The ROLES OF FOREIGN DIRECT INVESTMENT INFLOW IN CARBON EMISSION: A MALAYSIAN PERSPECTIVE

BY

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DECLARATION

We hereby declare that:

1) This undergraduate FYP is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

2) No portion of this FYP has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

3) Equal contribution has been made by each group member in completing the FYP.

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Dedication

This study is dedicated to every person who had put effort to make this study a success. The efforts, regardless direct or indirect are priceless for us.

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Table of Content

Preface

This study is very important for the completion of our undergraduate course which is Bachelor of Economics (Hons) Financial Economics offered by Universiti Tunku Abdul Rahman. The topic of this study is "The Roles of Foreign Direct Investment Inflow in Carbon Emission: A Malaysian Perspective". Therefore, this study is conducted to evaluate if there is positive relationship or negative relationship between FDI inflow and carbon emission in Malaysia.

Due to the worsening environmental conditions, carbon emissions have been a serious problem nowadays. FDI inflow is known to bring economic growth to the country but the aftereffects of FDI may have positive or negative impacts on carbon emissions due to the possibility of green technology and industrialization that comes along with FDI inflows.

Therefore, this study evaluates the relationship between FDI inflows and carbon emissions because it may help build a sustainable environment. This study studies the influence of FDI inflow along with GDP per capita, trade and population. This study can offer insights to the government, educational institutions and organizations on how the FDI inflows affects the carbon emissions in Malaysia.

Abstract

In recent years, globalization has led to the acceleration of capital in the world, especially foreign direct investment (FDI), which promotes the economic growth of the host country. As the promotion of the economy, which also leads to carbon emissions. We study in a developing country like Malaysia, are boosting economic growth. However, this economic progress has a downside, it often leads to more pollution and carbon emissions. In these recent years there hasn't been much research on this connection in the context of Malaysia. In this study, we aim to examine the effects of FDI on Malaysia's carbon emissions from 1990 to 2020. We employ the ARDL model and incorporate relevant control variables to unravel the complex relationship between economic growth and carbon emissions in Malaysia. Our research result indicates that in the long run, FDI, population, and trade has a positive relationship to the carbon emission. The GDP per capita has a negative relationship in the long run. Significantly, the study's outcomes offer essential policy suggestions directed towards policymakers.

Chap 1 Introduction

1.1 Background of Study

In recent decades, the rapid development of science and technology, as well as economy has led to the economic growth of various countries. The improvement of technology has brought the world into the Web 1.0 and Web 2.0 era. However, this represents the advent of the era of globalization, both in terms of resources and information sharing, which has led to the rapid development of the global economy and technology. This has also led to a gradual normalization of international mutual investment. Although the rapid development of has brought economic growth but also caused serious harm to the global environment. This is because people will start using more energy to produce products and compete. Foreign direct investment (FDI) may be one of the factors that harm the global environment. Foreign direct investment (FDI) will bring in more money to help open factories in the country. In the process of construction, it might cause environmental degradation such as pollution. At this time, if the country's laws are not perfect, it will cause some damage to the country's environment.

International Effort and Malaysia Effort

During the 1990s, several nations directed their attention towards carbon emissions. The United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 during the United Nations Conference on Environment and Development., with the goal of limiting the increase in global average temperatures as a means of slowing down the then-occurring climate change. Negotiations to bolster the worldwide response to climate change began in 1995, and the Kyoto Protocol was adopted. The Protocol legally binds developed countries to meet specific emission reduction targets, with the first commitment period commencing in 2008 and concluding in 2012. Malaysia is a member of the Protocol, having signed and ratified it on March 12, 1999, and September 4, 2002, respectively *(United Nations Climate Change: Malaysia)* and the second commitment period are began on the January 1, 2013, and ended in 2020. *(United Nations Climate Change: History of Convention)*. However,

issues with the Kyoto Protocol became evident a few years after its implementation, prompting negotiations in 2011 to address these problems. In 2015, a more precise accord called the Paris Agreement was initiated with the objective of limiting the rise in the Earth's average temperature to a range of 1.5 to 2.0 degrees Celsius above levels from the pre-industrial era. Malaysia is among the countries that have signed the Paris Agreement and has committed to lowering its greenhouse gas emissions by 45% by 2030. Of this target, 35% is unconditional, while 10% is conditional on Malaysia receiving including climate finance and making sure technology transfer, and capacity building from developed countries. *(Malaysia and the Paris Agreement: Current Wants or Future Needs?, n.d.)*

With the rapid development of technology, the international CO2 emissions are rapidly increasing. According to the (*Global Energy Review: CO2 Emissions in 2021 – Analysis - IEA*, n.d.), many industries were hit and shut down during covid 19, resulting in a 5.2% reduction in global co2 emissions. However, in 2021, many countries began vaccinating people against energy combustion and industries began to resume operations, increasing by 6% compared to 2020 to 36.3 (GT), the highest level ever.

According to (Malaysia Steeping up efforts to transition to low-carbon, Climate-resilient economy 2021), the Malaysian government plans to incorporate clean, green, and resilient development of low-carbon measures into the 12th Malaysia Plan. The Malaysian government hopes to promote green energy through fiscal policy and the use of public policy, while integrating the green agenda and sustainable development goals in the 2021 national development budget. Not only that, according to the (Solar Panel In Malaysia: Should You Install This For Your Home?), Residential customers in Malaysia can sell excess electricity generated by having solar panels on their roofs back to the grid. This is part of a partnership between the Malaysian government and TNB to attract more households who can afford to install solar power to reduce their dependence on traditional energy sources and create greener homes. Not only that, TNB also plans to sell the excess electricity generated by solar energy to neighbours to create a greener community, a program called P2Ph or point-to-point. Also, to provide companies or individuals with the convenience and

liquidity to purchase solar panels, the Malaysian government and banks have partnered to allow businesses or individuals to apply for the "U-solar Program" which provides customers with an interest-free loan for 36 months to install solar panels. For example, Aeon has entered into a Supply Agreement for Renewable Energy (SARE) with TNB and GSPARX, under which Aeon will deploy solar PV systems within its shopping centres to support the development of sustainability initiatives. It is estimated that Aeon will help reduce CO2 emissions by 70,000 tons per year when the installation is completed (*AEON Signs SARE With TNB and GSPARX; to Install PV Solar Facilities Nationwide*, 2023).

Foreign Direct Investment

Foreign direct investment (FDI) is a kind of investment in which an individual or company invests in a business situated in a foreign country. It is a type of international investment where a company invests in or takes over a business in another country with the purpose of controlling it. FDI can take different forms, including building a new factory, purchasing a stake in an existing business, or merging with a foreign company. Additionally, FDI can be made by individuals through buying property or shares in a foreign company. FDI plays a crucial role in promoting economic growth and development as it can introduce new technologies, generate income, and create job opportunities. Furthermore, FDI can provide access to new markets, resources, and skills. Policymakers, investors, and analysts often rely on FDI data to evaluate the desirability of a country as an investment location and to monitor investment flows over time. (Hayes, 2023b) According to the (*Department of Statistics Malaysia Official Portal*, n.d.-b), it received a net inflow of RM49.48 billion in 2022. Among the major investment countries in Malaysia are the United States, Singapore, the United Kingdom, and the Netherlands. And services, manufacturing, electrical and transportation are the sectors that provide a large amount of direct investment in Malaysia until the end of 2021 with a FDI position of RM788.8 billion.

