nations (Wu, 2017). Pena and Rollins (2017) and Mannucci and Franchini (2017) indicate that environmental air pollution is considerably higher in developing regions, whereby population growth and accelerated industrialisation have poor air quality. Thus, the harmful effects of air pollution on health will heavily affect people in developing countries.

Air pollution is a foremost health issue as the effect of pollution can cause poor health and even death. It was found to be the leading environmental threat to health globally, and research shows that air pollution is a significant risk factor for the burden of disease (Balakrishnan et al., 2019; Cao, Rui & Liang, 2018). Based on Figure 1.4, air pollution is one of the main risk factors for some leading causes of death worldwide, including stroke, cardiac disease, lung cancer, and respiratory diseases. It can be seen that the leading risk factors for death globally among environmental concerns are outdoor air pollution. Conferring to the Global Burden of Disease (GBD) study, 3.4 million people died as a result of outdoor air pollution in 2017. To put that in context, this would be more than two times the number of people who died from indoor air pollution and almost three times the number of unsafe water source death.

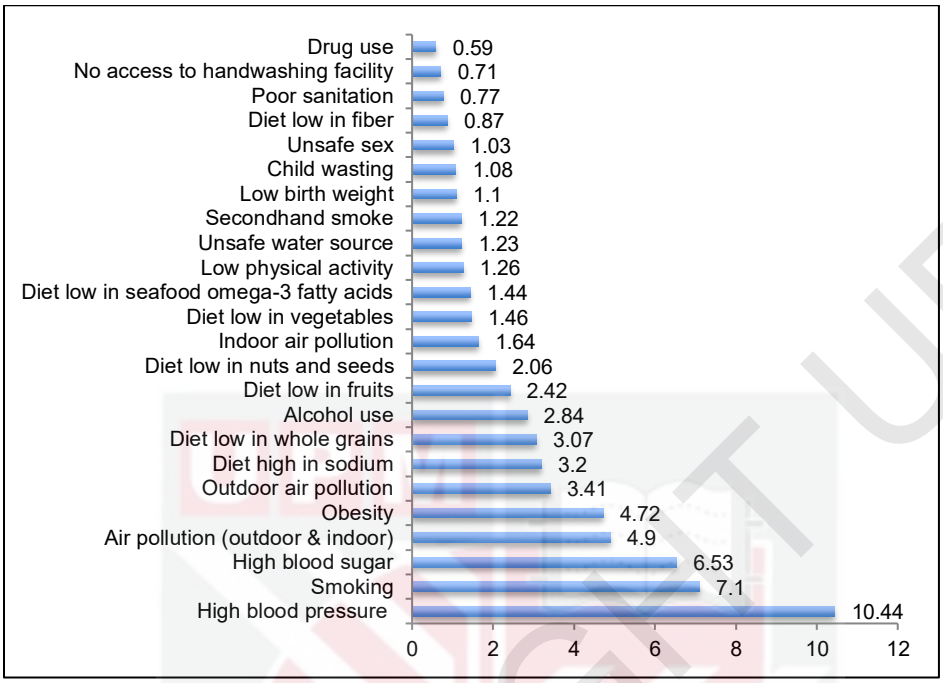

Figure 1.9 : Number of global deaths by risk factor (millions) in 2017
(Source: Global Burden of Disease (GBD), 2018)

Due to air pollution, a significant number of deaths worldwide emerge annually (Figure 1.9), demonstrating that the air pollution problem is a crucial issue in every country. Particulate matter is among the various air pollutants that have been most strongly linked to adverse health effects. Disclosure to outdoor concentrations of fine particulate matter is well thought out as an important global health issue (Burnett et al., 2018). It has been acknowledged that the size of particles is directly associated with the potential cause of health problems. Compared to large particles (PM_{10}), $PM_{2.5}$ (particles less than 2.5 micrometres in diameter) has been posited to be more harmful. It reveals higher health risks because the particles can reach deep into the lungs and bloodstream, leading to cardiovascular and respiratory diseases and consequently deteriorates health conditions (Kloog et al., 2014; Lu et al., 2015; Garcia et al., 2016; Jin et al., 2017).

However, many countries in the developing regions have the highest exposed populations to ambient pollution of $PM_{2.5}$ with annual means of concentrations above World Health Organisation (WHO) guidelines (Figure 1.10). The figure also confirms that the developing countries are among the countries that have the highest populations exposed to high concentrations of $PM_{2.5}$ (e.g., China, India, Bangladesh, Myanmar, Iraq, Egypt, Sudan, Libya, Mauritania, Cameroon and Congo).

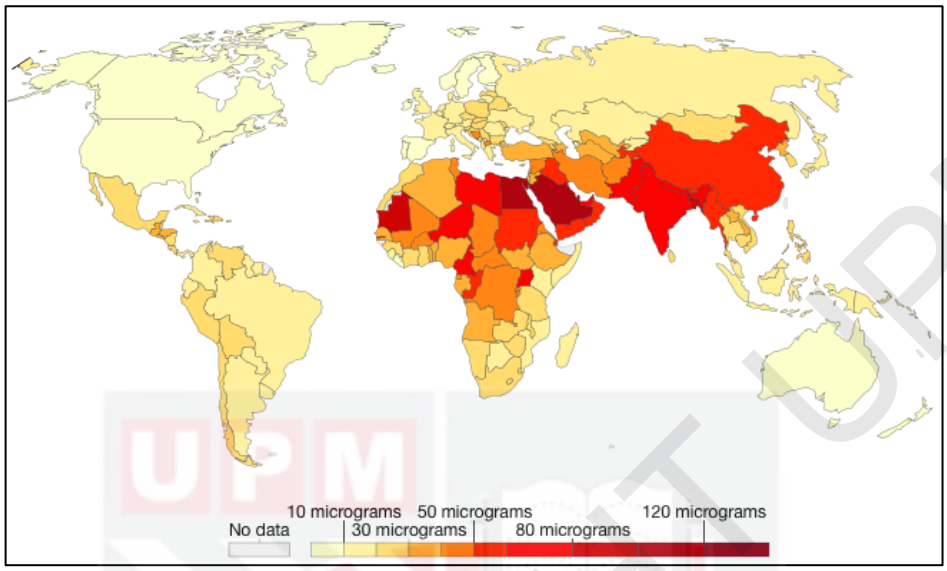

Figure 1.10 : Particulate matter ($PM_{2.5}$) concentration
(Source: Environmental Performance Index (EPI), 2018[2])

A rising body of research has confirmed the harmful impacts of PM2.5 on human health in recent years. Evidence suggests that $PM_{2.5}$ is a significant root cause of the burden of death, disease and disability as exposure to polluted air increases the frequency of various types of diseases that lead to a greater incidence of mortality (Cao et al., 2018; Chen et al., 2017; Fang et al., 2016) and lower life expectancy (de Keijzer et al., 2017; Wu et al., 2020; Bennett et al., 2019; Chen, Chen & Yang, 2019). Over the last century, average years of life (life expectancy) have risen continuously in many other countries (Beltrán-Sánchez, Soneji & Crimmins, 2015). While infectious diseases, the major cause of death, has decreased massively, it was fair to associate the rise in life expectancy with improved health.

However, the increase in the significance of chronic diseases as the primary cause of death has meant that life expectancy is less adequate to estimate the health and, therefore, should be integrated by indicators that measure the quantity as well as the quality of life (Stiefel, Perla & Zell, 2010; Jagger, 2015). The matter of either the extended years of life obtained are spent in good or poor health has become increasingly significant with rising life expectancy in most countries. Hence, healthy life expectancy (also known as disability-free life expectancy), which integrates mortality and morbidity information, has attained importance as a population health measurement. Healthy life expectancy evaluates the number of anticipated disability-free years, which could be

[2] The dark red areas of the map show higher concentrations of particulate matter in the air. The map was developed based on the EPI report on worldwide pollution by Yale University, and can be found at https://epi.envirocenter.yale.edu/2018-epi-report/air-quality.

influenced by chronic diseases that may be responsive to factors such as the ambient environment.

The scatterplots in Figures 1.11 and 1.12 show the relationship between $PM_{2.5}$ levels with the life expectancy and healthy life expectancy. The figures indicate that, on average, many countries with relatively higher levels of $PM_{2.5}$ concentration tend to have a lower life expectancy and healthy life expectancy. For example, as the concentration of $PM_{2.5}$ increases, as indicated by China, Egypt and India, life expectancy and healthy life expectancy decrease. This means that acquaintance to outdoor fine particulate matter ($PM_{2.5}$) air pollution may cause adverse health effects on the lifespan of the population. Tian et al. (2019) indicate that even in areas where concentration levels are deemed safe, $PM_{2.5}$ can lead to decreasing life spans, indicating that the unfavourable consequence may be more widespread as air pollution rises. While these health indicators have shown growth rates over a long period of time, developing countries still lag behind high-income countries. Thus, the extent to which the enhancement in the quality of life keeps pace with the rise in life expectancy is, therefore, a significant health policy issue in many countries.

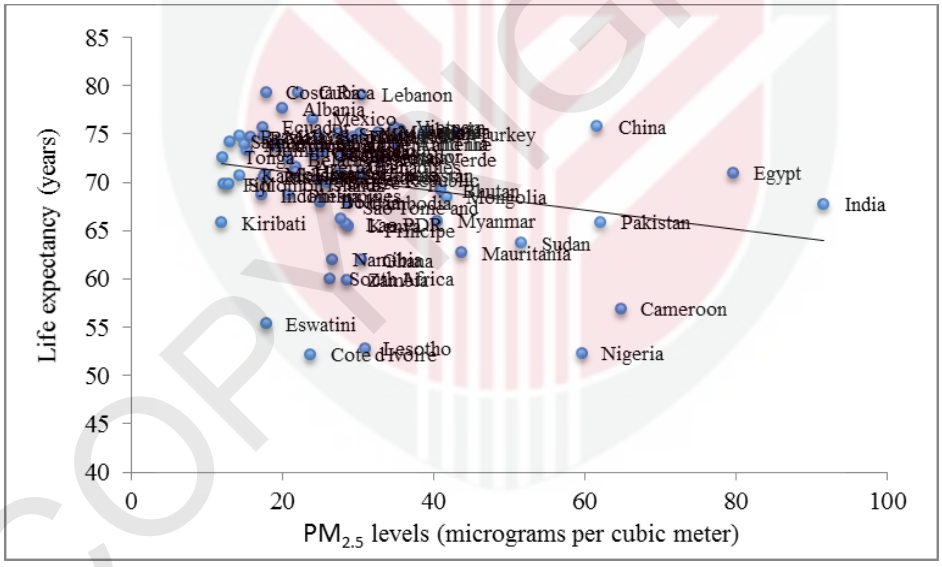

Figure 1.11 : $PM_{2.5}$ levels and life expectancy, average 2010–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018)

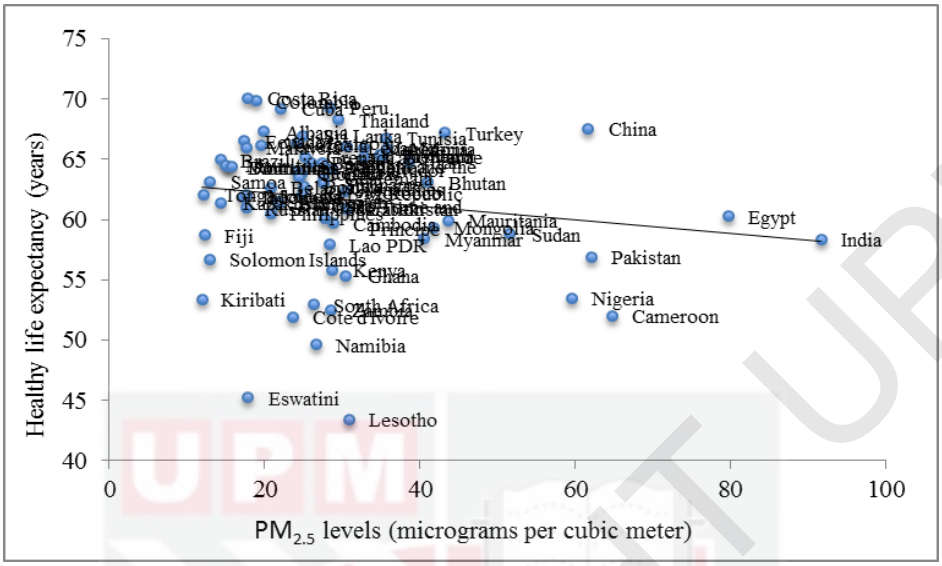

Figure 1.12 : $PM_{2.5}$ levels and healthy life expectancy, average 2010-2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018 and Institute for Health Metrics and Evaluation's (IHME) Global Burden of Disease, 2018)

On the contrary, higher CO_2 emissions (primary sources of greenhouse gas emissions) positively correlate with life expectancy and healthy life expectancy (Figures 1.13 and 1.14). However, the positive correlation may not suggest that CO_2 is not dangerous to human health. The levels of carbon dioxide do not necessarily have a direct impact on health, but the rise in CO_2 levels will significantly increase greenhouse gas emissions, contribute to severe weather conditions and expand the spectrum of diseases. It can also be asserted that when nations emit immense quantities of greenhouse gases due to industrialisation and energy use, which then, in turn, causes economic growth, they can invest more in social welfare and health care, which may have desired effects on human health, apart from the adverse health impact of global warming. Even though greenhouse gases harm the biosphere and human health, they may also foster economic growth, enabling societies to spend more on health care. Thus, the implication of the sign and magnitude of CO_2 on the health needs further empirical estimation.

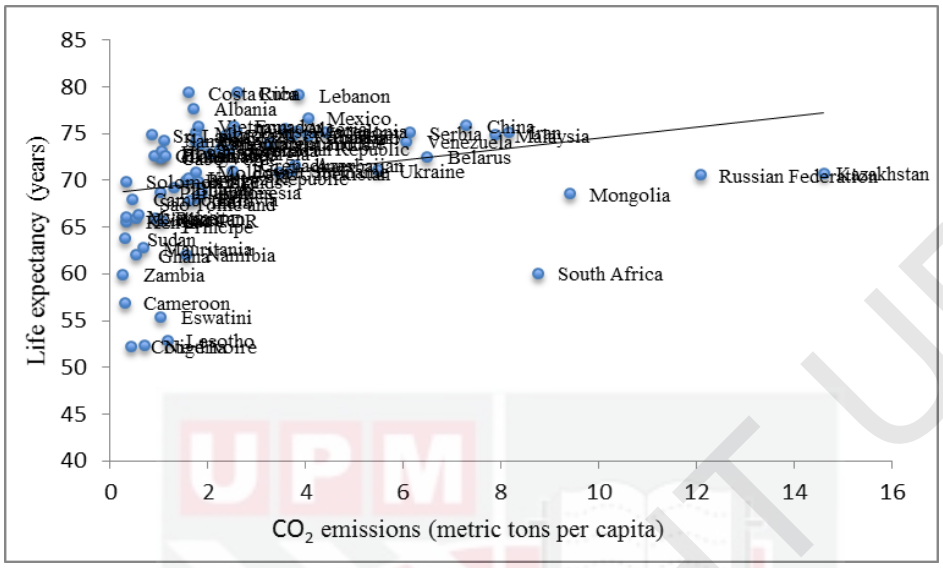

Figure 1.13 : CO_2 levels and healthy life expectancy, average 2010–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018)

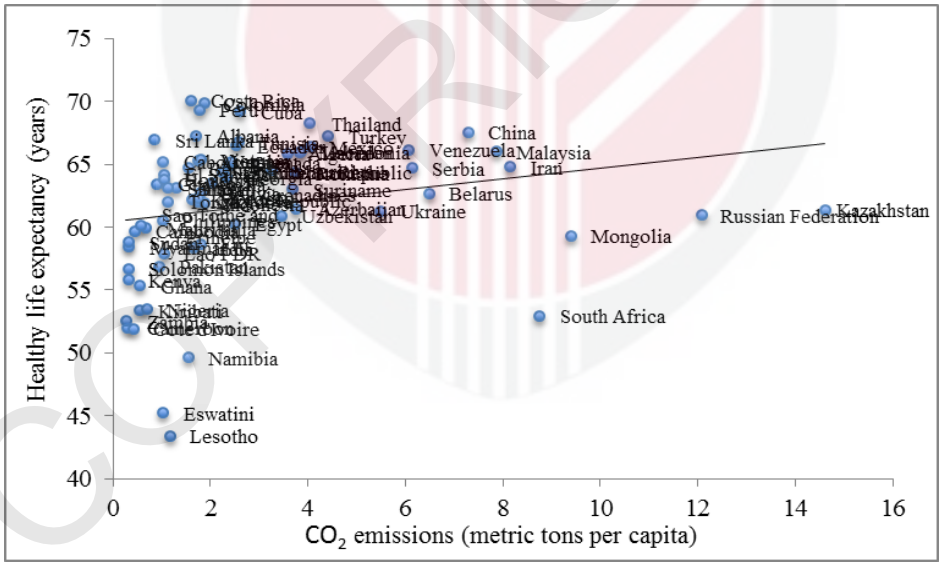

Figure 1.14 : CO_2 levels and healthy life expectancy, average 2010–2017
(Source: Computed based on data from World Development Indicators, World Bank, 2018)

In recent years, due to the vital role of governance in the health community, good governance seems to be an important matter. Furthermore, previous studies indicate that in developing countries, good governance is one of the most significant factors (Daryaei et al., 2012). Through the integration of good governance, rather than ignoring environmental issues, the economy will achieve greater economic and social benefits. The development policy community argues that exterminating inefficiency in governance draws growth back and helps restore environmental quality (Heckelman & Powell, 2010; McMullen-Laird et al., 2015). Therefore, good governance principles in decision-making may be the best way to resolve the increasingly visible risks to health from environmental degradation by framing successful policy frameworks and implementing appropriate strategies. Weak governance, in contrast, can impede advancing well-being in many developing nations.