We can observe that the Malaysia FDI's inflows is stable and low before 1990. We can observe that FDI inflows was a little bit affected much during the Asian

financial crisis in 1997, and the FDI outflow started to show a rapid upward trend from 2000 until 2009 when the inflow and outflow of Malaysian FDI were also affected by the events of the 2008 global financial crisis. After two years of recovery, Malaysia's FDI inflow has been stabled in the range of 5% -3%. However, FDI inflows and outflows were hit to some extent in 2020 by the covid 19 pandemic, but gradually rebounded from 2021 onwards.

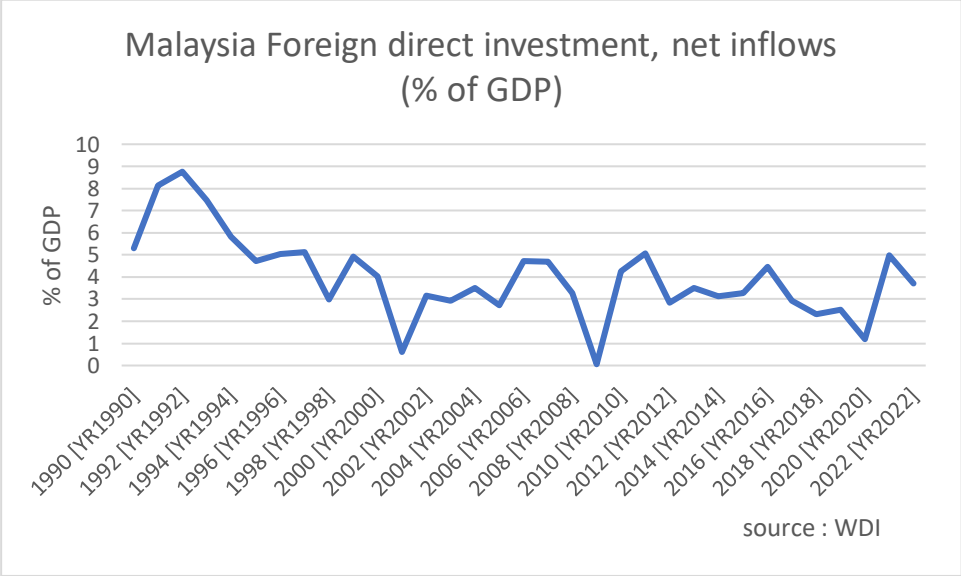
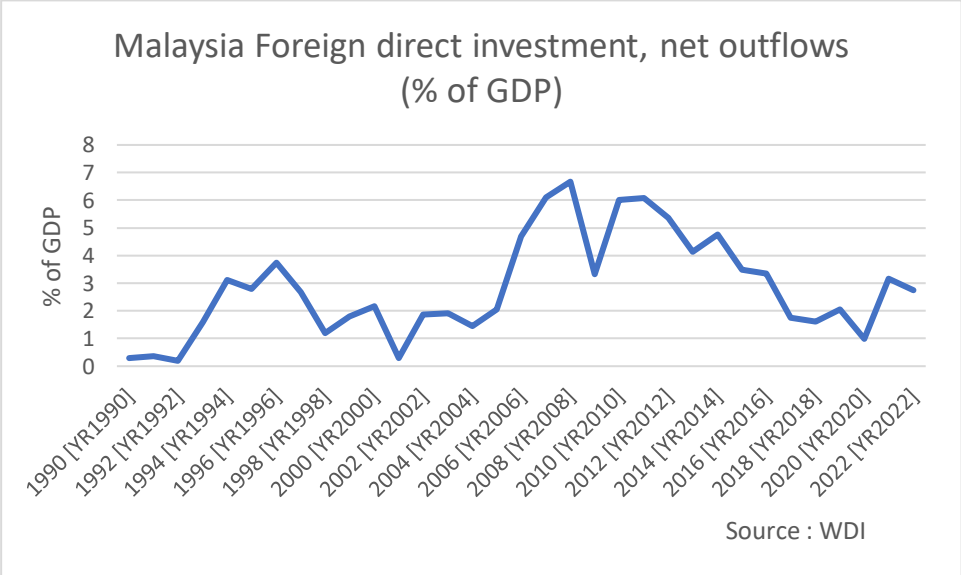


Chart 1



Co2 emission

Carbon dioxide is the most prevalent greenhouse gas, along with other greenhouse gases such as methane, nitrous oxide, and fluorinated gases,

however, to better measure the impact of greenhouse gases on humans these gas emissions are all converted into carbon dioxide equivalents. (Mschmitz, 2022) CO2 accounts for three-quarters of total global greenhouse gas emissions. The rapid global technological development since the industrial revolution, and especially the globalization that has become more widespread since the beginning of the Internet era (web 1.0 and Web 2.0), has led to a continuous increase in the total amount of greenhouse gases. Eventually, these greenhouse gases will lead to the greenhouse effect and eventually, the enhancement of these greenhouse effects will affect ecological consequences and economic issues. The ecological consequences of the greenhouse effect include sea level rise, water supply shortages, global temperature increase, glacier melting, species extinction, heat waves, droughts, storms, etc. The economic consequences of the greenhouse effect include reduced human productivity due to high temperatures, the need to invest more money in maintenance and prevention of damage from extreme weather events, the cost of coastal protection against tsunamis, etc. (Mschmitz, 2022) However, the energy sector such as industry, construction, and transportation accounts for 73.2% of co2 emissions, while agriculture, forestry, etc. account for 18.4%. China and the United States are among the highest emitters of CO2 in the world.

We can observe through chart 2 that the co2 emission in Malaysia is increasing annually until 2019. According to the (Ritchie, 2020), the electricity and heat occupies the highest co2 emissions in Malaysia in 2019 which is 130.03 million t. The second highest is land-use change and forestry (83.09 million t), third highest is Transport occupies 65.31 million t, and following the manufacturing and construction (37.11million t), industry (22.89 million t), waste (20.96 million t), Fugitive emissions (15.74 million t), agriculture (14.36 million t), Aviation and shipping (9.58 million t), Buildings (3.47 million t) and other fuel combustion (3.14 million t).

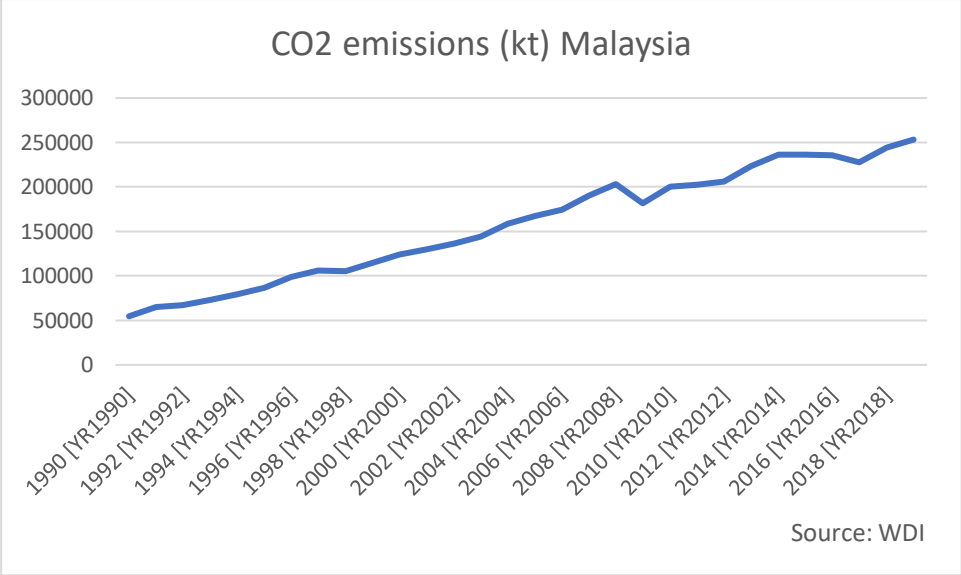


Chart 2

The relationship between Co2 emissions and Foreign Direct Investment

According to the (Essandoh et al., 2020), it is mentioned that Foreign Direct Investment leads to cross-border transfers of industrial production, and most of these transfers are from cash countries to developing countries. When industrial production processes are transferred across borders, the emissions associated with those processes are also transferred among countries. If a country transfers the production units of goods to its trading partners, which are then imported back as intermediate inputs, it can reduce its associated domestic emissions. However, this transfer can lead to an increase in emissions in its partner countries. According to the chart 1 and chart 2 can observe that the Malaysia co2 emission and FDI inflow are increase significantly. Malaysia co2 emission and FDI inflow is showing the same trending pattern which are upward trending.

1.2 Problem Statement

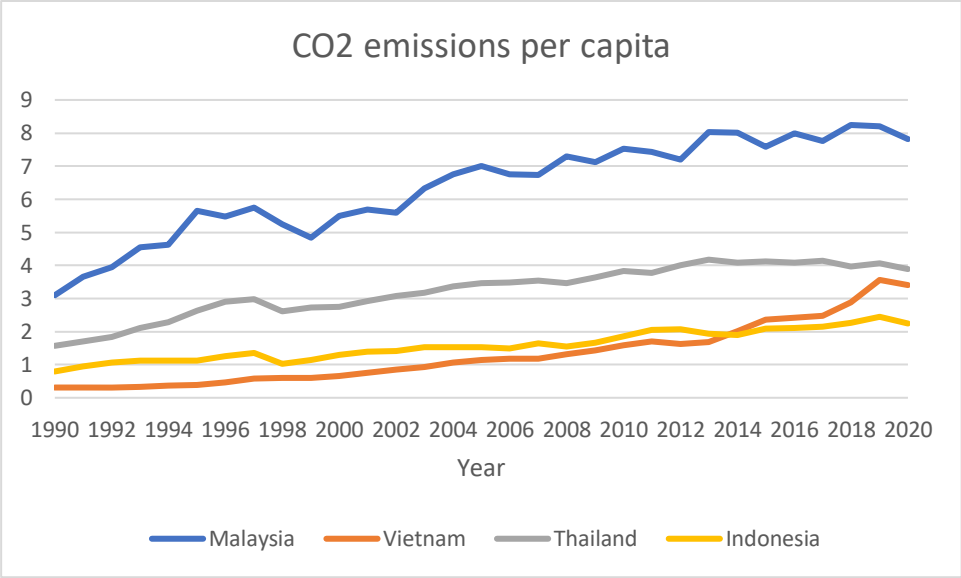
Nowadays, climate change has become an issue and discussed by every country. Climate change has a big impact toward human healthy and security of food in the world. One of the major factors that causing climate change is the carbon emissions especially carbon dioxide emissions. Foregin Direct Investment (FDI) inflow toward developing countries especially Malaysia has played an important role because FDI can bring technology and skill to improve the productivity of Malaysia. However, this subject remains a subject of contention regarding whether the transfer of technology can alleviate or exacerbate environmental deterioration. Consequently, prior research has yielded conflicting findings regarding the correlation between FDI inflow and CO2 emissions. The previous studies have produced different results on the relationship between FDI inflow and CO2 emissions. Some scholar found that FDI inflow can bring green technologies to reduce the CO2 emissions. On the other hand, some scholar found that FDI inflow has caused the degradation of environmental because non-renewable energy needs more fossil fuel and coal to produce, hence led to environmental degradation. The inconclusive results from previous research set the stage for this investigation to revisit the issue, seeking to determine whether FDI inflows have a mitigating or exacerbating effect on environmental degradation. Thus, this research intends to delve into the influence of FDI on CO2 emissions within the Malaysian context.

Looking into past data (refer to Figure 3), Malaysia always had higher CO2 emissions per capita compared to neighbouring countries such as Vietnam, Thailand, and Indonesia, despite its relatively low FDI amount and percentage of GDP. As developing countries, the need for industrialization would be important to boost the economy and thus leads to higher CO2 emissions. However, to boost the economy, Foreign Direct Investment is crucial for the countries, and it is hypothesized that the increase in FDI in developing countries would lead to industrialization and then increase the CO2 emissions.

According to the United Nations Conference on Trade and Development (UNCTAD) World Investment Report, Malaysia has experienced sluggish Foreign Direct Investment (FDI) growth since 2008, especially when compared

to the performance of many neighbouring countries. In 2020, Malaysia's FDI has dropped by 68% and is now experiencing lower FDI levels than our neighbouring countries such as Vietnam, Philippines, and Indonesia. This is 37% more than the average decrease in FDI of Southeast Asia.

Given the situation above, Malaysia is still aiming to reduce 45% of carbon intensity by 2030 but other developing countries with high carbon emissions as well have much lower goals where Thailand aims for 20-25% reduction and Indonesia aims for 29% reduction respectively. At the same time, Bank Negara Malaysia announced further liberalisation of foreign exchange policy (FEP) in 2021 where this aims to enhance Malaysia's position in the global supply chain and to cultivate a favourable environment for the attraction of FDI into Malaysia. The problem comes in where Malaysia as a developing country, is unable to achieve both reducing CO2 emissions while maintaining FDI inflows at the same time. Therefore, this conflict motivates us to study the relationship between CO2 emissions and FDI inflows in Malaysia.



Source: Ourworldindata.org

Figure 3

1.3 Research Objective

1. To evaluate the relationship between the co2 emission and FDI inflow in Malaysia.

1.4 Research Question

1. Does the Foreign Direct Investment inflow affect the co2 emission in Malaysia?

1.5 Significance of Study

Our research is to study the role of foreign direct investment inflow (FDI) in carbon emission in Malaysia. We try to investigate the relationship between foreign direct investment inflow (FDI) and carbon emission in Malaysia. Foreign direct investment is one of the major factors that affect carbon emissions. This is because many developing countries may prioritize attracting foreign direct investment (FDI) without considering its potentially negative impact on the environment. Although FDI can bring in low-carbon technologies that are beneficial to the host country, but it can also have detrimental effects on the environment if the FDI is not environmentally sustainable (Huang & Chen, 2022).

In recent years, the rise of the developing country has caused a higher concentration of carbon emissions in the atmosphere. This issue has prompted many researchers to explore the topic of carbon emissions. Based on similar past studies, the researchers are examining how FDI inflows affect carbon emissions and investigate the pathways through which FDI inflows exert influence, considering the moderating effects of economic development and regulatory quality. The study employs panel data for the period of the year 1996 to 2018, covering the G20 economies. The researchers conclude that the inflow of foreign direct investment (FDI) has a positive correlation with carbon emission, meaning that as FDI inflow increases, the G20 economies will emit more carbon dioxide (Shabir & Gill, 2022).

In contrast to previous studies, our research is uniquely centered on Malaysia, exploring the intricate connection between foreign direct investment (FDI) and carbon emissions within this specific national context. This targeted focus allows for a more thorough examination of Malaysia's economic and

environmental dynamics and the underlying influencing factors. While numerous prior studies have explored the influence of FDI on carbon emissions, few have specifically delved into the Malaysian context.