In addition, the effect of governance on health was discovered to be indirect or modified by contextual variables. It is argued that stronger governance could enforce improved environmental legislation to enhance environmental conditions (Greenstone & Hanna, 2013; Tanaka, 2015; Ibrahim & Law, 2016). Countries with stricter environmental rules would be better able to protect their citizens from the negative impacts of unintended pollution and improve the population's health outcomes. On the other hand, unregulated air pollution tends to increase dangers not just to workers' safety but also to the health of the whole society, which might be susceptible to air pollution (Grossman & Krueger, 1991). Because of its significant impact on health and human capital development, this circumstance may indicate the necessity for immediate attention to air quality supervision. Thus, this study investigates whether the role of governance in reducing the health effects of air pollution is viable.

As such, environmental concerns to human health must be considered in shaping future policy interventions in developing countries. Better knowledge of the proportion of environmental health effects related to air pollution in these countries is crucial for policymakers to design an air quality standard that can lessen the detrimental impacts of greenhouse gasses upon human health.

1.5 Problem Statement

The rapid expansion of economic activity across developing countries has been found to be more environmentally damaging, owing to the production structure of these countries, which is marked by a significant level of manufacturing participation in the gross domestic product (Wang et al., 2018; Felipe, 2018). This has raised concerns about the detrimental effects on the environment as greater material and energy inputs are needed for increasing economic activities. Moreover, despite concerted international attempts on environmental concerns such as the Kyoto Protocol to reduce greenhouse gas emissions, emissions rates are increasing, especially in developing economies (Bernad & Mandal, 2016). According to CO_2 emission trajectories, emissions in advanced

economies decreased by 380 Mt in 2019, whereas emissions in the rest of the world increased by 360 Mt (IEA, 2020). On the other hand, rapid economic activity also contributes to excessive levels of pollution that can result in a range of health problems. At present, environmental concerns have taken centre stage not only in national and international policy debates but also in the court of public opinion. Consequently, based on the above discussions, three environmental implications were of interest to the present study.

First, increasing trade openness gives every country access to the international market. Most developing countries have adopted trade policies focused on greater exposure to international trade, emphasising manufacturing as the catalyst of economic growth and growing living standards (Hossain, 2011; Tran, 2020). Thus, trade orientation in developing countries is said to contribute to environmental degradation. However, it is not conclusive to say that manufacturing or specialising in the production of merchandise goods cause environmental problems. For instance, according to Ayeche, Barhoumi and Hammas (2016), the countries facing competitive pressure can be more solid in using resources, resulting in decreasing pollution emissions.

Furthermore, increased trade openness may motivate firms from rich countries to relocate their polluting industries to poor or developing countries where environmental standards are loose as developed countries adopt tighter environmental protection (Chakraborty & Mukherjee, 2013; Hakimi & Hamdi, 2015; Cherniwchan, 2017). Thus, manufacturing industries (which are considered more polluting) are primarily concentrated in less developed countries. In contrast, the high-tech and service industries (which are considered to be much less polluting) are concentrated in rich industrialised countries. Then, they will be shifted to a decline in environmental degradation in developed nations as countries with less environmental rules turned into pollution havens in the developing world to stay attractive as low-cost boards for manufacturing.

If the developing countries seek to curb the pollution, there would be a corresponding decrease in the income growth rate and/or trade volume. Increased trade could boost economic growth, resulting in increased income, but it could also have an undesirable impact on the environment by emitting emissions into the air. If the countries afflicted were able to use more environmentally friendly industrial processes, it would be beneficial to the environment. The costs of protecting the environment, on the other hand, are needlessly costly. They are the consequence of a regulatory structure that is inefficient and ineffectual, which is a crucial issue for developing countries (Zhao, 2019). However, whether openness to trade that leads to more economic progress is significantly harmful to the environment in developing countries is still not adequately answered and measured. Therefore, the pollution that may be associated with trade openness can be clarified through empirical investigation.

Second, there appears to be a relatively clear connection concerning financial development and the quality of the environment, as there are several mechanisms by which the environment is influenced by the financial sector. For instance, improvements in financial activities will promote economic activities that influence environmental quality. It is convenient to provide capital for technologies that need significant amounts of investment in developed financial structures. This would stimulate investments and encourage companies to implement advanced, safer and environmentally sustainable methods to save the environment from degradation (Mesagan & Nwachukwu, 2018). In turn, this can accelerate advancement in technologies and positively affect energy efficiency and hence influences a cleaner environment in developing countries.

Contradicting, financial development level of a country can vigorously influence the provision of credit to investments that can reduce the quality of the environment. The reason is that the financial development may provide the credit facilities for the expansion of manufacturing activities that lead to the exploration and exploitation of natural resources. Efficient financial intermediation often tends to be beneficial to consumers' loan activities, making it easier for customers to purchase big-ticket products such as vehicles, properties, machinery, etc. and then emit further pollution (Raza & Shah, 2018; Sehrawat, Giri, & Mohapatra, 2015). The developed financial system can, therefore, negatively affect environmental health and ecosystem vitality.

Scholars believe that real, sustainable gains from foreign direct investment and R&D activities can only be realised with the development of a country's financial system (Mahmood, Furqan & Bagais, 2019). The developed financial system serves as a resource allocator and information provider, as well as a cost-cutting instrument that can spur further innovation and serve as a sign of trust for international investors (Jiang & Ma, 2019). However, according to the World Bank (2014), certain developing economies' financial growth is still in its early stages, which will likely stifle FDI and R&D because a less developed financial system makes investments more costly and uncertain. Furthermore, it may worsen the environmental quality in developing countries if they do not have appropriate resources to invest in pollution mitigation initiatives due to inadequate institutional structures. It is apparent that financial development can take a vital role, through mixed findings, in evaluating a nation's environmental quality. Therefore, the conflicting empirical findings point to the need for a follow-up investigation to elucidate this link.

Third, the levels of exposure on the general population in the developing countries are typically greater compared to developed countries whereby air pollution is more tightly regulated, and residential areas are usually far away from industry (Sekrafi & Sghaier, 2018; Stavropoulos, Wall & Xu, 2018; Song & Wang, 2013). According to a current nature assessment on air pollution, the concentration of several outdoor air pollutants, such as $PM_{2.5}$, in developing nations surpasses the WHO's air quality limit (UNEP, 2019), which will have a

detrimental impact on health outcomes. While air pollution in high-income countries has decreased dramatically, WHO reported that it still accounted for some 4.9 million fatalities in 2017, mainly in low- and middle-income countries, where air pollution has risen in the last 25 years (Boogaard et al., 2019). Poor air quality is thus unavoidable in many developing countries, and it can have a variety of health repercussions, including increased disability and a shorter lifespan (Anser et al., 2020; Wang et al., 2019; Ebenstein et al., 2017).

Air pollution's health effects may correspond to low productivity and high costs for health care. Despite the undesirable costs of pollution, there are relatively inadequate governance improvements to enhance environmental quality, where pollution mitigation remains mostly ignored in developing countries. Even most of these countries have long-established legislations and formal governmental systems to resolve their environmental concerns, but little have succeeded in relieving those issues, so environmental laws and regulations are only a formality (Ghosh, 2018; Nazeer, Tabassum & Alam, 2016). Thus, the rapid economic activities together with the weak environmental standards pose fundamental threats to human health due to poor air quality across developing countries.

The health consequences of air pollution have already been demonstrated in a wide range of epidemiological studies, but few studies have attempted to quantify the economic perspective of this issue in developing countries (Aliyu & Ismail, 2016). Understanding the influence of air pollution on human health is vital for the formulation of effective pollution control strategies (Callan & Thomas, 2010). If the scarcity of developing specific research on the public health effect of air pollution persists, then the formulation of effective pollution regulation strategies may be difficult to achieve. Thus, the need to examine if air pollution affects health outcomes across developing countries has been raised.

1.6 Research Questions

The following research questions were formulated:

i. What are the effects of trade openness on the environment in developing countries?
ii. What are the effects of interaction between trade openness and income on the environment?
iii. What are the effects of financial development on environmental quality in developing countries?
iv. What are the effects of interaction between financial development with R&D and FDI on environmental quality?
v. What is the impact of air pollution on health outcomes in developing countries?
vi. What is the impact of the interaction between air pollution and governance quality on health outcomes?

1.7 Research Objectives

The general purpose of the current research was to examine the environmental effects of trade openness and financial development and the impact of air pollution on health outcomes in developing countries empirically.

1.7.1 Specific Objectives

The specific objectives of the present study were stated as follows:

i. To examine the effects of trade openness on the environment
ii. To examine the effects of interaction between trade openness and income on the environment.
iii. To investigate the effects of financial development on environmental quality.
iv. To investigate the effects of interaction between financial development with R&D and FDI on environmental quality.
v. To analyse the impact of air pollution on health outcomes.
vi. To analyse the impact of the interaction between air pollution and governance quality on health outcomes.

1.8 Significance of the Study

The current study intends to add to the examination of the issues as mentioned above by providing an extension of empirical analysis. Firstly, there are many concepts with respect to assessing the degree of trade openness. The most common trade openness measure is expressed as the total trade ratio to GDP as it is the most straightforward estimation of trade openness (Aliyev & Gasimov, 2014; Lau, Choong & Eng, 2014; Yu et al., 2019). More recently, a composite trade share established by Squalli and Wilson (2011) has taken into account the multidimensional nature of trade openness. However, according to Fujii (2019), conveyed trade information can be better described as the magnitude of the specific distribution of sectoral production. As such, in contrast to most other prior studies, the present study used the merchandise trade (contribution to GDP), apart from total trade to GDP, to examine if the trade orientation in developing countries facilitated the concentration of environmentally damaging factors. Only a few studies on developing regions, for example, by Jayanthakumaran, Verma and Liu (2012) and more recently by Khan, Peng and Li (2019), have provided supportive evidence for the potential effects of merchandise trade on trade-related environmental pollution.

However, limited empirical studies in these areas, particularly in developing regions, also meant that these countries could not take advantage of practical evidence on how decision-makers could make the right choices to enable the

developing countries to benefit from freer trade without compromising environmental conditions. In an attempt to bridge this gap, the present study emphasises merchandise trade in relation to local and global types of pollutants. The outcome of this study is to clarify certain empirical consequences regarding developing countries' trade orientation, allowing evaluation of the good (and bad) of developing countries' trade openness by examining its direct and indirect environmental effects.

Openness to trade would encourage developing countries to specialise in manufacturing, which can be considered dirtier, and export their products to countries with stronger environmental requirements. as posited by the pollution havens hypothesis. Transitioning developing economies to manufacturing tends to pollute the environment since these countries are less motivated to adhere to environmental requirements in order to reduce production costs and remain competitive in the international market. On the other hand, the manufacturing sector is the engine of productivity growth and, as a result, the sustenance of technological advancement. Manufacturing has predominantly played a crucial role in developing nations' economic growth (Jiang et al., 2020; Chakraborty & Mukherjee, 2013). This study will empirically investigate whether the concentration of manufacturing activity in developing countries is beneficial to the environment. The findings would increase the knowledge available to governments and policymakers regarding the types of environmental policies appropriate in developing countries to reduce pollution caused by freer trade.

To evaluate the environmental effects of trade openness, it is necessary to empirically look at the environmental effects caused by trade openness directly as well as indirectly from the rapid economic expansion. Trade and economic growth give countries the means to clean the air. Increased trade openness can, in turn, by supporting economic growth and development, contribute to a greater capacity to manage the environment more effectively. More importantly, greater openness can boost access to new technologies that reduce the consumption of energy, water, and other environmentally hazardous substances in local industrial processes, making them more efficient. The outcomes can be used to investigate the phases of development, which could influence how trade influences the environment. As a result, this study will add to the argument over whether trade promotes or hinders the environment in the context of growing economic activities, particularly in developing countries.

Secondly, according to the literature, managing the financial development process to encourage environmental sustainability is the main issue for policymakers, financial institutions, and investors (Zhong & Li, 2020). The financial development and environmental sustainability nexus are crucial to balancing the transition of economic development and enhancing developmental quality. Additional empirical study was therefore required to assess the validity of the positive view of the development of the financial sector as a source of financial services for environmentally sustainable projects that would boost the

quality of the environment in developing countries as the sector evolves in the future.

However, the existing literature has rarely considered the association of financial development with sustainability when discussing the association of financial development and environmental quality, with the available empirical evidence mostly concentrated on using CO_2 emissions as the environmental outcome (Javid & Sharif, 2016; Dogan & Turkekul, 2016; Ali et al., 2019). Therefore, the present study adopted domestic credit extended to the private sector as a financial development indicator and then deployed the EPI to measure environmental quality, which incorporated the element of sustainability. It was anticipated that this study would provide empirical evidence on the strength of financial institution support of environmental sustainability and would guide future research efforts in these developing regions.

In addition, this study looks at the direct effect of financial development on environmental quality and the indirect effect. Unlike earlier research (Abbasi & Riaz, 2016; Hafeez et al., 2018; Saud & Chen, 2018), this study supplements the body of knowledge by looking at the moderating effect of financial development and foreign direct investment on the environmental study. FDI could be attracted to developing host countries if their financial development improves. FDI is a way of transmitting production technology, skills, innovative ability, and organisational and managerial practices from one area to another, resulting in increased economic development and reduced pollution (Frankel & Rose, 2002; Tamazian & Rao, 2010). On the other hand, it appears that a more developed financial sector allocates more resources to R&D, which, in turn, upgrades technology and innovation to advance up the development ladder and favourably influence environmental quality (Hwang, Min & Han, 2010). Thus, this study is necessary as it provides a comprehensive understanding of this issue and contributes to the literature.

Thirdly, although the health outcomes related to air pollution have been modestly investigated empirically, most of the available studies can be found outside the economic literature (mostly based on epidemiological studies) and in the perspective of high-income countries. However, this issue is especially relevant for the developing countries facing pressure to achieve rapid economic growth while facing the risk of implementing economic policies that run counter to long-term social objectives. As a result, research on the health effects of exposure to poor air quality in middle-income countries has been limited and mostly focused on mortality and life expectancy. As such, these studies provided decision-makers with inadequate and ineffective information about overall population health.

Consequently, more scholars became interested not only in life spans but also in life quality as measures of population health, therefore leading to the measure of healthy life expectancy to illustrate this concern (Gangadharan & Valenzuela, 2001; Grigoli & Kapsoli, 2017). However, in many countries, the increase in life expectancy does not always imply an increase in the number of years spent in good health (Dicker et al., 2018). People are only able to work if they are in good health, but the fact that poor air quality exposes human populations to dangerous airborne compounds can exacerbate the state of population health. This signifies the need to measure healthy life states, an area that has been minimally reported in the literature. Due to the limited studies conducted on developing countries where air quality problems are growing (West et al., 2016; Hao et al., 2018), this may be the reason for environmental policy neglect. Therefore, the present study is significant as it can add empirical evidence by considering the effects of elevated levels of air pollution on healthy life expectancy in developing regions.