Nevertheless, it's important to note that foreign direct investment (FDI) inflows alone do not exert a direct and independent impact on carbon emissions. Rather, multiple additional factors play a role in shaping carbon emissions. To enhance the comprehensiveness of our analysis, we will incorporate economic growth, population, total imports and exports as control variables. These variables will help us better discern the extent to which these factors contribute to the relationship between FDI and carbon emissions (Apergis & Pinar, 2022). By considering these control variables, we aim to provide a more precise and nuanced understanding of how FDI influences carbon emissions in Malaysia.

Hence, our study is poised to make a valuable contribution to the existing body of literature on the relationship between foreign direct investment (FDI) and carbon emissions. By offering fresh insights and findings tailored to the Malaysian context, we aim to advance the understanding of this complex interplay.

Moreover, our study can add to the growing body of research on sustainable development and climate change. By examining the relationship between foreign direct investment (FDI) and carbon emissions in Malaysia, our research can effectively contribute to Malaysia and help accelerate the policy framework of Malaysia Madani. (Ignatius, 2023). Our research can help policymakers and businesses develop strategies and policies that promote sustainable economic growth while reducing environmental impact.

1.6 Structure of Study

The structure of the study will comprise of five chapters. Chapter 1 will be the introduction and will provide the background of the topic, define the topic, and discuss its importance. Additionally, the current issue of carbon emissions will be highlighted, and the research gap that exists in studying the impact of foreign direct investment on carbon emissions will be addressed.

Chapter 2 will focus on the literature review and will discuss the various variables that will be considered in the study. The chapter will include the theoretical framework, empirical review, hypothesis testing, and research gap.

Chapter 3 will provide the research methodology and will discuss the data sources and variables used. The chapter will also detail the data analysis techniques used in the study, with the data sources coming from the World Bank Data.

Chapter 4 will include descriptive statistics of the data and the regression analysis results. The chapter will also interpret and discuss the results.

Finally, Chapter 5 will provide the conclusion of the study, including a summary of the key findings and the contribution of the study. The chapter will also recommend policies and practices that can be implemented based on the study's results.

Chap 2 literature Review

2.1 Relevant Theory/ Concepts/ Model

Some researchers such as Hu et al. (2021), Zhang et al. (2023) and Pujiati et al. (2023) support the "Pollution Haven Hypothesis" where it concerns the developing countries that developed countries will implement their heavily polluting companies in them, causing them to benefit financially and at the same time avoid the environmental risk, where it causes the particular county's carbon emissions to rise. Nations will express varying viewpoints and make distinct choices when confronted with the trade-off between fostering economic growth and mitigating carbon dioxide emissions. It is notable that most countries that need FDI to boost their economy would be developing or undeveloped countries that have laxer environmental laws which could be exploited by the developed countries.

On the other hand, researchers such as Yang et al. (2023), Wang and Huang (2022) and Huang et al. (2022) also suggest a conflicting hypothesis which is known as the "Pollution Halo Hypothesis". This hypothesis argues that FDI can benefit host countries through substitution effect and technology spillover effect. The FDI flow can help attract new, efficient and greener technologies to replace the current ones to reduce carbon emissions. Studies also found that although FDI tends to have a positive relationship with carbon dioxide emissions, countries with higher economic development levels are able to mitigate this affect. This may lead to indication of FDI flows may increase carbon dioxide emissions at the starting period, but after a threshold point, the increase of FDI inflow will then decrease the carbon dioxide emissions due to the excess capital available to use for enhancing the environmental quality. Given the two contradicting hypotheses, the relationship between FDI and carbon dioxide emissions is still controversial where some have positive relationships, but some have negative relationships.

According to the Stern (2018), The EKC theory posits that the relationship between environmental degradation (such as pollution or CO2 emissions) and economic development follows an inverted U-shaped curve. In other words, as an economy initially develops and becomes wealthier, environmental

degradation worsens, but once a certain level of economic development is reached, environmental quality begins to improve. This pattern is visualized as a curve that slopes upward at first and then downward.

2.2 Review impact of foreign direct investment inflow in carbon emission

Foreign direct investment (FDI) is one of the sources of additional capital in most countries. Generally, this additional capital can help the host country's economy to develop and build more factories. Therefore, some economists believe that FDI can lead to an increase in CO2 emissions, however, there are some different arguments.

The majority of the researchers found that Foreign direct investment inflow affects carbon emission positively but to different extents, depending on various factors of country or organization. According to (Huang, Chen, Wei, 2022), this is a panel data analysis in G20 economies. The researchers mention that FDI inflow will lead to the increased emission of carbon dioxide, however, higher levels of economic development and regulatory quality will help mitigate the carbon emission. Also, the research finding is having a significant relationship between co2 emissions and FDI inflow, in G20 countries. Besides, some of the researchers explore the FDI and co2 relationship in developing and developed countries differently. The researcher noted that the present trajectory of increased trade and foreign direct investment (FDI) might lead to the transfer of high-emission production facilities from developed to developing nations. This could create a scenario in which developed countries lower their emissions, but at the expense of developing countries. Not only that, the study also mentions that weaker environmental policies and imperfect management systems in developing countries can lead to attracting more low-tech industries. Some multinationals or developed countries will gain more profits by moving energy-intensive industries to developing countries. This finding in the study is in a developing country the co2 emissions and FDI inflow has a significant positive relationship, however in a developed country the co2 emission and FDI inflow in unclear. The result also shows that the FDI inflow increase by 1%, and the

co2 emissions will increase by 0.25% in a developing country. (Essandoh et al., 2020)

The G20 membership includes both developing and developed countries, yet the G20 is the world's leading economy where most of the FDI is done. Although many researchers have argued that FDI has a direct impact on CO2 emissions, it is however insignificant in this study (The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth. *Energy Policy*). The paper mentions that the arrival of foreign direct investment leads to technological advances that result in more efficient use of energy and a reduction in CO2 emissions. The study also found that the use of clean energy leads to economic growth and that technological advances from FDI lead to the rapid development of clean energy. As a result, G20 member countries have started building nuclear power plants to meet energy demand, and it is also mentioned that most developed countries have established non-fossil energy systems and other renewable energy sources. Finally, the study mentions that some policymakers will attract FDI by making policies that will benefit both the environment and the economy. In this research is always mentioned that the green energy is very important.

Kuwait and Malaysia have a lot of similarities. Both Kuwait and Malaysia are developing countries, then both countries are predominantly Islamic religions, and thirdly both countries have oil as one of their main economic output. This paper is used the ARDL method focus on Kuwait, and this paper result showing whether short term or long-term relationship there are significant relationship between FDI inflow and co2 emission. (Salahuddin et al., 2018) Therefore, Kuwait needs to develop a lot of green energy and implement energy saving policies.

Some of the research is more focused on developing countries or in Asian. Malaysia also is an Asian country and an emerging country. This paper is more focused on China’s state and uses panel data analysis. According to Zhang and Zhou (2016), has mention that the FDI inflow and CO2 emission has a negative relationship means that the FDI inflow will decrease the Co2 emission in China. However, this paper also mentions that FDI inflows can assist in improving the

industrial structure and reducing CO2 emissions since the tertiary industry typically emits fewer emissions compared to the secondary industry. Not only that, the paper also proposes that inflows of foreign direct investment (FDI) can play a role in transferring environmentally sustainable technologies, potentially leading to further advancements in green energy adoption, increased energy efficiency, and reduced emissions. In another study (Xie et al., 2020), the PSTR model was applied, and it was found that FDI has a significant relationship with CO2 emissions. However, the study also found that there is a positive relationship in the early stages, which supports the pollution haven assumption. On the other hand, in the long term, FDI and CO2 emissions have a negative relationship, which confirms the pollution halo hypothesis. Then the studies have mentioned that in the early stages of FDI, developing countries tend to prioritize economic growth and may have lower environmental standards, resulting in high-polluting industries being transferred to local countries and causing an increase in CO2 emissions. Furthermore, the influx of foreign direct investment (FDI) can potentially boost production levels and resource utilization, resulting in additional CO2 emissions through spillover effects. Nonetheless, as FDI levels rise, developing nations tend to emphasize the quality of incoming investments, giving preference to multinational corporations engaged in advanced manufacturing, modern service sectors, and high-tech industries. This strategic focus often involves greater investments in pollution control measures, ultimately leading to a decrease in CO2 emissions. Additionally, FDI has the potential to enhance the efficiency of domestic enterprises, resulting in reduced energy consumption, particularly in high-pollution industries. This, in turn, can contribute to a decline in CO2 emissions through spillover effects. Another paper is using panel data and the ARDL model focuses on a developing country in East Asia. This paper's results show that FDI and CO2 emission are a significant relationship in short term, however, in the long term there are insignificant relationships.

To summarize, the situation varies from country to country. Some argue that FDI inflows in developed countries will lead to increased CO2 emissions in the short term but will reduce CO2 emissions in the long term because of the availability of mature green energy technologies. Then the developed countries

will move the highly polluting industries to the developing countries with less sophisticated policies.

2.3 Control variables

2.3.1 Reviews on population growth

Population is one of the factors that influencing the carbon emissions. We know that the largest population size in a country will release more carbon emission compared with small population's countries. Population size has a significant positive relationship in carbon emissions. (Zhao & Xi, 2022, on China country; Guo & Jiang, 2012, on China country; Dong & Zhang, 2018, across regions; Namahoro & Wu, 2021, East African Region; Cui & Xia, 2019, on China country; Sulaiman & Abdul-Rahim, 2018, on Nigeria country).

Conversely, (Begum & Sohag, 2015, on Malaysia country) captured that the increase in population did not have a significant effect on the carbon emissions in the Malaysian economy. Previous studies show us that different countries have diverse population sizes. Hence, the different result with the population growth on carbon emissions.

Overall, based on the past studies, we can see that the result from each study is difference. By using the various approach to examine the result of population size on carbon emissions. Population growth as a one of the factors to influence the carbon emissions. Meanwhile, (Ribeiro, 2019) has captured that for every 1% increase in population size, there is a corresponding 0.76% increase in carbon emissions.

2.3.2 Reviews on Economic Growth

Economic growth is one of the factors that influencing the carbon emissions. A developed countries have been more impressive in terms of economic growth compared with developing countries and poor countries. Global warming is always the issue discuss by people, and the increase of carbon emissions are caused by the economic growths. GDP per capita is reflecting the economic growth. Based on the past studies (Cuma & Yusuf, 2014, on Turkish country; Sari & Soytas, 2009, on EU alliance; Jenny & Sara, 2016; Narayan & Saboori, 2016) have proved that there is a significant relationship between economic growth and carbon emissions.

Besides, they used Environmental Kuznets Curve (EKC) to examine the relationship between economic growth and carbon emissions. It showed that there exists a relationship between environmental degradation and income growth that takes the shape of an inverted U-shaped. In other words, during the early phases of economic development, there is a tendency for environmental degradation to escalate as per capita income rises. However, as the economy progresses and per capita income surpasses a certain threshold, there is a shift towards reduced environmental degradation despite ongoing income growth. (Zhang & Cheng, 2009).

In short, the economic growth is one of the major components to influence that carbon emissions, since economic growth is influenced by several factors such as workforce, technology, human capital and so on. Hence, we use economic growth as our control variables to determine the extent to which these factors may be influencing the relationship between foreign direct investment (FDI) and carbon emissions.

2.3.3 Reviews on Trade

Trade is one of the factors that influenced the carbon dioxide emissions. Many researchers have studied the relationship between trade and carbon emissions, most researcher have concluded that trade has a significant relationship for carbon emissions. According to Andersson, (2018), suggest that approximately one out of every three emissions originated from the manufacturing of goods intended for export. The quantity and nature of emissions associated with a nation's imports and exports are influenced by the extent and types of trade. Increased trade leads to higher emissions, and trading in heavy manufacturing products results in more emissions compared to trading in services.

Besides, Gurtzgen et al, (2000), suggest that when international trade is introduced, it leads to a growth in production and a rise in negative externalities such as gas emissions within the hosting country. Nevertheless, countries with stricter environmental regulations experience reduced environmental harm. Also, Galvan et al, (2022), indicates that in higher-income countries, foreign direct investment (FDI), gross domestic product (GDP), and trade play crucial roles as influential factors that strongly contribute to CO2 emissions in a

positive manner. Conversely, in middle-income and transition (MIT) countries, the positive impact of these variables on CO2 emissions is relatively weak.

2.4 Hypothesis Testing

H_0 = Foreign direct investment inflows do not affect carbon dioxide emissions

H_1 = Foreign direct investment inflows do affect carbon dioxide emissions

2.5 Literature Gap

In our studies, we use time series data however most of past studies are focused on panel data analysis. Panel data can get diverse results however the time series data can concentrate on the country-specific and find out more relationships and details. Panel data can only provide a little guidance for policymakers, but the time series data can contrate it.