This indicator is regarded as a key indicator of a country's health and an individual's well-being because it incorporates fatal and non-fatal health states. World Health Organisation (WHO) reports that significant resources are spent to decrease the occurrence, prevalence, and incidence of severe diseases that cause morbidity but not mortality and their impact on people's lives. Reduced morbidity risks can lead to longer and healthier working lives. Because capital is a scarce input in developing countries, the first and most important driver of economic development, particularly in low- and middle-income countries, is the labour force. An enhancement in labour force health status upsurges the productivity resultant in economic growth.

On the other hand, the interactive terms suggest that when government quality is directly targeted at air pollution, it can significantly impact health outcomes. This study differs from others in that the previous studies examine the interaction effects of public health spending and government quality on health outcomes (Makuta & O'hare, 2015; Kim & Wang, 2019). It is expected that the results of the current study would provide convincing evidence that could be useful to environmental health researchers and those responsible for public policy. Governance's effective engagement leads to better government decision-making, more environmentally responsible business practices, and more comprehensive environmental law. This would enable the enforcement of environmental policy options that unveil more sustainable development policies to lessen the consequence of air pollution on long-term economic development and population health within developing countries.

1.9 Scope of the Study

This study covers the effect of trade openness on the environment in developing countries. Three measures of trade openness are included, namely merchandise trade (% of GDP), total trade (% of GDP) as well as composite trade shares, which is the recently trade openness measurement propositioned

by Squalli and Wilson (2011). The study includes the investigation of environmental quality effects of financial development. The EPI scores from historical data allow countries to measure their progress over time. In this way, the EPI provides some relevant insights to identify how close countries are to achieving better environmental quality.

This study is also limited to two pollutants, namely the concentration of particulate matter ($PM_{2.5}$) and carbon dioxide (CO_2) emissions. Particulate matter is a general term for very small solid and liquid particles in the atmosphere. They vary in size, with the most damaging particles being the smaller particles, known as $PM_{2.5}$ (US EPA, 2019). This pollutant is created primarily as a by-product of burning fossil fuels emitted from agricultural activities, power plants, industrial production, transport which is largely from diesel-fuelled vehicles, domestic energy use including smokes from biofuels burning, fugitive dust from paved and unpaved roads, among others (US EPA, 2019; West et al., 2016). Additionally, due to the chemical reaction of certain gaseous pollutants such as SO_2 and nitrogen oxides (Nox), it may also be formed secondarily from fine particles in the atmosphere.

Differently, CO_2 is produced through burning substances of fossil fuels that consist of carbon, while other sources are made up of breathing and fermentation (US EPA, 2019). In an attempt to understand how environmental damages affect human growth, the study is confined to examining the effects of air pollution on health outcomes, with a particular focus on life expectancy and healthy life expectancy.

The study does not consider pollutants other than the two pollutants identified above due to the limited data availability. The inclusion of the developing countries is based on the availability of all the data needed for evaluating every objective of the study. Countries with insufficient and up-to-date data are removed from the analysis, relying on the required data for each objective and methodology employed.

1.10 Organisation of the Study

The remaining of the thesis is organised as follows. Chapter 2 comprises literature reviews of the previous studies. The chapter critically reviews the theoretical as well as the empirical literature on the association of trade openness and the environment followed by financial development and environmental quality. The chapter correspondingly surveys the literature regarding the pollution and health outcomes effects.

Chapter 3 presents the research methodology. The chapter starts with the theoretical frameworks covering derivations of applicable mathematical models associated with theoretical considerations that supported that empirical assessment of the thesis. Then, the empirical models, study variables and econometric methods employed are reported and discussed in this chapter. Finally, the chapter justifies the sample size and defines the sources of data.

Chapter 4 covers regression results. It starts with the presentation of the descriptive statistics and correlation matrices related to the study variables. Next is followed by the presentation of estimated results, interpretations and discussions. Chapter 5 gives a summary of the research and major findings, as well as suggests policy implications from the estimated results. The final part outlines the limitations of this work and offers recommendations on the directions for future research.

REFERENCES

Abbasi, F., & Riaz, K. (2016). CO_2 emissions and financial development in an emerging economy: an augmented VAR approach. *Energy Policy, 90*, 102-114.

Abdouli, M., & Hammami, S. (2017). Investigating the causality links between environmental quality, foreign direct investment and economic growth in MENA countries. *International Business Review*, *26*(2), 264-278.

Abid, M. (2016). Impact of economic, financial, and institutional factors on CO_2 emissions: Evidence from Sub-Saharan Africa economies. *Utilities Policy*, *41*, 85-94.

Abid, M. (2017). Does economic, financial and institutional developments matter for environmental quality? A comparative analysis of EU and MEA countries. *Journal of environmental management*, *188*, 183-194.

Acheampong, A. O. (2018). Economic growth, CO_2 emissions and energy consumption: what causes what and where?. *Energy Economics*, *74*, 677-692.

Acheampong, A. O. (2019). Modelling for insight: does financial development improve environmental quality?. *Energy Economics*, *83*, 156-179.

Acheampong, A. O., & Boateng, E. B. (2019). Modelling carbon emission intensity: Application of artificial neural network. *Journal of Cleaner Production*, *225*, 833-856.

Achim, M. V., Văidean, V. L., & Borlea, S. N. (2020). Corruption and health outcomes within an economic and cultural framework. *The European journal of health economics*, *21*(2), 195-207.

Adams, S., & Klobodu, E. K. M. (2018). Financial development and environmental degradation: does political regime matter?. *Journal of Cleaner Production*, *197*, 1472-1479.

Agbanike, T. F., Nwani, C., Uwazie, U., Uma, K. E., Anochiwa, L., Igberi, C., ... & Ogbonnaya, I. O. (2019). Oil, environmental pollution and life expectancy in Nigeria. *Applied Ecology And Environmental Research*, *17*(5), 11143-11162.

Ahmad, R. & Hasan, J. (2016). Public health expenditure, governance and health outcomes in Malaysia. *Jurnal Ekonomi Malaysia, 50*(1), 29-40.

Ahmad, M., & Zhao, Z. Y. (2018). Empirics on linkages among industrialization, urbanization, energy consumption, CO_2 emissions and economic growth: a heterogeneous panel study of China. *Environmental Science and Pollution Research*, *25*(30), 30617-30632.

Ahmad, M., Ur Rahman, Z., Hong, L., Khan, S., Khan, Z., & Naeem Khan, M. (2018). Impact of environmental quality variables and socio-economic factors on human health: empirical evidence from China. *Pollution*, *4*(4), 571-579.

Ahmad, M., Zhao, Z. Y., Irfan, M., & Mukeshimana, M. C. (2019). Empirics on influencing mechanisms among energy, finance, trade, environment, and economic growth: a heterogeneous dynamic panel data analysis of China. *Environmental Science and Pollution Research*, *26*(14), 14148-14170.

Ahmadi, Z., Dehaghi, M. R., Meybodi, M. E., Goodarzi, M., & Aghajani, M. (2014). Pollution levels in Iranian economy sectors using input-output analysis and TOPSIS technique: An approach to sustainable development. *Procedia-Social and Behavioral Sciences*, *141*, 1363-1368.

Ahmed, K., Shahbaz, M., & Kyophilavong, P. (2016). Revisiting the emissions-energy-trade nexus: evidence from the newly industrializing countries. *Environmental Science and Pollution Research*, *23*(8), 7676-7691.

Ahmed, K., Ozturk, I., Ghumro, I. A., & Mukesh, P. (2019). Effect of trade on ecological quality: a case of D-8 countries. *Environmental Science and Pollution Research*, *26*(35), 35935-35944.

Ahmed, F., Kousar, S., Pervaiz, A., & Ramos-Requena, J. P. (2020). Financial development, institutional quality, and environmental degradation nexus: New evidence from asymmetric ARDL co-integration approach. *Sustainability*, *12*(18), 7812.

Akin, C. S. (2014). The impact of foreign trade, energy consumption and income on CO_2 emissions. *International Journal of Energy Economics and Policy*, *4*(3), 465.

Alam, A., Azam, M., Abdullah, A. B., Malik, I. A., Khan, A., Hamzah, T. A. A. T., ... & Zaman, K. (2015). Environmental quality indicators and financial development in Malaysia: unity in diversity. *Environmental Science and Pollution Research*, *22*(11), 8392-8404.

Alfaro, L., Kalemli- Ozcan, S., & Sayek, S. (2009). FDI, productivity and financial development. *World Economy*, *32*(1), 111-135.

Ali, A., & Ahmad, K. (2014). The impact of socio-economic factors on life expectancy for sultanate of Oman: An empirical analysis.

Ali, H. S., Law, S. H., & Zannah, T. I. (2016). Dynamic impact of urbanization, economic growth, energy consumption, and trade openness on CO_2 emissions in Nigeria. *Environmental Science and Pollution Research*, *23*(12), 12435-12443.

Ali, H. S., Law, S. H., Lin, W. L., Yusop, Z., Chin, L., & Bare, U. A. A. (2019). Financial development and carbon dioxide emissions in Nigeria: evidence from the ARDL bounds approach. *GeoJournal*, *84*(3), 641-655.

Aliyu, A. J., & Ismail, N. W. (2016). The effects of air pollution on human mortality: does gender difference matter in African countries?. *Environmental Science and Pollution Research*, *23*(21), 21288-21298.

Aliyev, K., & Gasimov, I. (2014). Openness-inflation nexus in South Caucasus economies. MPRA Paper No. 62761.

Aller, C., Ductor, L., & Herrerias, M. J. (2015). The world trade network and the environment. *Energy Economics*, *52*, 55-68.

Al-Mulali, U., Saboori, B., & Ozturk, I. (2015). Investigating the environmental Kuznets curve hypothesis in Vietnam. *Energy Policy*, *76*, 123-131.

Alonso-Borrego, C., & Arellano, M. (1999). Symmetrically normalized instrumental-variable estimation using panel data. *Journal of Business & Economic Statistics*, *17*(1), 36-49.

Alvarez-Herranz, A., Balsalobre-Lorente, D., Shahbaz, M., & Cantos, J. M. (2017). Energy innovation and renewable energy consumption in the correction of air pollution levels. *Energy Policy*, *105*, 386-397.

Amri, F. (2018). Carbon dioxide emissions, total factor productivity, ICT, trade, financial development, and energy consumption: testing environmental Kuznets curve hypothesis for Tunisia. *Environmental Science and Pollution Research*, *25*(33), 33691-33701.

Amuakwa-Mensah, F., & Adom, P. K. (2017). Quality of institution and the FEG (forest, energy intensity, and globalization)-environment relationships in sub-Saharan Africa. *Environmental Science and Pollution Research*, *24*(21), 17455-17473.

Amuka, J. I., Asogwa, F. O., Ugwuanyi, R. O., Omeje, A. N., & Onyechi, T. (2018). Climate change and life expectancy in a developing country: Evidence from greenhouse gas (CO_2) emission in Nigeria. *International Journal of Economics and Financial Issues*, *8*(4), 113.

Andrews, M., Hay, R., & Myers, J. (2010). Can governance indicators make sense? Towards a new approach to sector-specific measures of governance. *Oxford Development Studies*, *38*(4), 391-410.

Anenberg, S. C., Horowitz, L. W., Tong, D. Q., & West, J. J. (2010). An estimate of the global burden of anthropogenic ozone and fine particulate matter on premature human mortality using atmospheric modeling. *Environmental health perspectives*, *118*(9), 1189-1195.

Ang, J. B. (2007). CO_2 emissions, energy consumption, and output in France. *Energy policy*, *35*(10), 4772-4778.

Ang, B. (2008). Economic Development, Pollutant Emissions and Energy Consumption in Malaysia. *Journal of Policy Modelin*g, *30*, 271-278.

Anser, M. K., Hanif, I., Vo, X. V., & Alharthi, M. (2020). The long-run and short-run influence of environmental pollution, energy consumption, and economic activities on health quality in emerging countries. *Environmental Science and Pollution Research*, 1-15.

Antweiler, W., Copeland, B. R., & Taylor, M. S. (2001). Is Free Trade Good for the Environment? *American Economic Review*, *91*(4), 877-908.

Anwar, S., & Alexander, W. R. J. (2016). Pollution, energy use, GDP and trade: estimating the long-run relationship for Vietnam. *Applied Economics*, *48*(53), 5221-5232.

Apergis, N., & Payne, J. E. (2009). CO_2 emissions, energy usage, and output in Central America. *Energy Policy*, *37*(8), 3282-3286.

Apergis, N., & Ozturk, I. (2015). Testing environmental Kuznets curve hypothesis in Asian countries. *Ecological Indicators, 52*, 16-22.

Apte, J. S., Brauer, M., Cohen, A. J., Ezzati, M., & Pope III, C. A. (2018). Ambient $PM_{2.5}$ reduces global and regional life expectancy. *Environmental Science & Technology Letters*, *5*(9), 546-551.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, *58*(2), 277-297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, *68*(1), 29-51.

Arceo, E., Hanna, R., & Oliva, P. (2016). Does the effect of pollution on infant mortality differ between developing and developed countries? Evidence from Mexico City. *The Economic Journal*, *126*(591), 257-280.

Ashraf, A., Doytch, N., & Uctum, M. (2020). Foreign direct investment and the environment: disentangling the impact of greenfield investment and merger and acquisition sales. *Sustainability Accounting, Management and Policy Journal*.

Aufderheide, P., & Rich, B. (1988). Environmental reform and the multilateral banks. *World Policy Journal*, *5*(2), 301-321.

Ayeche, M.B., Barhoumi, M., & Hammas, M.A. (2016). Causal Linkage between Economic Growth, Financial Development, Trade Openness and CO_2 Emissions in European Countries. *American Journal of Environmental Engineering*, *6*(4), 110-122.

Babatola, S. S. (2018). Global burden of diseases attributable to air pollution. *Journal of public health in Africa*, *9*(3).

Badamassi, A., Xu, D., & Leyla, B.H. (2017). The Impact of Residential Combustion Emissions on Health Expenditures: Empirical Evidence from Sub-Saharan Africa. *Atmosphere, 8*(9), 157.

Baek, J. (2016). A new look at the FDI–income–energy–environment nexus: dynamic panel data analysis of ASEAN. *Energy Policy*, *91*, 22-27.

Baek, J., Cho, Y., & Koo, W. W. (2009). The environmental consequences of globalization: A country-specific time-series analysis. *Ecological economics*, *68*(8-9), 2255-2264.

Baek, J., & Kim, H. (2011). Trade liberalization, economic growth, energy consumption and the environment: Time series evidence from G-20 economies. *Journal of East Asian Economic Integration*, *15*(1).

Balakrishnan, K., Dey, S., Gupta, T., Dhaliwal, R. S., Brauer, M., Cohen, A. J., ... & Sabde, Y. (2019). The impact of air pollution on deaths, disease burden, and life expectancy across the states of India: the Global Burden of Disease Study 2017. *The Lancet Planetary Health*, *3*(1), e26-e39.

Balan, F. (2016). Environmental quality and its human health effects: A causal analysis for the EU-25. *International Journal of Applied Economics*, *13*(1), 57-71.

Baloch, M. A., Meng, F., Zhang, J., & Xu, Z. (2018). Financial instability and CO 2 emissions: the case of Saudi Arabia. *Environmental Science and Pollution Research*, *25*(26), 26030-26045.

Balsalobre-Lorente, D., Shahbaz, M., Roubaud, D., & Farhani, S. (2018), How economic growth, renewable electricity, and natural resources contribute to CO_2 emissions? *Energy Policy*, *113*, 356-367.

Bardi, U., & Pierini, V. (2013). Declining trends of healthy life years expectancy (HLYE) in Europe. ArXiv preprint arXiv:1311.3799.

Bekhet, H. A., & Othman, N.S. (2017). Impact of urbanization growth on Malaysia CO_2 emissions: Evidence from the dynamic relationship. *Journal of Cleaner Production*, *154*, 374-388.

Bekhet, H. A., Matar, A., & Yasmin, T. (2017). CO_2 emissions, energy consumption, economic growth, and financial development in GCC countries: Dynamic simultaneous equation models. *Renewable and Sustainable Energy Reviews*, *70*, 117-132.

Beladi, H., & Oladi, R. (2011). Does trade liberalization increase global pollution. *Resource and Energy Economics*, *33*(1), 172-178.

Bello, A. K., & Abimbola, O. M. (2010). Does the Level of Economic Growth Influence Environmental Quality in Nigeria: A Test of Environmental Kuznets Curve (EKC) Hypothesis?. *Pakistan Journal of Social Sciences*, *7*(4), 325-329.

Beltrán-Sánchez, H., Soneji, S., & Crimmins, E. M. (2015). Past, present, and future of healthy life expectancy. *Cold Spring Harbor perspectives in medicine*, *5*(11), a025957.

Bennett, J. E., Tamura-Wicks, H., Parks, R. M., Burnett, R. T., Pope III, C. A., Bechle, M. J., ... & Ezzati, M. (2019). Particulate matter air pollution and national and county life expectancy loss in the USA: A spatiotemporal analysis. *PLoS medicine*, *16*(7), e1002856.

Bernard, J., & Mandal, K. S. (2016). The impact of trade openness on environmental quality: an empirical analysis of emerging and developing economies. *WIT Transactions on Ecology and The Environment*, *203*, 195-208.

Biadgilign, S., Ayenew, H. Y., Shumetie, A., Chitekwe, S., Tolla, A., Haile, D., ... & Gebre, B. (2019). Good governance, public health expenditures, urbanization and child undernutrition Nexus in Ethiopia: an ecological analysis. *BMC health services research*, *19*(1), 1-10.

Bist, J. P. (2018). Financial development and economic growth: Evidence from a panel of 16 African and non-African low-income countries. *Cogent Economics & Finance*, *6*(1), 1449780.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, *87*(1), 115-143.

Boateng, E., Amponsah, M., & Annor Baah, C. (2017). Complementarity Effect of Financial Development and FDI on Investment in Sub- Saharan Africa: A Panel Data Analysis. *African Development Review*, *29*(2), 305-318.

Bollyky, T. J., Templin, T., Cohen, M., Schoder, D., Dieleman, J. L., & Wigley, S. (2019). The relationships between democratic experience, adult health, and cause-specific mortality in 170 countries between 1980 and 2016: an observational analysis. *The Lancet*, *393*(10181), 1628-1640.

Bombardini, M., & Li, B. (2016). Trade, Pollution and Mortality in China (NBER Working Papers No. w22804).

Boogaard, H., Walker, K., & Cohen, A. J. (2019). Air pollution: the emergence of a major global health risk factor. *International health*, *11*(6), 417-421. https://doi.org/ 10.1093/inthealth/ihz078.

Boutabba, M. A. (2014). The impact of financial development, income, energy and trade on carbon emissions: Evidence from the Indian economy. *Economic Modelling*, *40*, 33- 41.

Brännlund, R., Ghalwash, T., & Nordström, J. (2007). Increased energy efficiency and the rebound effect: Effects on consumption and emissions. *Energy economics*, *29*(1), 1-17.

Brock, W. A., & Taylor, M. S. (2005). Economic growth and the environment: a review of theory and empirics. In Handbook of economic growth (Vol. 1, pp. 1749-1821). Elsevier.

Burchi, F. (2011). Democracy, institutions and famines in developing and emerging countries. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, *32*(1), 17-31.

Burnett, R., Chen, H., Szyszkowicz, M., Fann, N., Hubbell, B., Pope, C. A., ... & Coggins, J. (2018). Global estimates of mortality associated with long-term exposure to outdoor fine particulate matter. Proceedings of the National Academy of Sciences, *115*(38), 9592-9597.

Callan, S., & Thomas, J. (2010). Environmental Economics and Management: Theory, Policy and Applications. Cengage Learning.

Can, M., & Gozgor, G. (2017). The impact of economic complexity on carbon emissions: evidence from France. *Environmental Science and Pollution Research*, *24*(19), 16364-16370.

Cao, Q., Rui, G., & Liang, Y. (2018). Study on $PM_{2.5}$ pollution and the mortality due to lung cancer in China based on geographic weighted regression model. *BMC Public Health*, *18*(1), 925.

Carlsson, F., & Lundström, S. (2003). The effects of economic and political freedom on CO2 emissions. *Economic Studies, Department of Economics, School of Economics and Commercial Law, Göteborg University: Gothenburg, Sweden*, 79.

Cetin, M., Ecevit, E., & Yucel, A. G. (2018). The impact of economic growth, energy consumption, trade openness, and financial development on carbon emissions: empirical evidence from Turkey. Environmental Science and Pollution Research, *25*(36), 36589-36603.

Chakraborty, D., & Mukherjee, S. (2013). Do Trade and Investment Flows Lead to Higher CO_2 Emissions? Some Panel Estimation Results. Working Papers 1321, Indian Institute of Foreign Trade.

Chandran, V. G. R. (2009). Trade openness and manufacturing growth in Malaysia. *Journal of Policy Modeling*, *31*(5), 637-647.

Chang, S. C. (2015). The effects of trade liberalization on environmental degradation. *Quality & Quantity*, *49*(1), 235-253.

Charfeddine, L., & Khediri, B. (2016). Financial development and environmental quality in UAE: Cointegration with structural breaks. *Renewable and Sustainable Energy Reviews*, *55*, 1322-1335.

Charfeddine, L., & Kahia, M. (2019). Impact of renewable energy consumption and financial development on CO_2 emissions and economic growth in the MENA region: A panel vector autoregressive (PVAR) analysis. *Renewable energy*, *139*, 198-213.

Chen, M., & Ching, M. (2000). A statistical analysis of life expectancy across countries using multiple regression.

Chen, S., Ma, J., Ding, D., Yu, S., & Tang, Y. (2021). The Impact of Green R&D Activities on SO2 Emissions: Evidence from China. *Mathematical Problems in Engineering*, *2021*.

Chen, Y., Ebenstein, A., Greenstone, M., & Li, H. (2013). Evidence on the impact of sustained exposure to air pollution on life expectancy from China's Huai River policy. Proceedings of the National Academy of Sciences, *110*(32), 12936-12941.

Chen, R., Yin, P., Meng, X., Liu, C., Wang, L., Xu, X., ... & Zhou, M. (2017). Fine particulate air pollution and daily mortality. A nationwide analysis in 272 Chinese cities. *American journal of respiratory and critical care medicine*, *196*(1), 73-81.

Chen, C. C., Chen, P. S., & Yang, C. Y. (2019). Relationship between fine particulate air pollution exposure and human adult life expectancy in Taiwan. *Journal of Toxicology and Environmental Health*, Part A, *82*(14), 826-832.

Cheng, Q., Li, M., Li, F., & Tang, H. (2019). Response of Global Air Pollutant Emissions to Climate Change and Its Potential Effects on Human Life Expectancy Loss. *Sustainability*, *11*(13), 3670.

Cherniwchan, J. (2017). Trade liberalization and the environment: Evidence from NAFTA and U.S. manufacturing. *Journal of International Economics*, *105*, 130-149.

Chin, Y. S. J., De Pretto, L., Thuppil, V., & Ashfold, M. J. (2019). Public awareness and support for environmental protection—A focus on air pollution in peninsular Malaysia. *PloS one*, *14*(3), e0212206.

Choong, C. K., & Lim, K. P. (2009). Foreign direct investment, financial development, and economic growth: the case of Malaysia. *Macroeconomics and Finance in Emerging Market Economies*, *2*(1), 13-30.

Choudhary, M. P., Chauhan, G. S., & Kushwah, Y. K. (2015). Environmental degradation: causes, impacts and mitigation. In *National Seminar on Recent Advancements in Protection of Environment and Its Management Issues (NSRAPEM-2015)*.

Christopoulos, D. K., & Tsionas, E. G. (2004). Financial development and economic growth: evidence from panel unit root and cointegration tests. Journal of development Economics, *73*(1), 55-74.

Ciccone, D. K., Vian, T., Maurer, L., & Bradley, E. H. (2014). Linking governance mechanisms to health outcomes: a review of the literature in low-and middle-income countries. *Social science & medicine*, *117*, 86-95.

Cole, M. A., Elliott, R. J., & Shimamoto, K. (2005). Industrial characteristics, environmental regulations and air pollution: an analysis of the UK manufacturing sector. *Journal of environmental economics and management*, *50*(1), 121-143.

Cole, M. A., Elliott, R. J., & Strobl, E. (2008). The environmental performance of firms: The role of foreign ownership, training, and experience. *Ecological Economics*, *65*(3), 538-546.

Cole, M. A., Elliott, R. J., & Zhang, L. (2017). Foreign direct investment and the environment. *Annual Review of Environment and Resources*, *42*, 465-487.

Collier, P., & Venables, A. (2007). Re-thinking Trade Preferences to Help Diversify African Exports. *Policy Insight, 30*(8), 1326-1345.

Cook, R. D. (1977). Detection of influential observation in linear regression. *Technometrics*, *19*(1), 15-18.

Copeland, B. R., & Taylor, M. S. (2004). Trade, Growth, and the Environment. *Journal of Economic Literature, 42*(1), 7-71.

Copeland, B. R., & Taylor, M. S. (2014). Trade and the environment: Theory and evidence: Theory and evidence.

Cristea, A., Hummels, D., Puzzello, L., & Avetisyan, M. (2013). Trade and the greenhouse gas emissions from international freight transport. *Journal of environmental economics and management*, *65*(1), 153-173.

Cutler, D., Deaton, A.D., & Lleras-Muney, A. (2006). The Determinants of Mortality. *Journal of Economic Perspectives, 20*, 97-120.

Damania, R., Fredriksson, P. G., & List, J. A. (2003). Trade liberalization, corruption, and environmental policy formation: theory and evidence. *Journal of environmental economics and management*, *46*(3), 490-512.

Danish, Zhang, B., Wang, B., & Wang, Z. (2017), Role of renewable energy and non-renewable energy consumption on EKC: Evidence from Pakistan. *Journal of Cleaner Production, 156*, 855-864.

Dar, J. A., & Asif, M. (2018). Does financial development improve environmental quality in Turkey? An application of endogenous structural breaks based cointegration approach. *Management of Environmental Quality: An International Journal.*

Daryaei, A., Aliashrafipour, M., Eisapour, K., & Afsharian, M. (2012). The effect of good governance on tourism industry development. *Advances in environmental biology*, 2046-2053.

Dasgupta, S., Laplante, B., & Mamingi, N. (2001). Pollution and capital markets in developing countries. *Journal of Environmental Economics and management*, *42*(3), 310-335.

Dasgupta, S., Laplante, B., Wang, H., & Wheeler D. (2002). Confronting the Environmental Kuznets Curve. *Journal of Economic Perspectives, 16*(1), 147-168.

Dean, J. (2002). Does trade liberalization harm the environment? A new test, *Canadian Journal of Economics, 35*(4), 819-842.

de Keijzer, C., Agis, D., Ambrós, A., Arévalo, G., Baldasano, J. M., Bande, S., ... & Ghigo, S. (2017). The association of air pollution and greenness with mortality and life expectancy in Spain: A small-area study. *Environment international, 99*, 170-176.

Demena, B. A., & Afesorgbor, S. K. (2020). The effect of FDI on environmental emissions: Evidence from a meta-analysis. *Energy Policy, 138*, 111192.

Deng, Q., Wei, Y., Chen, L., Liang, W., Du, J., Tan, Y., & Zhao, Y. (2019). Relationship between Air Pollution and Regional Longevity in Guangxi, China. *International Journal of Environmental Research and Public Health, 16*(19), 3733.

Desbordes, R., & Wei, S. J. (2014). The effects of financial development on foreign direct investment. Technical report, World Bank Policy Research Working Paper 7065.

Dhrifi, A. (2019). Does Environmental Degradation, Institutional Quality, and Economic Development Matter for Health? Evidence from African Countries. *Journal of Knowledge Economy, 10,* 1098 - 1113.

Dicker, D., Nguyen, G., Abate, D., Abate, K. H., Abay, S. M., Abbafati, C., ... & Abdelalim, A. (2018). Global, regional, and national age-sex-specific mortality and life expectancy, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The lancet, 392*(10159), 1684-1735.

Dinda, S. (2004). Environmental Kuznets curve hypothesis: a survey. *Ecological economics*, *49*(4), 431-455.

Dkhili, H. (2019). Environmental Performance and Economic Growth in Middle East and North Africa Countries. *Journal of Health and Pollution*, *9*(24), 191208.

Dogan, E., & Seker, F. (2016). Determinants of CO2 emissions in the European Union: the role of renewable and non-renewable energy. *Renewable Energy*, *94*, 429-439.

Dogan, E., & Turkekul, B. (2016). CO_2 emissions, real output, energy consumption, trade, urbanization and financial development: testing the EKC hypothesis for the USA. *Environmental Science and Pollution Research*, *23*(2), 1203-1213.

Doucouliagos, H., Hennessy, J., & Mallick, D. (2019). Health Aid, Governance and Infant Mortality. IZA Discussion Papers 12166, Institute of Labor Economics (IZA).

Dursun, B., Cesur, R., & Mocan, N. (2018). The Impact of education on health outcomes and behaviors in a middle-income, low-education country. *Economics & Human Biology, 31*, 94-114.

Ebenstein, A., Fan, M., Greenstone, M., He, G., Yin, P., & Zhou, M. (2015). Growth, pollution, and life expectancy: China from 1991-2012. *American Economic Review*, *105*(5), 226-31.

Ebenstein, A., Fan, M., Greenstone, M., He, G., & Zhou, M. (2017). New evidence on the impact of sustained exposure to air pollution on life expectancy from China's Huai River Policy. *Proceedings of the National Academy of Sciences, 114*(39), 10384-10389.

Ederington, J., Levinson, A., & Minier, J. (2004). Trade liberalization and pollution havens. *The BE Journal of Economic Analysis & Policy*, *4*(2).

Ehigiamusoe, K. U., & Lean, H. H. (2019). Effects of energy consumption, economic growth, and financial development on carbon emissions: evidence from heterogeneous income groups. *Environmental Science and Pollution Research, 26*(22), 22611-22624.

Eliste, P., & Fredriksson, P. G. (2004). Does trade liberalization cause a race-to-the-bottom in environmental policies? A spatial econometric analysis. In *Advances in spatial econometrics* (pp. 383-396). Springer, Berlin, Heidelberg.

Environmental Performance Index. (2018). *EPI 2018 – Global Metrics for the Environment: Ranking Country Performance on High-Priority Environmental Issues.* https://epi.yale.edu/downloads/epi2018reportv06191901.pdf.

Erdoğan, S., Yıldırım, D. Ç., & Gedikli, A. (2019) The Relationship Between CO_2 Emissions and Health Indicators: The Case of Turkey. *Econometrics Letters, (6)*1, 28-39.

Ertugrul, H. M., Cetin, M., Seker, F., & Dogan, E. (2016). The impact of trade openness on global carbon dioxide emissions: evidence from the top ten emitters among developing countries. *Ecological Indicators*, *67*, 543-555.

Esty, D. C., & Dua, A. (1997). Sustaining the Asia Pacific miracle: environmental protection and economic integration. *Peterson Institute Press: All Books*.

Esty, D. C., & Geradin, D. (1997). Market access, competitiveness, and harmonization: Environmental protection in regional trade agreements. *Harv. Envtl. L. Rev.*, *21*, 265.

Fotourehchi, Z (2015). Health effects of air pollution: An empirical analysis for developing countries. *Atmospheric Pollution Research, 30*, 1-6.

Fang, D., Wang, Q. G., Li, H., Yu, Y., Lu, Y., & Qian, X. (2016). Mortality effects assessment of ambient $PM_{2.5}$ pollution in the 74 leading cities of China. *Science of The Total Environment, 569*, 1545-1552.

Fang, Z., Huang, B., & Yang, Z. (2018). Trade Openness and the Environmental Kuznets Curve: Evidence from Cities in the People's Republic of China. https://www.adb.org/publications/trade- openness-environmental-kuznets-curve-evidence-cities-prc.

Fang, J., Gozgor, G., Lu, Z., & Wu, W. (2019). Effects of the export product quality on carbon dioxide emissions: evidence from developing economies. *Environmental Science and Pollution Research*, *26*(12), 12181-12193.