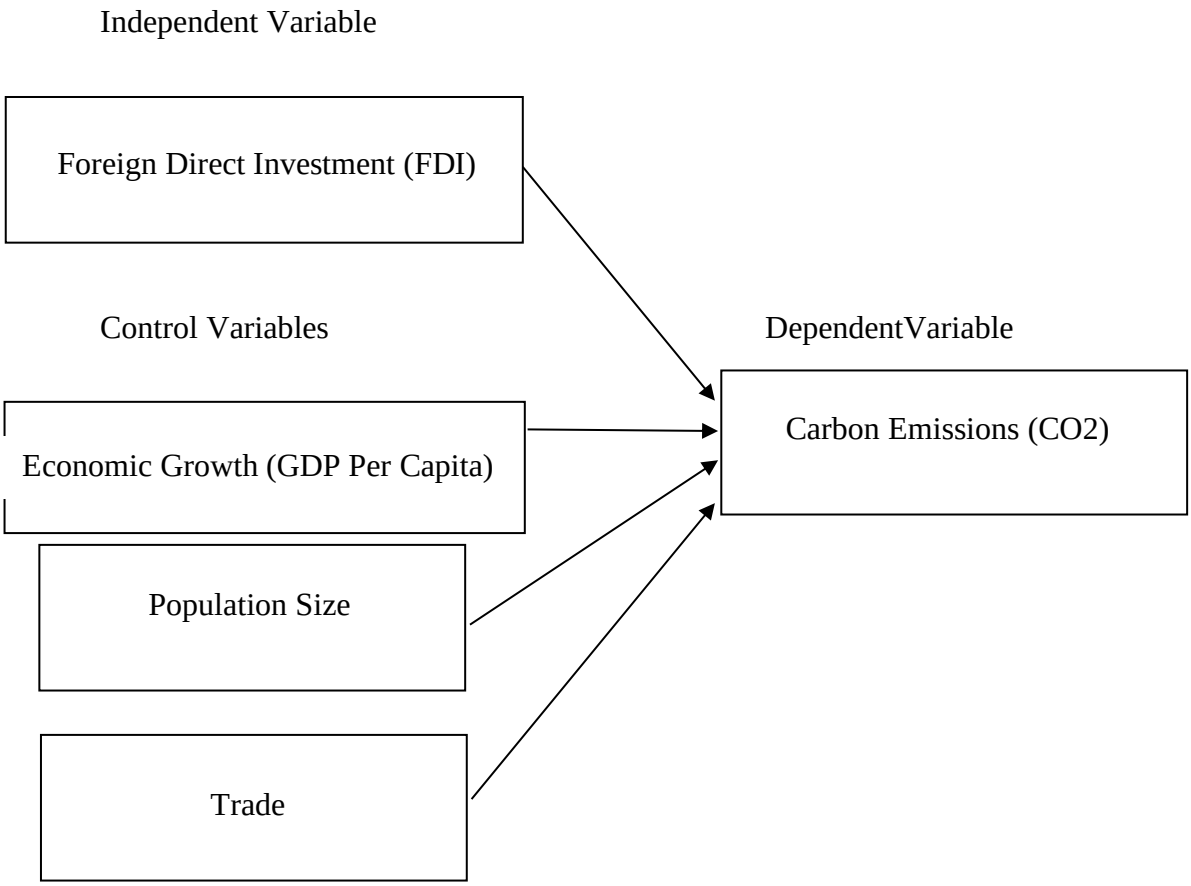
Chap 3: Methodology

3.1 Theoretical Framework

We apply by using Environmental Kuznets Curve as our theoretical framework. The EKC is named by Simon Kuznets, who originally postulated a pattern where income inequality initially rises and later declines with economic development and pertains to a theoretical association between diverse measures of environmental deterioration and income per person. During the initial phases of economic expansion, there is an upsurge in pollution emissions, causing a degradation in environmental conditions. However, this trajectory reverses beyond a certain threshold of per capita income (which may vary depending on the specific indicator). At higher income levels, economic growth becomes synonymous with environmental amelioration. In essence, this suggests that environmental impacts or emissions per person are an inverted U-curve relative to per capita income." Hence, this is fit with our research.

According to the most of past studies, they adopt the theoretical framework by using Environmental Kuznets Curve. The theory Environmental Kuznets Curve is fit to our research which is the relationship between carbon emissions, Foreign direct investment, and GDP per capita. The EKC states that in the early stages, when a country's per capita income is low, the country will be willing to accept FDI and industrialisation will develop substantially, but natural resources will be severely depleted. As time passes and the economy reaches a certain level of development, the country begins to value and receive better technology, quality information, etc., and this time the degree of environmental degradation begins to decrease (Kostakis et al., 2023). Besides, we will also hypothesis that Malaysia’s economic growth by using GDP per capita, population size, total import of goods and services, as well as total export of goods and services will have an impact on carbon emissions. For this purpose, we will be utilizing variables that have data from 1990 to 2020. The relationship between the independent variable, dependent variable, and control variables can be illustrated as follow:

Theoretical Framework



Foreign direct investment (FDI) has a significant relationship with carbon emissions. According to (Apergis et al. 2022), foreign direct investment (FDI) can result in an increase in carbon emissions within developing nations. This is due to the belief that developing nations have less strict environmental regulations, making them more prone to becoming pollution havens. Besides, (Apergis et al, 2022) have proved that the pollution haven hypothesis is confirmed by the fact that carbon emissions in BRICS countries are increasing because of Denmark and the UK's foreign direct investment (FDI) inflows to these countries. Moreover, (Wang & Huang, 2022) has captured that FDI is driven by the fact that developed countries tend to have strict energy and environmental regulations in place. As a result, some companies that produce

pollution may choose to relocate their factories to developing countries where environmental standards are lower and production costs are cheaper. This can lead to environmental pollution due to FDI, even as it promotes economic growth in the host country.

Contrary to opposing views, FDI from developed countries to developing countries may have the potential to enhance the management techniques and modern technologies used in developing countries. foreign investment is seen as the only means of transferring the latest technology from developed to underdeveloped nations. Therefore, the implementation of modern technology can lead to a reduction in pollution levels when compared to the outdated and environmentally damaging technologies used by poorer countries (Mahmood et al, 2020).

The terms of control variables, the control variables above have a significant relationship with carbon emissions. By controlling the variables, we can isolate the effects of the foreign direct investment (FDI) on carbon emissions, thereby increasing the internal validity of the research. According to (Liu et al, 2022), as economic growth leads to an increase in consumer purchasing power, including the acquisition of new vehicles, luxury products and so on, there is a corresponding rise in carbon emissions. However, as the economic growth, the government can integrate economic growth into the execution of sustainable green economy strategies at the municipal, provincial, and urban levels. Besides, (Zhang & Cheng, 2009) use Environmental Kuznets curve (EKC) to examine the validity of the economic growth and carbon emissions. Initially, as income increases, the state of the environment is expected to worsen, but in the long term, the quality of the environment is likely to improve as income continues to increase.

Moreover, population size has also a significant relationship between carbon emissions, due to the larger population size, the increase of carbon emissions. Based on the previous study, (Dong et al, 2018) in the past decades, the increase of population size and economic growth has caused the energy consumption increase rapidly. According to (Ribeiro et al, 2019), by using Cobb-Douglas

model, for every 1% increase in population size, there is a corresponding 0.76% increase in carbon emissions.

Trade has an impact on the carbon emissions. According to (Hu et al, 2020), a rise in trade activity results in a significantly higher need for energy, which can result in harm to the environment. Also, the diversification of products has led to an increase in imports and exports, which in turn has boosted trade activity and accelerated carbon emissions. Based on the previous study, (Salman et al, 2019) the increase of imports of goods and services will lead to the increases of transportation activity. The transportation of imported goods from one location to another requires the use of fuel. Therefore, an increase in the amount of imported goods would lead to higher fuel consumption by transportation machinery, resulting in increased carbon emissions. Also, the higher exports can harm the environment in three ways, including increased energy consumption leading to higher CO2 emissions, depletion of natural resources resulting in increased carbon emissions, and direct harm to environmental quality.

3.2 Empirical Model

This study is discussed about how FDI inflow relate the CO2 emissions at the country level in Malaysia. This study we are estimated that the FDI inflow, export, import, GDP per capita and total population have long term relationship with the CO2 emissions. To study the long-term relationship between these variables advocated by the Essandoh et al (2020).

Economic Model

$$CO2 = f(FDI, TRADE, GDP, POP) \quad (1)$$

Where CO_2 refers to CO_2 emissions per kt in Malaysia, FDI refer to the Foreign Direct Investment inflow (current US$) in Malaysia, TRADE refer to the sum of total exports and imports of good and service by GDP, GDP refers to the Gross Domestic Product per capita (constant 2015 US$) in Malaysia, the POP refers to the total population in Malaysia. The argument of the environmental Kuznets curve (EKC) suggests that there are substantial differences in the relationship between income and emissions in developed and developing countries.

3.3 Econometric Model

The model is converted into natural logs.