Fann, N., Kim, S. Y., Olives, C., & Sheppard, L. (2017). Estimated changes in life expectancy and adult mortality resulting from declining $PM_{2.5}$ exposures in the contiguous United States: 1980–2010. *Environmental health perspectives*, *125*(9), 097003.

Farag, M., Nandakumar, A. K., Wallack, S., Hodgkin, D., Gaumer, G., & Erbil, C. (2013). Health expenditures, health outcomes and the role of good governance. *International journal of health care finance and economics*, *13*(1), 33-52.

Farhani, S., & Ozturk, I. (2015). Causal relationship between CO 2 emissions, real GDP, energy consumption, financial development, trade openness, and urbanization in Tunisia. *Environmental Science and Pollution Research*, *22*(20), 15663-15676.

Farhani, S., Shahbaz, M., & Arouri, M. E. H. (2013). Panel analysis of CO_2 emissions, GDP, energy consumption, trade openness and urbanization for MENA countries. https://mpra.ub.uni-muenchen.de/49258/1/MPRA_paper_49258.pdf.

Felipe, J. (2018). Asia's Industrial Transformation: The Role of Manufacturing and Global Value Chains (Part 1). *Asian Development Bank Economics Working Paper Series*, (549).

Feng, K., Davis, S. J., Sun, L., Li, X., Guan, D., Liu, W., ... & Hubacek, K. (2013). Outsourcing CO2 within china. *Proceedings of the National Academy of Sciences*, *110*(28), 11654-11659.

Feng, S., Gao, D., Liao, F., Zhou, F., & Wang, X. (2016). The health effects of ambient $PM_{2.5}$ and potential mechanisms. *Ecotoxicology and environmental safety, 128*, 67-74.

Feng, X., Xin, M., & Cui, X. (2020). Impact of Global Value Chain Embedding on Total-Factor Energy Productivity of Chinese Industrial Sectors. *Journal of Renewable Energy*, *2020*.

Fonseca, R., Michaud, P. C., & Zheng, Y. (2020). The effect of education on health: evidence from national compulsory schooling reforms. *SERIEs, 11*(1), 83-103.

Foreman, K. J., Marquez, N., Dolgert, A., Fukutaki, K., Fullman, N., McGaughey, M., ... & Brown, J. C. (2018). Forecasting life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: reference and alternative scenarios for 2016–40 for 195 countries and territories. *The Lancet, 392*(10159), 2052-2090.

Frankel, J. (2009). Environmental effects of international trade. John F. Kennedy School of Government, Harvard University, Research Working Paper 09-006.

Frankel, J.A., & Romer, D.H. (1999). Does Trade Cause Growth? American Economic Review, *American Economic Association, 89*(3), 379-399.

Frankel, J., & Rose, A. (2002). An estimate of the effect of common currencies on trade and income. *The quarterly journal of economics*, *117*(2), 437-466.

Frankel, J. A., & Rose, A. K. (2005). Is trade good or bad for the environment? Sorting out the causality. *Review of economics and statistics*, *87*(1), 85-91.

Fredriksson, P. G., List, J. A., & Millimet, D. L. (2003), Corruption, environmental policy, and FDI: theory and evidence from the United States. *Journal of Public Economics, 87*, 1407-1430.

Fujii, E. (2019). What does trade openness measure?. *Oxford Bulletin of Economics and Statistics, 81*(4), 868-888.

Fung, K. W. T., & Lau, C. K. M. (2013). Financial Development, Econmic Growth and R&D Cyclical Movement.

Gale, R. L., & Mendez, A. J. (1998). The Empirical Relationship Between Trade, Growth and the Environment. *International Review of Economics and Finance*, *7*(1), 53-61.

Ganda, F. (2019). The environmental impacts of financial development in OECD countries: a panel GMM approach. *Environmental Science and Pollution Research, 26*(7), 6758-6772.

Gangadharan, L., & Valenzuela, M.R. (2001), Interrelationships between income, health and the environment: extending the Environmental Kuznets Curve hypothesis. *Ecological Economics, 36*(3), 513-531.

Garcia, C. A., Yap, P. S., Park, H. Y., & Weller, B. L. (2016). Association of long-term $PM_{2.5}$ exposure with mortality using different air pollution exposure models: impacts in rural and urban California. *International journal of environmental health research*, *26*(2), 145-157.

Ghorani-Azam, A., Riahi-Zanjani, B., & Balali-Mood, M. (2016). Effects of air pollution on human health and practical measures for prevention in Iran. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences, 21*.

Ghosh, S. (2018). Globalization and Environment: An Asian Experience. *Journal of International Commerce, Economics and Policy*, *9*(03), 1850010.

Glatman-Freedman, A., Cohen, M. L., Nichols, K. A., Porges, R. F., Saludes, I. R., Steffens, K., ... & Britt, D. W. (2010). Factors affecting the introduction of new vaccines to poor nations: a comparative study of the Haemophilus influenzae type B and hepatitis B vaccines. *PLoS One*, *5*(11), e13802.

Golub, S. S., Kauffmann, C., & Yeres, P. (2011). Defining and measuring green FDI: An exploratory review of existing work and evidence.

Gozgor, G. (2017). Does trade matter for carbon emissions in OECD countries? Evidence from a new trade openness measure. *Environmental Science and Pollution Research, 24*(36), 27813-27821.

Greenstone, M., & Hanna, R. (2013). Environmental regulations, air and water pollution, and infant mortality in India. *American Economic Review*, *104*(10), 3038-72.

Grigoli, F., & Kapsoli, J. (2017). Waste not, want not: The efficiency of health expenditure in emerging and developing economies. *Review of Development Economics, 22*(1), 384-403.

Grossman, G. (1994). Pollution and growth: what do we know? (No. 848). CEPR Discussion Papers.

Grossman, G. M., & Krueger, A. B. (1991). *Environmental impacts of a North American free trade agreement* (No. w3914). National Bureau of economic research.

Grossman, G. M., & Krueger, A. B. (1993). Environment Impacts of a North American Free Trade Agreement. In: Garber, P.M. Ed., The Mexican-US Free Trade Agreement, MIT Press, Cambridge.

Grossman, G., & Krueger, A. (1995). Economic growth and the environment. *Quarterly Journal of Economics, 110*, 353–377.

Gujarati, D. N. (2014). *Basic Econometrics*. New Delhi: McGraw Hill Publishing Company.

Guo, Y., Xia, X., Zhang, S., & Zhang, D. (2018). Environmental regulation, government R&D funding and green technology innovation: evidence from China provincial data. *Sustainability, 10*(4), 940.

Guo, M., Hu, Y., & Yu, J. (2019). The role of financial development in the process of climate change: evidence from different panel models in China. *Atmospheric Pollution Research*, *10*(5), 1375-1382.

Gupta, S., Davoodi, H., & Tiongson, E. (2000). Corruption and the provision of health care and education services. International Monetary Fund Working Paper, 00/116, pp 1–33.

Gurung, A., Son, J. Y., & Bell, M. L. (2017). Particulate matter and risk of hospital admission in the Kathmandu Valley, Nepal: a case-crossover study. *American journal of epidemiology*, *186*(5), 573-580.

Hadi, S., Retno, S., & Yuliani, S. (2018). The Impact of Foreign Direct Investment to the Quality of the Environment in Indonesia. In *E3S Web of Conferences* (Vol. 73, p. 10025). EDP Sciences.

Hadian, M., Raeissi, P., & Khalilabad, T. H. (2020). The economic burden of mortality and morbidity due to air pollution in Tehran, Iran: a systematic review. *Air Quality, Atmosphere & Health*, *13*(8), 1001-1011.

Hafeez, M., Chunhui, Y., Strohmaier, D., Ahmed, M., & Jie, L. (2018). Does finance affect environmental degradation: evidence from One Belt and One Road Initiative region?. *Environmental Science and Pollution Research*, *25*(10), 9579-9592.

Hahn, R. A., & Truman, B. I. (2015). Education improves public health and promotes health equity. *International journal of health services, 45*(4), 657-678.

Hakimi, A., & Hamdi, H. (2015). Trade liberalization, FDI inflows, environmental quality and economic growth: a comparative analysis between Tunisia and Morocco. *Renewable and Sustainable Energy Reviews*, *58*, 1445-1456.

Hakimi, A., & Hamdi, H. (2020). Environmental effects of trade openness: what role do institutions have?. *Journal of Environmental Economics and Policy*, *9*(1), 36-56.

Halicioglu, F. (2009). An econometric study of CO2 emissions, energy consumption, income and foreign trade in Turkey. *Energy Policy, 37*(3), 1156-1164.

Halicioglu, F. (2011). Modeling life expectancy in Turkey. *Economic Modelling, 28*(5), 2075-2082.

Halicioglu, F., & Ketenci, N. (2016). The impact of international trade on environmental quality: The case of transition countries. *Energy*, *109*, 1130-1138.

Halkos, G., & Polemis, M. (2016). Examining the impact of financial development on the environmental Kuznets curve hypothesis. https://mpra.ub.uni-muenchen.de/75368/1/MPRA_paper_75368.pdf

Hamdi, H., Hakimi, A., Sbia, R., & Jlassi, N. B. (2015). Financial liberalization and the environmental quality: Evidence from Tunisia. *Energy Studies Review*, *22*, 71.

Hao, Y., & Liu, Y. M. (2016). The influential factors of urban PM2. 5 concentrations in China: a spatial econometric analysis. *Journal of Cleaner Production, 112*, 1443-1453.

Hao, Y., Zhang, Z. Y., Liao, H., Wei, Y. M., & Wang, S. (2016). Is CO_2 emission a side effect of financial development? An empirical analysis for China. *Environmental Science and Pollution Research*, *23*(20), 21041-21057.

Hao, Y., Liu, S., Lu, Z. N., Huang, J., & Zhao, M. (2018). The impact of environmental pollution on public health expenditure: dynamic panel analysis based on Chinese provincial data. *Environmental Science and Pollution Research*, *25*(19), 18853-18865.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of econometrics*, *93*(2), 345-368.

Harbaugh, W. T., Levinson, A., & Wilson, D. M. (2002). Reexamining the empirical evidence for an environmental Kuznets curve. *Review of Economics and Statistics, 84*(3), 541-551.

Haseeb, A., Xia, E., Baloch, M. A., & Abbas, K. (2018). Financial development, globalization, and CO_2 emission in the presence of EKC: evidence from BRICS countries. *Environmental Science and Pollution Research, 25*(31), 31283-31296.

He, J., & Wang, H. (2012). Economic structure, development policy and environmental quality: An empirical analysis of environmental Kuznets curves with Chinese municipal data. *Ecological economics*, *76*, 49-59.

He, X. (2014). Research on optimal regulation structure of green technology innovation-Based on the dual interactive effect of R&D support and environmental regulation. *J. Environ. Econ. Manag*, *36*, 144-153.

Heckelman, J. C., & Powell, B. (2010). Corruption and the institutional environment for growth. *Comparative Economic Studies*, *52*(3), 351-378.

Hendryx, M., Luo, J., Chojenta, C., & Byles, J. E. (2019). Air pollution exposures from multiple point sources and risk of incident chronic obstructive pulmonary disease (COPD) and asthma. *Environmental research*, *179*, 108783.

Hermes, N., & Lensink, R. (2003). Foreign direct investment, financial development and economic growth. *The journal of development studies*, *40*(1), 142-163.

Heutel, G., & Ruhm, C. J. (2016). Air pollution and procyclical mortality. *Journal of the Association of Environmental and Resource Economists*, *3*(3), 667-706.

Hill, T. D., Jorgenson, A. K., Ore, P., Balistreri, K. S., & Clark, B. (2019). Air quality and life expectancy in the United States: An analysis of the moderating effect of income inequality. *SSM-population health, 7*, 100346.

Ho, S. Y., & Iyke, B. N. (2019). Trade openness and carbon emissions: evidence from central and eastern European countries. *Review of Economics, 70*(1), 41-67.

Hocking, M. B. (2016). Handbook of chemical technology and pollution control. Elsevier.

Holmberg, S., & Rothstein, B. (2011). Dying of corruption. *Health Econ. Policy Law 6*(4), 529e547.

Holtz-Eakin, D., Newey, W., & Rosen, H. S. (1988). Estimating vector autoregressions with panel data. *Econometrica: Journal of the Econometric Society*, 1371-1395.

Honma, S. (2015). Does international trade improve environmental efficiency? An application of a super slacks-based measure of efficiency. *Journal of Economic Structures, 4*(1), 13.

Hossain, M. S. (2011). Panel estimation for CO_2 emissions, energy consumption, economic growth, trade openness and urbanization of newly industrialized countries. *Energy Policy, 39*(11), 6991-6999.

Houda, B., & Lamia, M. J. (2016). Interaction between Financial Development and Sustainable Development, Evidence from Developing Countries: A Panel Data Study. *International Journal of Economics and Finance, 8*(2).

Hu, B., & Mendoza, R. U. (2013). Public health spending, governance and child health outcomes: revisiting the links. *Journal of Human Development and Capabilities, 14*(2), 285-311.

Hubbard, T. P. (2014). Trade and transboundary pollution: quantifying the effects of trade liberalization on CO_2 emissions. *Applied Economics, 46*(5), 483-502.

Hwang, Y. S., Min, H. G., & Han, S. H. (2010). The influence of financial development on R&D activity: cross-country evidence. *Review of Pacific Basin Financial Markets and Policies*, *13*(03), 381-401.

Ibrahim, M. H., & Law, S. H. (2016). Institutional Quality and CO_2 Emission-Trade Relations: Evidence from Sub- Saharan Africa. *South African Journal of Economics*, *84*(2), 323-340.

Ibukun, C. O. (2021). The role of governance in the health expenditure–health outcomes nexus: insights from West Africa. *International Journal of Social Economics*.

International Energy Agency. (2020). *Global Energy Review 2019*. https://www.iea.org/reports/global-energy-review-2019.

Issaoui, F., Toumi, H., & Touili, W. (2015). Effects of CO_2 emissions on economic growth, urbanization and welfare: application to MENA countries. Munich Personal RePEc Archive (MPRA) No. 65683.

Jaba, E., Balan, C. B., & Robu, I. B. (2014). The relationship between life expectancy at birth and health expenditures estimated by a cross-country and time-series analysis. *Procedia Economics and Finance, 15*, 108-114.

Jacobson, M. Z. (2008). On the causal link between carbon dioxide and air pollution mortality. *Geophysical Research Letters, 35*(3).

Jagger, C. (2015). Trends in life expectancy and healthy life expectancy. *Future of an ageing population: evidence review. London: Foresight, Government Office for Science*.

Jagger, C., & Robine, J. M. (2011). Healthy life expectancy. In *International handbook of adult mortality* (pp. 551-568). Springer, Dordrecht.

Jalil, A., & Feridun, M. (2011). Long-run relationship between income inequality and financial development in China. *Journal of the Asia Pacific Economy, 16*(2), 202-214.

Javid, M., & Sharif, F. (2016). Environmental Kuznets curve and financial development in Pakistan. *Renewable and Sustainable Energy Reviews*, *54*, 406-414.

Jayanthakumaran, K., Verma, R., & Liu, Y. (2012). CO_2 emissions, energy consumption, trade and income: a comparative analysis of China and India. *Energy Policy, 42*, 450-460.

Jebeli, S. S. H., Hadian, M., & Souresrafil, A. (2019). Study of health resource and health outcomes: Organization of economic corporation and development panel data analysis. *Journal of education and health promotion, 8.*

Jena, P. R. (2018). Does trade liberalization create more pollution? Evidence from a panel regression analysis across the states of India. *Environmental Economics and Policy Studies, 20*(4), 861-877.

Jensen, A. L. (1996). Beverton and Holt life history invariants result from optimal trade-off of reproduction and survival. *Canadian Journal of Fisheries and Aquatic Sciences*, *53*(4), 820-822.

Jerumeh, T.R., Ogunnubi, C.S., & Yusuf, S.A. (2015). Industrial pollution and its attendant effects on public health in Nigeria. *Journal of Economics and Sustainable Development*, *6*(24), 164-175.

Ji, X., Yao, Y., & Long, X. (2018). What causes $PM_{2.5}$ pollution? Cross-economy empirical analysis from socioeconomic perspective. *Energy Policy, 119*, 458-472.

Jiang, C., & Ma, X. (2019). The impact of financial development on carbon emissions: a global perspective. *Sustainability*, *11*(19), 5241.

Jiang, M., Kim, E., & Woo, Y. (2020). The relationship between economic growth and air pollution—a regional comparison between China and South Korea. *International journal of environmental research and public health*, *17*(8), 2761.

Jin, Q., Fang, X., Wen, B., & Shan, A. (2017). Spatio-temporal variations of $PM_{2.5}$ emission in China from 2005 to 2014. *Chemosphere, 183*, 429-436.

Jordaan, S. M., Romo-Rabago, E., McLeary, R., Reidy, L., Nazari, J., & Herremans, I. M. (2017). The role of energy technology innovation in reducing greenhouse gas emissions: A case study of Canada. *Renewable and Sustainable Energy Reviews, 78*, 1397-1409.

Joseph, A. I. (2020). Environmental pollution and life expectancy in Nigeria. *Journal of Economic Studies, 17*(1), 80-93.

Joumard, I., André, C., Nicq, C., & Chatal, O. (2010). Health status determinants: lifestyle, environment, health care resources and efficiency. Environment, Health Care Resources and Efficiency (May 27, 2010). OECD Economics Department Working Paper, (627).

Kais, S., & Sami, H. (2016). An econometric study of the impact of economic growth and energy use on carbon emissions: panel data evidence from fifty eight countries. *Renewable and Sustainable Energy Reviews*, *59*, 1101-1110.

Kang, Y. Q., Zhao, T., & Yang, Y. Y. (2016). Environmental Kuznets curve for CO_2 emissions in China: A spatial panel data approach. *Ecological Indicators, 63*, 231-239.

Katircioğlu, S. T., & Taşpinar, N. (2017). Testing the moderating role of financial development in an environmental Kuznets curve: empirical evidence from Turkey. *Renewable and Sustainable Energy Reviews, 68*, 572-586.

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2007). Growth and governance: A reply. *The Journal of Politics, 69*(2), 555-562.

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). The Worldwide Governance Indicators: Methodology and Analytical Issues (World Bank Policy Research Working Paper No. 5430). *Washington, DC: The World Bank*.

Keho, Y. (2016). Trade openness and the environment: a time series study of ECOWAS countries. *Journal of Economics and Development Studies*, *4*(4), 61-69.

Kelly, F. J., & Fussell, J. C. (2015). Air pollution and public health: emerging hazards and improved understanding of risk. *Environmental geochemistry and health, 37*(4), 631-649.

Khan, A., Saleem, N., & Fatima, S. (2018). Financial development, income inequality, and CO_2 emissions in Asian countries using STIRPAT model. *Environmental Science and Pollution Research, 25*(7), 6308-6319.

Khan, S., Peng, Z., & Li, Y. (2019). Energy consumption, environmental degradation, economic growth and financial development in globe: Dynamic simultaneous equations panel analysis. *Energy Reports, 5*, 1089-1102.

Khreis, H., Kelly, C., Tate, J., Parslow, R., Lucas, K., & Nieuwenhuijsen, M. (2017). Exposure to traffic-related air pollution and risk of development of childhood asthma: a systematic review and meta-analysis. *Environment international*, *100*, 1-31.

Kim, S. Y., Olives, C., Sheppard, L., Sampson, P. D., Larson, T. V., Keller, J. P., & Kaufman, J. D. (2017). Historical prediction modeling approach for estimating long-term concentrations of $PM_{2.5}$ in cohort studies before the 1999 implementation of widespread monitoring. *Environmental health perspectives*, *125*(1), 38-46.

Kim, D., & Go, S. (2020). Human Capital and Environmental Sustainability. *Sustainability, 12*(11), 4736.

Kim, S., & Wang, J. (2019). Does quality of government matter in public health?: comparing the role of quality and quantity of government at the National Level. *Sustainability*, *11*(11), 3229.

Kiross, G.T., Chojenta, C., Barker, D., & Loxton, D. (2020). The effects of health expenditure on infant mortality in sub-Saharan Africa: evidence from panel data analysis. *Health Economics Review, 10*(1), 1-9.

Kloog, I., Nordio, F., Zanobetti, A., Coull, B. A., Koutrakis, P., & Schwartz, J. D. (2014). Short term effects of particle exposure on hospital admissions in the Mid-Atlantic states: a population estimate. *PloS one*, *9*(2), e88578.

Kohler, M. (2013). CO_2 Emissions, Energy Consumption, Income and Foreign Trade: A South African Perspective. *Energy Policy, 63*, 1042-1050.

Komen, M. H., Gerking, S., & Folmer, H. (1997). Income and environmental R&D: empirical evidence from OECD countries. *Environment and Development Economics, 2*(4), 505-515.

Kirkpatrick, C., & Scrieciu, S., S. (2008). Is Trade Liberalisation Bad for Environment? A Review o f the Economic Evidence. *Journal o f Environmental Planning and Management,* 51 ,No. 4,497-510.

Kukla-Gryz, A. (2009). Economic growth, international trade and air pollution: a decomposition analysis. *Ecological Economics, 68*(5), 1329-1339.

Kusumawardani, D. (2011). Economic development and environmental quality: an environmental Kuznets curve (EKC) investigation using cross-countries data. *Journal of Economics and Business Airlangga, 21*(1).

Kuznets, S. (1955). Economic Growth and Income Inequality. *American Economic Review*, 49, 1–28.

Lan, J., Kakinaka, M., & Huang, X. (2012). Foreign direct investment, human capital and environmental pollution in China. *Environmental and Resource Economics*, *51*(2), 255-275.

Lange, S., & Vollmer, S. (2017). The effect of economic development on population health: a review of the empirical evidence. *British medical bulletin, 121*(1), 47-60.

Lanoie, P., Laplante, B., & Roy, M. (1998). Can capital markets create incentives for pollution control?. *Ecological Economics,* 26(1), 31-41.

Lau, L. S., Choong, C. K., & Eng, Y. K. (2014). Investigation of the environmental Kuznets curve for carbon emissions in Malaysia: do foreign direct investment and trade matter?. *Energy Policy, 68*, 490-497.

Le, T. H. (2016). Dynamics between energy, output, openness and financial development in sub-Saharan African countries. *Applied Economics, 48*(10), 914-933.

Le, T. H., Chang, Y., & Park, D. (2016). Trade openness and environmental quality: International evidence. *Energy Policy, 92*, 45–55.

Le, T. H., Le, H. C., & Taghizadeh-Hesary, F. (2020). Does financial inclusion impact CO_2 emissions? Evidence from Asia. *Finance Research Letters,* 101451.

Lean, H. H., & Smyth, R. (2010). CO_2 emissions, electricity consumption and output in ASEAN. *Applied Energy, 87*(6), 1858-1864.

Lee, K. H., & Min, B. (2015). Green R&D for eco-innovation and its impact on carbon emissions and firm performance. *Journal of Cleaner Production, 108*, 534-542.

Lee, S. H., & Thiel, M. (2017). Relations between GDP growth and environmental performance using latent growth curve model applied for environmental Kuznets curve. *International Journal of Sustainable Economy*, *9*(2), 87-104.

Lelieveld, J., Pozzer, A., Pöschl, U., Fnais, M., Haines, A., & Münzel, T. (2020). Loss of life expectancy from air pollution compared to other risk factors: a worldwide perspective. *Cardiovascular Research.*

Lewis, M. (2006). Governance and corruption in public health care systems. Center for Global Development working paper, (78).

Li, G., Fang, C., Wang, S., & Sun, S. (2016). The effect of economic growth, urbanization, and industrialization on fine particulate matter ($PM_{2.5}$) concentrations in China. *Environmental science & technology, 50*(21), 11452-11459.

Li, P., & Tu, Y. (2014). The impacts of openness on air quality in China. *Environment and Development Economics, 19*(2), 201–227.

Li, Z., Xu, N., & Yuan, J. (2015). New evidence on trade-environment linkage via air visibility. *Economics Letters, 128*, 72-74.

Li, X., Tang, K., Jin, X. R., Xiang, Y., Xu, J., Yang, L. L., ... & Cai, T. J. (2018). Short-term air pollution exposure is associated with hospital length of stay and hospitalization costs among inpatients with type 2 diabetes: a hospital-based study. *Journal of Toxicology and Environmental Health, Part A*, *81*(17), 819-829.

Liddle, B., & Lung, S. (2010). Age-structure, urbanization, and climate change in developed countries: revisiting STIRPAT for disaggregated population and consumption-related environmental impacts. *Population and Environment, 31*(5), 317-343.

Lin, R. T., Chien, L. C., Chen, Y. M., & Chan, C. C. (2014). Governance matters: an ecological association between governance and child mortality. *International health, 6*(3), 249-257.

Lin, F. (2017). Trade openness and air pollution: City-level empirical evidence from China. *China Economic Review, 45*, 78-88.

Ling, C. H., Ahmed, K., Muhamad, R. B., & Shahbaz, M. (2015). Decomposing the trade-environment nexus for Malaysia: what do the technique, scale, composition, and comparative advantage effect indicate?. *Environmental Science and Pollution Research, 22*(24), 20131-20142.

Linh, D. H., & Lin, S. M. (2014). CO 2 Emissions, Energy Consumption, Economic Growth and FDI in Vietnam. *Managing Global Transitions: International Research Journal*, *12*(3).

Lio, M. C., & Lee, M. H. (2016). Corruption costs lives: a cross- country study using an IV approach. *The International journal of health planning and management*, *31*(2), 175-190.

Lisciandra, M., & Migliardo, C. (2017). An empirical study of the impact of corruption on environmental performance: Evidence from panel data. *Environmental and Resource Economics*, *68*(2), 297-318.

Liu, X., & Bae, J. (2018). Urbanization and industrialization impact of CO_2 emissions in China. *Journal of Cleaner Production, 172*, 178–186.

Liu, Q., Wang, S., Zhang, W., Zhan, D., & Li, J. (2018). Does foreign direct investment affect environmental pollution in China's cities? A spatial econometric perspective. *Science of the total environment, 613*, 521-529.

Liu, H., Kim, H., & Choe, J. (2019). Export diversification, CO_2 emissions and EKC: panel data analysis of 125 countries. *Asia-Pacific Journal of Regional Science, 3*(2), 361-393.

Lopez, R., & Mitra, S. (2000). Corruption, pollution, and the Kuznets environment curve. *Journal of Environmental Economics and Management*, *40*(2), 137-150.

Lu, F., Xu, D., Cheng, Y., Dong, S., Guo, C., Jiang, X., & Zheng, X. (2015). Systematic review and meta-analysis of the adverse health effects of ambient $PM_{2.5}$ and PM_{10} pollution in the Chinese population. *Environmental research, 136*, 196-204.

Lucas Jr, R. E. (1988). On the mechanics of economic development. *Journal of monetary economics, 22*(1), 3-42.

McCarney, G. R., & Adamowicz, W. L. (2005). *The effects of trade liberalization on the environment: an empirical study* (No. 522-2016-37715).

Mahmood, H., Furqan, M., & Bagais, O. A. (2019). Environmental accounting of financial development and foreign investment: spatial analyses of East Asia. *Sustainability*, *11*(1), 13.

Mahmoodi, M., & Mahmoodi, E. (2018). Environmental quality, renewable energy, trade openness and economic growth: Evidence from two groups of developing countries. *Asian Journal of Water, Environment and Pollution, 15*(2), 177-185.

Majeed, M. T., & Mazhar, M. (2019). Financial development and ecological footprint: A global panel data analysis. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, *13*(2), 487-514.

Maji, I. K. (2015). Does clean energy contribute to economic growth? Evidence from Nigeria. *Energy Reports*, *1*, 145-150.

Maji, I., Habibullah, M., & Saari, M. (2017). Financial development and sectoral CO_2 emissions in Malaysia. *Environmental Science and Pollution Research, 24*(8), 7160-7176.

Makuta, I., & O'Hare, B. (2015). Quality of governance, public spending on health and health status in Sub Saharan Africa: a panel data regression analysis. *BMC public health, 15*(1), 932.

Managi, S., Hibiki, A., & Tsurumi, T. (2009). Does trade openness improve environmental quality?. *Journal of Environmental Economics and Management, 58*, 346-363.

Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E. (2020). Environmental and health impacts of air pollution: a review. *Frontiers in public health*, *8*.

Mannucci P., & Franchini M. (2017). Health Effects of Ambient Air Pollution in Developing Countries. *International Journal of Environmental Research and Public Heatlh, 14* (9).

Matthew, O., Osabohien, R., Olawande, T. I., & Urhie, E. S. (2019). Manufacturing industries and construction emissions in Nigeria: Examining the effects on health conditions. *International Journal of Civil Engineering and Technology (IJCIET), 10*(1), 2401-2414.

McMillan, M., Rodrik, D., & Sepulveda, C. (2017). *Structural change, fundamentals and growth: A framework and case studies* (No. w23378). National Bureau of Economic Research.

McMullen-Laird, L., Zhao, X., Gong, M., & McMullen, S. J. (2015). Air pollution governance as a driver of recent climate policies in China. *Carbon & Climate Law Review*, *9*(3), 243-255.

Melnyk, S. A., Sroufe, R. P., & Calantone, R. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. *Journal of operations management*, *21*(3), 329-351.

Mert, M., & Bölük, G. (2016). Do foreign direct investment and renewable energy consumption affect the CO_2 emissions? New evidence from a panel ARDL approach to Kyoto Annex countries. *Environmental Science and Pollution Research, 23*(21), 21669-21681.

Mesagan, E. P., & Nwachukwu, M. I. (2018). Determinants of environmental quality in Nigeria: Assessing the role of financial development. *Econometric Research in Finance*, *3*(1), 55-78.

Mhango, C. T., & Chirwa, G. C. (2018). Government health expenditure and health outcomes in Malawi: does governance matter?. *Journal of Public Administration and Development Alternatives (JPADA), 3*(1-1), 1-14.

Miah, M. D., Masum, M. F. H., Koike, M., Akther, S., & Muhammed, N. (2011). Environmental Kuznets Curve: the case of Bangladesh for waste emission and suspended particulate matter. *The environmentalist, 31*(1), 59-66.

Minier, J. (2009). Opening a stock exchange. *Journal of Development Economics*, *90*(1), 135-143.

Minx, J. C., Baiocchi, G., Peters, G. P., Weber, C. L., Guan, D., & Hubacek, K. (2011). A "carbonizing dragon": China's fast growing CO2 emissions revisited. *Environmental science & technology*, *45*(21), 9144-9153.

Moghadam, H. E., & Dehbashi, V. (2017). The impact of financial development and trade on environmental quality in Iran. *Empirical Economics, 54*(3).

Moghadam, H. E., & Lotfalipour, M. R. (2014). Impact of financial development on the environmental quality in Iran. *Chinese Business Review, 13*(9), 537-551.

Mohammed Saud M, A., Guo, P., Haq, I. U., Pan, G., & Khan, A. (2019). Do government expenditure and financial development impede environmental degradation in Venezuela?. *PloS one, 14*(1), e0210255.

Moldan, B., Hák, T., Kovanda, J., Havránek, M., & Kušková, P. (2005). Composite indicators of environmental sustainability. *Statistics, Knowledge and Policy, 154.*

Monsef, A., & Mehrjardi, A. S. (2015). Determinants of life expectancy: A panel data approach. *Asian Economic and Financial Review, 5*(11), 1251.

Murshed, M., & Dao, N. T. T. (2020). Revisiting the CO_2 emission-induced EKC hypothesis in South Asia: the role of Export Quality Improvement. *GeoJournal*, 1-29.

Nadpara, N., & Samanta, S. (2015). An empirical examination of the effect of corruption on health outcomes. *The College of New Jersey*, 1-26.

Natrah, M. S., Ezat, S. W., Syed, M. A., Rizal, A. M., & Saperi, S. (2012). Quality of life in Malaysian colorectal cancer patients: a preliminary result. *Asian Pacific Journal of Cancer Prevention*, *13*(3), 957-962.

Nasreen, S., & Anwar, S. (2015). The impact of economic and financial development on environmental degradation. *Studies in Economics and Finance*.

Nasreen, S., Anwar, S., & Ozturk, I. (2017). Financial stability, energy consumption and environmental quality: Evidence from South Asian economies. *Renewable and Sustainable Energy Review, 67*, 1105–1122.

Nazeer, M., Tabassum, U., & Alam, S. (2016). Environmental pollution and sustainable development in developing countries. *The Pakistan Development Review*, 589-604.