Short Run Model

$$\Delta CO_2 = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta CO_{2\ t-i} + \sum_{i=1}^{q} \beta_2 \Delta FDI\ t-i + \sum_{i=1}^{r} \beta_3 \Delta TRADE + \sum_{i=1}^{s} \beta_4 \Delta GDP_{t-i} + \sum_{i=1}^{t} \beta_5 \Delta GDP2_{t-i} + \sum_{i=1}^{u} \beta_6 \Delta POP_{t-I} + \beta_7 ECT_{\ t-1} + \epsilon_t$$

Long Run Model

$$\ln CO_{2t} = \beta_0 + \beta_1 \ln FDI_t + \beta_2 \ln TRADE_t + \beta_3 \ln GDP_t + \beta_4 \ln GDP2_t + \beta_5 \ln POP_t\ \epsilon_t \quad (2)$$

Some recent studies have reintroduced FDI and trade opening into the EKC model, however, the effect of FDI and trade opening on co2 emissions is still ambiguous. The EKC model suggests that at the beginning of economic growth, it leads to an increase in pollution emissions, but until a certain level is exceeded it reverses, and economic growth can lead to environmental improvement. So the relationship between co2 emissions and economic growth shows an inverted U-shaped curve. The reason for the inverted U-shape is that in the early stages of economic development, the economy needs to expand a lot and usually the government focuses on developing industries to attract FDI to open factories in the country, so this type of economic expansion can have a negative impact on the environment. However, as the economy develops the structure of the economy starts to change from labor-intensive to information-intensive, service-intensive, and capital-intensive, along with the increase in environmental awareness and the availability of better technology and human resources, which leads to the improvement of environmental quality.

3.3.1 Econometric techniques - ARDL

The ARDL model, which stands for Autoregressive Distributed Lag Model, is a regression model that uses ordinary least squares (OLS) to analyze time series data. It is particularly useful for analyzing non-stationary or mixed-order integrated variables. One of the key advantages of the ARDL model is its ability to integrate the long-run and short-run relationships between variables in a standardized framework, regardless of their regression terms, whether they are I(0) or I(1). Moreover, the model is robust and can be estimated with a relatively

small sample size, such as 30 years of annual data, making it suitable for economic studies that are constrained by data availability or practical considerations. Apart from that, the ARDL model utilizes both endogenous and exogenous variables, whereas the VAR model only deals with endogenous variables.

3.3.2 ARDL Bound test

The ARDL bounds testing approach, developed by Pesaran et al. in 2001, is a technique used to determine the presence of a long-term relationship between variables through the evaluation of cointegration. This method offers several advantages when compared to traditional cointegration tests. Firstly, it can be applied regardless of whether the series is integrated into order 0 (I(0)) or order 1 (I(1)). Secondly, the unrestricted error correction model (UECM) can be derived directly from the ARDL bounds testing procedure through a simple linear transformation. This model accounts for both short-term and long-term dynamics in the relationship between variables. Thirdly, empirical studies have shown that this approach tends to be more effective and yields consistent results, particularly when dealing with small sample sizes.

ARDL bound cointegration test model:

$$\Delta \ lnCO_{2t} = \theta_{10} + \alpha_{11} \ lnCO_{2t-1} + \alpha_{12} \ lnFDI_{t-1} + \alpha_{13} \ lnTRADE_{t-1} + \alpha_{14} \ lnGDP_{t-1} + \alpha_{15} \ lnGDP2_{t-1} + \alpha_{16} lnPOP_{t-1} + \sum_{i=0}^{p} \alpha_{17} \Delta lnCO2_{t-i} + \sum_{i=0}^{p} \alpha_{18} \Delta lnFDI_{t-i} + \sum_{i=0}^{p} \alpha_{19} \ \Delta lnTRADE_{t-i} + \sum_{i=0}^{p} \alpha_{20} \ \Delta lnGDP_{t-1} + \sum_{i=0}^{p} \alpha_{21} \ \Delta lnGDP2_{t-1} + \sum_{i=0}^{p} \alpha_{22} \Delta lnPOP_{t-1} + \epsilon_{1t} \quad (3)$$

$$\Delta \ lnFDI_{t} = \theta_{30} + \alpha_{31} \ lnFDI_{t-1} + \alpha_{32} \ lnCO_{2t-1} + \alpha_{33} \ lnTRADE_{t-1} + \alpha_{34} \ lnGDP_{t-1} + \alpha_{35} \ lnGDP2_{t-1} + \alpha_{36} lnPOP_{t-1} + \sum_{i=0}^{p} \alpha_{37} \ \Delta lnFDI_{t-i} + \sum_{i=0}^{p} \alpha_{38} \ \Delta lnCO2_{t-i} + \sum_{i=0}^{p} \alpha_{39} \ \Delta lnTRADE_{t-i} + \sum_{i=0}^{p} \alpha_{40} \ \Delta lnGDP_{t-i} + \sum_{i=0}^{p} \alpha_{41} \ \Delta lnGDP2_{t-i} + \sum_{i=0}^{p} \alpha_{42} \ \Delta lnPOP_{t-i} + \epsilon_{2t} \quad (4)$$

Δ is represents the difference operator

t represents the different years or time series

ϵ represents the error term. Error term is when the model cannot fully represent the actual relationship between endogenous and exogenous.

α_0 to α_{40} is coefficient.

So to investigate the long run relationship between the CO2, FDI, EXP, IMP, GDP and POP, we can use the bound testing Pesaran,et al. (2001). The ARDL bound procedure will be based on the F- test.

H_0: $\alpha_{1i} = \alpha_{2i} = 0$

H_A: $\alpha_{1i} \neq \alpha_{2i} \neq 0$

The null hypothesis in this context asserts that all the coefficients in the long-run equation are equal to zero, indicating that there is no long-run relationship among the variables being tested. The alternative hypothesis, on the other hand, posits that at least one of these coefficients is not equal to zero, suggesting the presence of a long-run relationship involving at least one variable. However, when dealing with a mixture of integrated of order 0 (I(0)) and integrated of order 1 (I(1)) variables, it's important to note that you cannot use exact critical values for the F-test. Instead, you have to rely on a Wald test to evaluate the null hypothesis. If the computed F-statistic (Wald test) exceeds the upper bound critical value, you can reject the null hypothesis (H0) and conclude that there is indeed at least one variable with a long-run relationship. Conversely, if the F-statistic (Wald test) falls below the lower bound critical value, you do not have enough evidence to reject the null hypothesis, implying that there is no long-run relationship.

In cases where the F-statistic falls between the lower and upper bound critical values, you would typically reach an inconclusive result, as there isn't enough statistical evidence to confidently conclude whether or not a long-run relationship exists.

3.3.3 ARDL level relation

$$CO_{2t} = const + \sum_{i=1}^{p} \beta_1 CO_{2\ t-i} + \sum_{i=1}^{q} \beta_2 FDI\ t-i + \sum_{i=1}^{r} \beta_3 TRADE + \sum_{i=1}^{s} \beta_4 GDP_{t-i} + \sum_{i=1}^{t} \beta_5 GDP2_{t-i} + \sum_{i=1}^{u} \beta_6 POP_{t-I} + \epsilon_t$$

Const= constant

P,q,r,s,t,u = optimum lag length

ϵ = error term

To estimate the long-run relationship between carbon dioxide emissions and other explanatory variables such as foreign direct investments, import and export of goods and services, population and economic growth, we use the ARDL level relations which includes the short run model to analyse the relationships. We can use specific approach to find the optimal lag length.

3.3.4 Error Correction Model (ECM)

If the variables are existing the cointegration relationship, then the Error Correction Model can be derived. The ECM is to tell us how much of the adjustment to equilibrium takes place each period.