Neagu, O., Ardelean, D. I., & Lazăr, V. (2017). How is environmental performance associated with economic growth? A world cross-country analysis. *Studia Universitatis "Vasile Goldis" Arad–Economics Series, 27*(3), 15-32.

Nkalu, C. N., & Edeme, R. K. (2019). Environmental Hazards and Life Expectancy in Africa: Evidence From GARCH Model. *SAGE Open, 9*(1), 2158244019830500.

Novignon, J., Olakojo, S., & Nonvignon, J. (2012). The Effects of Public and Private Health Care Expenditure and Health Status in Sub-Sahara Africa: New Evidence from Panel Data Analysis. *Health economics review, 2*(22).

Ntow-Gyamfi, M., Bokpin, G. A., Aboagye, A. Q., & Ackah, C. G. (2020). Environmental sustainability and financial development in Africa; does institutional quality play any role?. *Development Studies Research, 7*(1), 93-118.

Okobia, L. E., Hassan, S. M., & Peter, A. (2017). Increase in outdoor carbon dioxide and its effects on the environment and human health in Kuje FCT Nigeria. *Environmental Health Review, 60*(4), 104-112.

Olafsdottir, A. E., Reidpath, D.D., Pokhrel, S., & Allotey, P. (2011). Health systems per- formance in Sub-Saharan Africa: governance, outcome and equity. *BMC Public Health, 11*(237).

Oliva, P. (2015). Environmental regulations and corruption: Automobile emissions in Mexico City. *Journal of Political Economy*, *123*(3), 686-724.

Omri, A., Daly, S., Rault, C., & Chaibi, A. (2015). Financial development, environmental quality, trade and economic growth: What causes what in MENA countries. *Energy Economics, 48*, 242-252.

Oyelami, L. O. (2019). Relative effects of regional and global trade on carbon emissions in ECOWAS member countries. *International Area Studies Review, 22*(1), 64-75.

Ozatac, N., Gokmenoglu, K. K., & Taspinar, N. (2017). Testing the EKC hypothesis by considering trade openness, urbanization, and financial development: the case of Turkey. *Environmental Science and Pollution Research, 24*(20), 16690-16701.

Panayotou, T. (2003). Economic growth and the environment. Paper prepared for and presented at the Spring Seminar of the United Nations Economic Commission for Europe, Geneva, and Economic Survey of Europe.

Pao, H. T., & Tsai, C. M. (2011). CO_2 Emissions, Energy Consumption and Economic Growth in BRIC Countries. *Energy Policy, 38*(12), 7850–7860.

Paramati, S. R., Ummalla, M., & Apergis, N. (2016). The effect of foreign direct investment and stock market growth on clean energy use across a panel of emerging market economies. *Energy Economics, 56*, 29-41.

Park, Y., Meng, F., & Baloch, M. A. (2018). The effect of ICT, financial development, growth, and trade openness on CO_2 emissions: an empirical analysis. *Environmental Science and Pollution Research, 25*(30), 30708-30719.

Pata, U. K. (2018). Renewable energy consumption, urbanization, financial development, income and CO_2 emissions in Turkey: testing EKC hypothesis with structural breaks. *Journal of Cleaner Production, 187*, 770-779.

Pautrel, X. (2008). Reconsidering the impact of the environment on long-run growth when pollution influences health and agents have a finite-lifetime. *Environmental and Resource Economics, 40*(1), 37-52.

Pautrel, X. (2009). Pollution and life expectancy: how environmental policy can promote growth. *Ecological Economics, 68*(4), 1040-1051.

Pena, M. S. B., & Rollins, A. (2017). Environmental exposures and cardiovascular disease: a challenge for health and development in low- and middle-income countries. *Cardiology clinics, 35*(1), 71-86.

Pethig, R. (1976). Pollution, welfare, and environmental policy in the theory of comparative advantage. *Journal of environmental economics and management*, *2*(3), 160-169.

Ponce, P., & Alvarado, R. (2019). Air pollution, output, FDI, trade openness, and urbanization: evidence using DOLS and PDOLS cointegration techniques and causality. *Environmental Science and Pollution Research, 26*(19), 19843-19858.

Poncet, S., Hering, L., & de Sousa, J. (2015). *Has trade openness reduced pollution in China?* (No. P132).

Pope, C. A., Burnett, R. T., Thun, M. J., Calle, E. E., Krewski, D., Ito, K., & Thurston, G. D. (2002). Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *Jama*, *287*(9), 1132-1141.

Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of economic perspectives*, *9*(4), 97-118.

Prakash, A., & Potoski, M. (2006). Racing to the bottom? Trade, environmental governance, and ISO 14001. *American journal of political science*, *50*(2), 350-364.

Quibria, M. G. (2015). Governance in developing Asia: concepts, measurements, determinants and a paradox. In *Governance in Developing Asia*. Edward Elgar Publishing.

Rafiq, S., Salim, R., & Nielsen, I. (2016). Urbanization, openness, emissions, and energy intensity: a study of increasingly urbanized emerging economies. *Energy Economics*, *56*, 20-28.

Rafique, M. Z., Li, Y., Larik, A. R., & Monaheng, M. P. (2020). The effects of FDI, technological innovation, and financial development on CO_2 emissions: evidence from the BRICS countries. *Environmental Science and Pollution Research*, 1-15.

Rajkumar, A. S., & Swaroop, V. (2008), Public spending and outcomes: Does governance matter? *Journal of Development Economics, 86*(1), 96-111.

Ray, D., & Linden, M. (2020). Health expenditure, longevity, and child mortality: dynamic panel data approach with global data. *International Journal of Health Economics and Management, 20*(1), 99-119.

Raza, S. A., & Shah, N. (2018). Impact of financial development, economic growth and energy consumption on environmental degradation: evidence from Pakistan.

Reidpath, D. D., & Allotey, P. (2003). Infant mortality rate as an indicator of population health. *Journal of Epidemiology & Community Health*, *57*(5), 344-346.

Rehman, M. Z., Ali, N., & Nasir, N. M. (2015). Linkage between financial development, trade openness and economic growth: Evidence from Saudi Arabia. *Journal of Applied Finance and Banking, 5*(6), 127-141.

Ren, C., & Tong, S. (2008). Health effects of ambient air pollution–recent research development and contemporary methodological challenges. *Environmental Health, 7*(1), 56.

Ren, S., Yuan, B., Ma, X., & Chen, X. (2014). International trade, FDI (foreign direct investment) and embodied CO_2 emissions: A case study of Chinas industrial sectors. *China Economic Review, 28*, 123-134.

Richter, F., & Klesta, M. (2011). Manufacturing and Pollution: Trends in Old and New Industrial Centers. *A Look Behind The Numbers*.

Riti, J.S., Shu, Y., Song, D., & Kamah, M. (2017). The contribution of energy use and financial development by source in climate change mitigation process: A global empirical perspective. *Journal of Cleaner Production 148*, 882-894.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The stata journal*, *9*(1), 86-136.

Rosenberg, D. Y. (2018). Political Economy of Infant Mortality Rate: Role of Democracy Versus Good Governance. *International Journal of Health Services, 48*(3), 435-460.

Roubaud, D., & Shahbaz, M. (2018). Financial development, economic growth, and electricity demand: A sector analysis of an emerging economy (MPRA paper no. 87212).

Sadorsky, P. (2010). The impact of financial development on energy consumption in emerging economies. *Energy Policy, 38*, 2528-2535.

Sadorsky, P. (2011). Financial development and energy consumption in Central and Eastern European frontier economies. *Energy Policy, 39*, 999-1006.

Sadorsky, P. (2014). The effect of urbanization on CO_2 emissions in emerging economies. *Energy Economics, 41*, 147-153.

Saidi, K., & Mbarek, M. B. (2017). The impact of income, trade, urbanization, and financial development on CO_2 emissions in 19 emerging economies. *Environmental Science and Pollution Research, 24*(14), 12748-12757.

Salahuddin, M., Gow, J., & Ozturk, I. (2015). Is the long-run relationship between economic growth, electricity consumption, carbon dioxide emissions and financial development in Gulf Cooperation Council Countries robust?. *Renewable and Sustainable Energy Reviews*, *51*, 317-326.

Salahuddin, M., Alam, K., Ozturk, I., & Sohag, K. (2017). The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO_2 emissions in Kuwait. *Renewable Sustainable Energy Reviews, 81*, 1–9.

Salim, R. A., Rafiq, S., & Shafiei, S. (2017). *Urbanization, energy consumption, and pollutant emission in Asian developing economies: an empirical analysis* (No. 718). ADBI Working Paper.

Samimi, A. J., Ahmadpour, M., Moghaddasi, R., & Azizi, K. (2011). Environmental performance and economic growth: new evidence from the Oic Countries. *Adv Environ Biol*, *5*(4), 655-66.

Sanstad, A. H., Roy, J., & Sathaye, J. A. (2006). Estimating energy-augmenting technological change in developing country industries. *Energy Economics*, *28*(5-6), 720-729.

Sarkodie, S. A., & Strezov, V. (2019). Effect of foreign direct investments, economic development and energy consumption on greenhouse gas emissions in developing countries. *Science of the Total Environment*, *646*, 862-871.

Satish, U., Mendell, M. J., Shekhar, K., Hotchi, T., Sullivan, D., Streufert, S., & Fisk, W. J. (2012). Is CO_2 an indoor pollutant? Direct effects of low-to-moderate CO_2 concentrations on human decision-making performance. *Environmental health perspectives, 120*(12), 1671-1677.

Sato, M. (2014). Embodied carbon in trade: a survey of the empirical literature. *Journal of economic surveys*, *28*(5), 831-861.

Saud, S., & Chen, S. (2018). An empirical analysis of financial development and energy demand: establishing the role of globalization. *Environmental Science and Pollution Research*, *25*(24), 24326-24337.

Saud, S., Chen, S., & Haseeb, A. (2019). Impact of financial development and economic growth on environmental quality: an empirical analysis from Belt and Road Initiative (BRI) countries. *Environmental Science and Pollution Research*, *26*(3), 2253-2269.

Saud, S., Chen, S., & Haseeb, A. (2020). The role of financial development and globalization in the environment: Accounting ecological footprint indicators for selected one-belt-one-road initiative countries. *Journal of Cleaner Production, 250*, 119518.

Savedoff, W. D. (2011). Governance in the Health Sector: a Strategy for Measuring Determinants and Performance. https://openknowledge.worldbank.org/handle/10986/3417.

Schiavon, M., Redivo, M., Antonacci, G., Rada, E. C., Ragazzi, M., Zardi, D., & Giovannini, L. (2015). Assessing the air quality impact of nitrogen oxides and benzene from road traffic and domestic heating and the associated cancer risk in an urban area of Verona (Italy). *Atmospheric Environment, 120*, 234-243.

Schmidheiny, S., & Zorraquin, F. J. (1998). *Financing change: the financial community, eco-efficiency, and sustainable development*. MIT press.

Schumpeter, J. A. (1911). The theory of economic development. Cambridge, MA: Harvard University Press.

Schwartz, J. D., Wang, Y., Kloog, I., Yitshak-Sade, M. A., Dominici, F., & Zanobetti, A. (2018). Estimating the effects of $PM_{2.5}$ on life expectancy using causal modeling methods. *Environmental health perspectives*, *126*(12), 127002.

Seetanah, B., Sannassee, R. V., Fauzel, S., Soobaruth, Y., Giudici, G., & Nguyen, A. P. H. (2018). Impact of economic and financial development on environmental degradation: evidence from small island developing states (SIDS). *Emerging Markets Finance and Trade, 55*(2), 308-322.

Sehrawat, M., Giri, A. K., & Mohapatra, G. (2015). The impact of financial development, economic growth and energy consumption on environmental degradation: Evidence from India. *Management of Environmental Quality An International Journal, 26*, 666-682.

Seker, F., Ertugrul, H., & Cetin, M. (2015). The impact of foreign direct investment on environmental quality: A bounds testing and causality analysis for Turkey. *Renewable and Sustainable Energy Reviews, 52*, 347-356.

Sekrafi, H., & Sghaier, A. (2018). The effect of corruption on carbon dioxide emissions and energy consumption in Tunisia. *PSU Research Review*.

Shafik, N., & Bandyopadhyay, S. (1992). *Economic growth and environmental quality: time-series and cross-country evidence* (Vol. 904). World Bank Publications.

Shah, M. H. (2016). Financial development and foreign direct investment: The case of Middle East and North African (MENA) developing nations. MPRA Paper 82013.

Shah, W. U. H., Yasmeen, R., & Padda, I. U. H. (2019). An analysis between financial development, institutions, and the environment: a global view. *Environmental Science and Pollution Research, 26*(21), 21437-21449.

Shahbaz, M., Lean, H. H., & Shabbir, M. S. (2012). Environmental Kuznets Curve Hypothesis in Pakistan: Cointegration and Granger Causality. *Renewable and Sustainable Energy Reviews, 16*(5), 2947–2953.

Shahbaz, M., Hye, Q. M. A., Tiwari, A. K., & Leitão, N. C. (2013). Economic growth, energy consumption, financial development, international trade and CO2 emissions in Indonesia. *Renewable and Sustainable Energy Reviews*, *25*, 109-121.

Shahbaz, M., Nasreen, S., Abbas, F., & Anis, O. (2015). Does foreign direct investment impede environmental quality in high-, middle-, and low-income countries?. *Energy Economics*, *51*, 275-287.

Shahbaz, M., Shahzad, S. J. H., Ahmad, N., & Alam, S. (2016). Financial development and environmental quality: the way forward. *Energy Policy, 98*, 353-364.

Shahbaz, M., Nasreen, S., Ahmed, K., & Hammoudeh, S. (2017a). Trade openness–carbon emissions nexus: the importance of turning points of trade openness for country panels. *Energy Economics*, *61*, 221-232.

Shahbaz, M., Shafiullah, M., Papavassiliou, V. G., & Hammoudeh, S. (2017b). The CO_2–growth nexus revisited: A nonparametric analysis for the G7 economies over nearly two centuries. *Energy Economics*, *65*, 183-193.

Shahbaz, M., Van Hoang, T. H., Mahalik, M. K., & Roubaud, D. (2017c). Energy consumption, financial development and economic growth in India: New evidence from a nonlinear and asymmetric analysis. *Energy Economics*, *63*, 199-212.

Shahbaz, M., Nasir, M. A., & Roubaud, D. (2018). Environmental degradation in France: the effects of FDI, financial development, and energy innovations. *Energy Economics, 74*, 843-857.

Shahzad, S. J. H., Kumar, R. R., Zakaria, M., & Hurr, M. (2017). Carbon emission, energy consumption, trade openness and financial development in Pakistan: a revisit. *Renewable and Sustainable Energy Reviews, 70*, 185-192.

Shapiro J. S. (2016). Trade costs, CO_2, and the environment. *American Economic Journal: Economic Policy, 8,* 220-54.

Shoaib, H. M., Rafique, M. Z., Nadeem, A. M., & Huang, S. (2020). Impact of financial development on CO_2 emissions: A comparative analysis of developing countries (D8) and developed countries (G8). *Environmental Science and Pollution Research*, 1-15.

Shukla, M. (2018). Impact of a health governance intervention on provincial health system performance in Afghanistan: a quasi-experimental study. *Health Systems & Reform, 4*(3), 249-266.

Siddiqi, S., Masud, T. I., Nishtar, S., Peters, D. H., Sabri, B., Bile, K. M., & Jama, M. A. (2009). Framework for assessing governance of the health system in developing countries: gateway to good governance. *Health policy, 90*(1), 13-25.

Silva, E. C., & Zhu, X. (2009). Emissions trading of global and local pollutants, pollution havens and free riding. *Journal of Environmental Economics and Management*, *58*(2), 169-182.

Sirag, A., Nor, N. M., Abdullah, N. M. R., & Abd Ghani, J. (2017). Public Health Financing and Infant Mortality: Does Governance Quality Matter?. *Public Finance and Management*, *17*(4), 341-370.

Sohag, K., Begum, R. A., Abdullah, S. M. S., & Jaafar, M. (2015). Dynamics of energy use, technological innovation, economic growth and trade openness in Malaysia. *Energy*, *90*, 1497-1507.

Sohag, K., Al Mamun, M., Uddin, G. S., & Ahmed, A. M. (2017). Sectoral output, energy use, and CO 2 emission in middle-income countries. *Environmental Science and Pollution Research*, *24*(10), 9754-9764.

Solarin, S.A., Al-Mulali, U., Musah, I., & Ozturk, I. (2017). Investigating the pollution haven hypothesis in Ghana: an empirical investigation. *Energy, 124*, 706-719.

Song, M., & Wang, S. (2013). How should developing countries cope with pollution-migration? An extended model of north-south trade and its numerical simulation. *Energy & environment*, *24*(6), 939-951.

Squalli, J., & Wilson, K. (2011). A new measure of trade openness. *The World Economy, 34*(10), 1745-1770.

Stavropoulos, S., Wall, R., & Xu, Y. (2018). Environmental regulations and industrial competitiveness: evidence from China. *Applied Economics*, *50*(12), 1378-1394.

Stiefel, M. C., Perla, R. J., & Zell, B. L. (2010). A healthy bottom line: healthy life expectancy as an outcome measure for health improvement efforts. *The Milbank Quarterly*, *88*(1), 30-53.

Sun, H., Clottey, S., Geng, Y., Fang, K., & Amissah, J. (2019). Trade openness and carbon emissions: evidence from belt and road countries. *Sustainability, 11*, 1-20.

Sun, P., & Heshmati, A. (2010). International trade and its effects on economic growth in China. IZA Discussion Paper No. 5151.

Suri, V., & Chapman, D. (1998). Economic growth, trade and energy: implications for the environmental Kuznets curve. *Ecological economics, 25*(2), 195-208.

Switzer, L. (1984). The determination of industrial R&D: a funds flow simultaneous equation approach. *Review of Economics & Statistics, 66*, 163-168.

Taguchi, H. (2013). The environmental Kuznets curve in Asia: The case of sulphur and carbon emissions. *Asia-Pacific Development Journal, 19*(2), 77-92.

Tamazian, A., Piñeiro, J., & Vadlamannati, K. (2009). Does higher economic and financial development lead to environmental degradation: Evidence from BRIC countries. *Energy Policy, 37*, 246-253.

Tamazian, A., & Rao, B. (2010). Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies. *Energy Economics, 32*(1), 137-145.

Tanaka, S. (2015). Environmental regulations on air pollution in China and their impact on infant mortality. *Journal of health economics, 42*, 90-103.

Tang, L., Li, K., & Jia, P. (2020). Impact of Environmental Regulations on Environmental Quality and Public Health in China: Empirical Analysis with Panel Data Approach. *Sustainability, 12*(2), 623.

Tariku, L. (2015). The Impact of Trade Liberalization on Air Pollution: In Case of Ethiopia. *New Media and Mass Communication, 40*, 42-52.

Tee, H. G., Kaliappan, S. R., Chin, L., & Said, R. (2018). Composite Trade Shares Measurement for Trade Openness on Inflation among Selected Developing Countries. *International Journal of Economics & Management*, *12*(1).

Tian, Y., Liu, H., Liang, T., Xiang, X., Li, M., Juan, J., ... & Hu, Y. (2019). Fine particulate air pollution and adult hospital admissions in 200 Chinese cities: a time-series analysis. *International journal of epidemiology*, *48*(4), 1142-1151.

Tong, S. (2019). Air pollution and disease burden. *The Lancet Planetary Health*, *3*(2), e49-e50.

Tran, N. V. (2020). The environmental effects of trade openness in developing countries: conflict or cooperation?. *Environmental Science and Pollution Research,* 1-15.

Tsaurai, K. (2019). The impact of financial development on carbon emissions in Africa. *International Journal of Energy Economics and Policy, 9*(3), 144.

Tsurumi, T., & Managi, S. (2012). The effect of trade openness on deforestation: empirical analysis for 142 countries. *Environmental Economics and Policy Studies, 16*(4), 305–324.

Tsurumi, T., & Managi, S. (2014). The effect of trade openness on deforestation: empirical analysis for 142 countries. *Environmental Economics and Policy Studies*, *16*(4), 305-324.

Uddin, G. A., Salahuddin, M., Alam, K., & Gow, J. (2017). Ecological footprint and real income: Panel data evidence from the 27 highest emitting countries. *Ecological Indicators, 77*, 166-175.

Ugur, M., & Dasgupta, N. (2011). Corruption and economic growth: A meta-analysis of the evidence on low-income countries and beyond.

Ullah, I., Ali, S., Shah, M. H., Yasim, F., Rehman, A., & Al-Ghazali, B. M. (2019). Linkages between Trade, CO2 Emissions and Healthcare Spending in China. *International journal of environmental research and public health, 16*(21), 4298.

Umer, F., Khoso, M., & Alam, S. H. (2014). Trade Openness, Public Sector Corruption, and Environment: A Panel Data Analysis for Asian Developing Countries. *Journal of Business & Economic Policy, 1*(2), 2375-0766.

United Nations Conference on Trade and Development. (2012). *Economic development in Africa: structural transformation and sustainable development in Africa.* https://unctad.org/system/files/official-document/tdb59d4_en.pdf.

United Nations Conference on Trade and Development. (2017). *Key Statistics and Trends in International Trade 2017.* https://unctad.org/webflyer/key-statistics-and-trends-international-trade-2017.

United Nations Conference on Trade and Development. (2018). *World Investment Report 2018: Investment and New Industrial Policies*. https://unctad.org/system/files/official-document/wir2018_en.pdf.

United Nations Environment Program. (2019). *Air Pollution in Asia and the Pacific: Science-based Solutions. https://wedocs.unep.org/handle/20.500.11822/26861*

United Nations. (2019). *World population prospects 2019: highlights*. https://www.un.org/development/desa/publications/world-population-prospects-2019-highlights.html.

Urhie, E., Afolabi, A., Afolabi, A., Matthew, O., Osabohien, R., & Ewetan, O. (2020). Economic growth, air pollution and health outcomes in Nigeria: A moderated mediation model. *Cogent Social Sciences, 6*(1), 1719570.

United States Environmental Protection Agency. (2019). *Particulate Matter (PM) Pollution*. Retrieved from https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM.

Vallero, D. A. (2014). *Fundamentals of air pollution*, *fifth ed. Academic Press, Boston*, 787-827.

Vo, D. H., & Le, Q. T. T. (2019). CO_2 emissions, energy consumption, and economic growth: New evidence in the ASEAN countries. *Journal of Risk and Financial Management, 12*(3), 145.

Veugelers, P. J., Yip, A. M., & Kephart, G. (2001). Proximate and contextual socioeconomic determinants of mortality: multilevel approaches in a setting with universal health care coverage. *American Journal of Epidemiology*, *154*(8), 725-732.

Wang, L., Liu, Z., Sun, Y., Ji, D., & Wang, Y. (2015). Long-range transport and regional sources of PM2. 5 in Beijing based on long-term observations from 2005 to 2010. *Atmospheric Research*, *157*, 37-48.

Wang, Z., Danish, Zhang, B., & Wang, B. (2018). The moderating role of corruption between economic growth and CO_2 emissions: evidence from BRICS economies. *Energy 148*, 506-513.

Wang, Q., Wang, J., Zhou, J., Ban, J., & Li, T. (2019). Estimation of $PM_{2.5}$-associated disease burden in China in 2020 and 2030 using population and air quality scenarios: a modelling study. *The Lancet Planetary health*, *3*(2), e71-e80.

Wen, M., & Gu, D. (2012). Air pollution shortens life expectancy and health expectancy for older adults: the case of China. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, *67*(11), 1219-1229.

West, J. J., Cohen, A., Dentener, F., Brunekreef, B., Zhu, T., Armstrong, B., ... & Dockery, D. W. (2016). What we breathe impacts our health: improving understanding of the link between air pollution and health. *Environmental Science & Technology, 50*(10), 4895-4904.

Witvliet, M. I., Kunst, A. E., Arah, O. A., & Stronks, K. (2013). Sick regimes and sick people: a multilevel investigation of the population health consequences of perceived national corruption. *Tropical Medicine & International Health*, *18*(10), 1240-1247.

World Bank (2014). Data show rise in domestic credit in developing countries. Retrieved from https:https://blogs.worldbank.org/opendata/data-show-rise-domestic-credit-developing-countries.

World Trade Organization. (2018). *World trade statistical review 2017*. Retrieved from https://www.wto.org/english/res_e/statis_e/wts2017_e/wts17_toc_e.hm

Wu, W. L. (2017). Institutional Quality and Air Pollution: International Evidence. *International Journal of Business & Economics*, *16*(1).

Wu, Z., Chen, X., Li, G., Tian, L., Wang, Z., Xiong, X., ... & Pan, X. (2020). The Impact of Air Pollution on Attributable Risks and Economic Costs of Hospitalization for Mental Disorders. Institute of Labor Economics Discussion Paper Series No. 12986.

Xing, T., Jiang, Q., & Ma, X. (2017). To facilitate or curb? The role of financial development in China's carbon emissions reduction process: A novel approach. *International Journal of Environmental Research and Public Health*, *14*(10), 1222.

Xiong, L., Tu, Z., & Ju, L. (2017). Reconciling regional differences in financial development and carbon emissions: a dynamic panel data approach. *Energy Procedia*, *105*, 2989-2995.

Xu, Z., Baloch, M. A., Meng, F., Zhang, J., & Mahmood, Z. (2018). Nexus between financial development and CO_2 emissions in Saudi Arabia: analyzing the role of globalization. *Environmental Science and Pollution Research, 25*(28), 28378-28390.

Xu, Y., Dietzenbacher, E., & Los, B. (2020a). International trade and air pollution damages in the United States. *Ecological Economics*, *171*, 106599.

Xu, Y., Fan, X., Zhang, Z., & Zhang, R. (2020b). Trade liberalization and haze pollution: Evidence from China. *Ecological Indicators, 109*, 105825.

Yao, X., Yasmeen, R., Li, Y., Hafeez, M., & Padda, I. U. H. (2019). Free trade agreements and environment for sustainable development: a gravity model analysis. *Sustainability, 11*(3), 597.

Yasmeen, R., Li, Y., Hafeez, M., & Ahmad, H. (2018). The trade-environment nexus in light of governance: a global potential. *Environmental Science and Pollution Research*, *25*(34), 34360-34379.

Yasmeen, R., Li, Y., & Hafeez, M. (2019). Tracing the trade–pollution nexus in global value chains: evidence from air pollution indicators. *Environmental Science and Pollution Research*, 1-13.

Yaqub, J. O., Ojapinwa, T. V., & Yussuff, R. O. (2012). Public health expenditure and health outcome in Nigeria: the impact of governance.

Yoshida, Y., & Honma, S. (2011). *Did international trade become dirtier in developing countries? On the composition effect of international trade on the environment* (No. 52).

Yu, C., Nataliia, D., Yoo, S. J., & Hwang, Y. S. (2019). Does trade openness convey a positive impact for the environmental quality? Evidence from a panel of CIS countries. *Eurasian Geography and Economics, 60*(3), 333-356.

Yuxiang, K., & Chen, Z. (2010). Resource abundance and financial development: Evidence from China. *Resources Policy, 36*(1), 72-79.

Yuxiang, K., & Chen, Z. (2011). Financial development and environmental performance: evidence from China. *Environment and Development Economics, 16*(1), 93-111.

Zafar, M. W., Saud, S., & Hou, F. (2019). The impact of globalization and financial development on environmental quality: evidence from selected countries in the Organization for Economic Co-operation and Development (OECD). *Environmental science and pollution research, 26*(13), 13246-13262.

Zaidi, S. A. H., Zafar, M. W., Shahbaz, M., & Hou, F. (2019). Dynamic linkages between globalization, financial development and carbon emissions: Evidence from Asia Pacific Economic Cooperation countries. *Journal of Cleaner Production, 228*, 533-543.

Zakaria, M., & Bibi, S. (2019). Financial development and environment in South Asia: the role of institutional quality. *Environmental Science and Pollution Research*, *26*(8), 7926-7937.

Zerbo, E. (2017). Income-environment relationship in Sub-Saharan African countries: further evidence with trade openness. *Environmental science and pollution research*, *24*(19), 16488-16502.

Zhao, J. (2019). *Environmental regulation: lessons for developing economies in Asia* (No. 980). ADBI Working Paper Series.

Zhang, Y. J. (2011). The impact of financial development on carbon emissions: an empirical analysis in China. *Energy Policy, 39*(4), 2197-2203.

Zhang, C., & Zhou, X. (2016). Does foreign direct investment lead to lower CO_2 emissions? Evidence from a regional analysis in China. *Renewable and Sustainable Energy Reviews, 58*, 943-951.

Zhang, D., Li, X., & Xue, J. (2015). Education inequality between rural and urban areas of the People's Republic of China, migrants' children education, and some implications. *Asian Development Review*, *32*(1), 196-224.

Zhang, H., & Xu, K. (2016). Impact of environmental regulation and technical progress on industrial carbon productivity: an approach based on proxy measure. *Sustainability, 8*(8), 819.

Zhang, Y. J., Jin, Y. L., Chevallier, J., & Shen, B. (2016). The effect of corruption on carbon dioxide emissions in APEC countries: a panel quantile regression analysis. *Technological Forecasting and Social Change*, *112*, 220-227.

Zhang, Y., & Zhang, S. (2018). The impacts of GDP, trade structure, exchange rate and FDI inflows on China's CO_2 emissions. *Energy Policy, 120*, 347-353.

Zheng, J., & Sheng, P. (2017). The Impact of Foreign Direct Investment (FDI) on the Environment: Market Perspectives and Evidence from China. *Economies, 5(*8).

Zhong, J., & Li, T. (2020). Impact of Financial Development and Its Spatial Spillover Effect on Green Total Factor Productivity: Evidence from 30 Provinces in China. *Mathematical Problems in Engineering, 2020*.

Zhu, H., Duan, L., Guo, Y., & Yu, K. (2016). The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: evidence from panel quantile regression. *Economic Modelling*, *58*, 237-248.

Zhu, L., Hao, Y., Lu, Z. N., Wu, H., & Ran, Q. (2019). Do economic activities cause air pollution? Evidence from China's major cities. *Sustainable Cities and Society*, *49*, 101593.

Zhuang, J., Gunatilake, H., Niimi, Y., Khan, M.E., Jiang, Y., Hasan, R., & Khor, N. (2009). Financial sector development, economic growth and poverty reduction: A literature review, African Development Bank Working Paper Series, No. 173.

Ziaei, S. M. (2015). Effects of financial development indicators on energy consumption and CO_2 emission of European, East Asian and Oceania countries. *Renewable and Sustainable Energy Reviews*, *42*, 752-759.

Zugravu-Soilita, N. (2017). How does foreign direct investment affect pollution? Toward a better understanding of the direct and conditional effects. *Environmental and Resource Economics*, *66*(2), 293-338.

Zugravu-Soilita, N. (2018). The impact of trade in environmental goods on pollution: what are we learning from the transition economies' experience?. *Environmental Economics and Policy Studies, 20*(4), 785-827.

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LIST OF PUBLICATIONS

Nor Asma Ahmad, Normaz Wana Ismail, Shaufique Fahmi Ahmad Sidique & Nur Syazwani Mazlan. (2021). Air pollution effects on adult mortality rate in developing countries. *Environmental Science and Pollution Research*, *28*, 8709-8721. DOI:org/10.1007/s11356-020-11191-3.

Nor Asma Ahmad, Normaz Wana Ismail, Shaufique Fahmi Ahmad Sidique & Nur Syazwani Mazlan. (2021). Effects of Air Pollution and Corruption Control on Life Expectancy in Middle-Income Countries. *International Journal of Economics and Management, 15*(2), 257-268.

Nor Asma Ahmad, Normaz Wana Ismail, Shaufique Fahmi Ahmad Sidique & Nur Syazwani Mazlan. (2021). *Effects of $PM_{2.5}$ and Corruption Control on Life Expectancy in Middle-Income Countries* [Paper presentation]. Persidangan Kebangsaan Ekonomi Malaysia Ke-15, 2020-2021 (PERKEM Ke-15, 2020-2021). (Best Paper Award).

Nor Asma Ahmad, Normaz Wana Ismail, Shaufique Fahmi Ahmad Sidique & Nur Syazwani Mazlan. (2021). *Air Pollution Effects, Governance Role and Health Outcomes: Evidence from Developing Countries*. (Submitted to Journal Production Cleaner).

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