The ECM model for the estimate the short run linkages as follow:

$$\Delta\ lnCO_{2t} = \theta_0 + \lambda[U_{t-1}] + \sum_{i=1}^{p-1} \alpha_1 \Delta X_{t-1} + \sum_{i=1}^{q-1} \beta_1 \Delta Y_{t-1} + \epsilon_t$$

$\Delta\ lnCO_{2t}$ represent the short run information

$\lambda[U_{t-1}]$ measure about the Error Correction Term, is means that the speed of adjustment back to the long-term equilibrium.

ϵ represents the error term

If the ECM the t-test must be significance and the ETC must be between zero to negative two. However, the ECM also has some limitation. One of the limitations is if there are more than two variables in the model, it is possible that it can have more then one cointegrating relationship.

3.3.5 Granger Causality Test

It is important to differentiate causality and correlation as correlation does not imply causation. According to Yang et al. (2023), they applied Granger causality test to find out if there was one-way or two-way relationship between the variables of GDP, carbon emissions and investment. By implying there is correlation merely means there is a relationship between the two variables, however, it does not mean that the variables affect each other. Therefore, further research needs to be done in order to investigate how well the variable causes the other variable or if there is a casual relationship between them. With this knowledge of effects, policies and programs are better targeted which can lead to a better outcome as we know for the source of the problem.

In this case to find out the short-run relationship between foreign direct investment and carbon dioxide emissions, we apply the Granger causality test. First, we establish the null hypothesis if the standard F-test of the restriction if the entire variable in the VAR is stationary:

$$H_0: \beta_1 = \beta_2 = \cdots = \beta_p = 0$$

where CO2E as X and FDI as Y

$$X_t = c_1 + \sum \alpha_i X_{t-2} + \sum \beta_j Y_{t-2} + \mu_t$$

$$Y_t = c_2 + \sum \lambda_i X_{t-2} + \sum \sigma_j Y_{t-2} + \varepsilon_t$$

First of all, ΔX and ΔY are stationary time series, and μ_t and ε_t are uncorrelated white noise error terms. We then regress X on all lagged X terms and other variables and restricted residual sum of square (RSS_R) is figured out. Next, the lagged Y terms are included to run the regression and find out the unrestricted residual sum of square (RSS_{UR}). If the null hypothesis is accepted, it means that the lagged Y does not belong to the regression while if the alternative hypothesis is accepted, it means the lagged Y does belong to the regression.

Next, we calculate the F statistic to perform hypothesis testing with the equation:

$$F = \frac{(RSS_R - RSS_{UR})/q}{RSS_{UR}/(n-k)}$$

Where RSS_R indicates restricted sum of squares residual; RSS_{UR} indicates unrestricted sum of squares residual; q indicates number of lags; k indicates the number of coefficients Fin the unrestricted regression. The decision rule is determined by the F statistic, where if the F statistic is greater than the critical value, we reject the null hypothesis, otherwise do not reject the null hypothesis. If the null hypothesis is rejected, we can conclude that the lagged Y does not belong to the regression which means Y causes X. Therefore, we can find out if X Granger causes Y in the model or not.

3.4 Data Description

Variable	Definition
CO_2	Carbon Dioxide Emission (metric tons per capita)
FDI	Foreign Direct Investment inflow (% of GDP)
TRADE	The sum of total exports and imports of good and service by GDP (% of GDP)
GDP	Economic Growth – GDP per capita (constant 2015 US$)
POP	Total Population

Chap 4 Research Result

4.1 Unit Root Test

Table 1

Test / Variable	ADF		Ng and Perron	
	Level	First difference	Level	First difference
CO_2	-1.8058	-6.7741***	-5.5303	-25.8675***
FDI	-3.6474**	-6.7738***	-13.1720	-23.4090**
Trade	-1.9506	-3.6693**	-18.6264**	-65.2573***
Log POP	0.2532	-2.6810	-25.0993***	-
Log GDP per capita	-2.1835	-4.1043**	-7.76354	-14.3426***
Log (GDP)2	-1.7674	-3.3845***	-4.9216	-13.9720

Notes: *,** and *** are indicate significant at the 0.1, 0.05 and 0.01 marginal level respectively.

Based on the outcomes presented in Table 1, which includes the results of both the ADF and Ng and Perron unit root tests in their level and first difference forms, we determined the optimal lag length using the Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC). Both result showing us most series of ADF are non-stationary except FDI, and in the part of Ng-Perron, all series are non-stationary at the level. Hence, we do not reject null hypothesis. However, we conduct the first difference to observe whether we have the ability to reject the null hypothesis at the significance level or not. The ADF test results indicate that, at a 1% significance level, than we can reject the null hypothesis for CO2, GDP2 and FDI when considering their first differences. Similarly, for Trade and GDP per capita, the null hypothesis can be rejected at a 5% significance level when observing their first differences. However, for Pop, the null hypothesis is rejected when considering the second difference. Besides, the Ng-Perron test result indicate that, at 1% significance level, we can reject the null hypothesis for Co2, Trade and GDP per capita at the first differences. Similarly, for FDI, the null hypothesis can be rejected at a 5% significance level

at the first differences. For the Log GDP2 we can consider that rejected in second difference, and the population we can rejected in level at 1% significant level.

4.2 Diagnostic tests for the co2 equation:

Table 2

Lags	Null hypothesis	Statistics	Decision
Breusch- Godfrey serial Correlation LM test:	No autocorrelation	F (2) =2.5358 (0.1105)	Do not reject H0
Ramsey RESET test	The model is correctly specified	F (1) =1.6022 (0.0608) *	Do not reject H0
ARCH test	Homoskedasticity	F (1) =0.3869 (0.5394)	Do not reject H0
Jarque-Bera test	Normality of error term	X^2=0.3552 (0.8373)	Do not reject H0

Notes: *, ** and *** indicate are significant at the 0.1, 0.05 and 0.01 marginal levels respectively.

Note: The probability values are showing in the brackets.

To support the model and confirm that model are stability and can strong, we have run a diagnostic test such as Breusch- Godfrey serial correction LM test, Ramsey Reset test, ARCH test, and also the Jarque-Bera test. In Breusch-Godfrey serial correction LM test, the result indicates that there is no autocorrelation, because the probability is (0.1105), hence we do not reject the null hypothesis, since the F statistics is greater than the significance level at 5%. Besides, the Ramsey RESET test result are indicates that the model is correctly specified, this is because the probability (0.0608) is larger than the significance level, hence, we do not reject the null hypothesis. For the ARCH test, we do not reject the null hypothesis, as the probability (0.5394) is greater than the significance level, so there is a homoskedasticity. For the Jarque-Bera test, since

the probability (0.8373) is larger than the significance level, so we do not reject the null hypothesis which mean there is a normality of error term.

4.3 Bound test

Table 3

Null Hypothesis: No cointegration	Critical Value	
	Lower	upper
1%	3.06	4.15
5%	2.39	3.38
10%	2.08	3
Computed F-Statistic: 6.9279		
Decision: Reject null hypothesis at 1% significance level		

We have determined that the bound testing procedure is the most suitable econometric approach for assessing the long-term relationship between CO2 emissions and Malaysia's FDI, particularly given the constraint of a small sample size. Our dataset spans from 1990 to 2020, providing only 30 observations.

In Table 3, the calculated F-statistic (Wald test) is 6.9279, surpassing the upper critical value at the 1% significance level (4.15). Consequently, we reject the null hypothesis, indicating that there is indeed a long-run relationship between CO2 emissions, FDI, Trade, population, and GDP per capita.

4.4 Level Relations

Table 4

Variable	Coefficient	t-statistic	Probability
FDI	0.1721	2.8938	0.0097***
LGDP	50.7928	2.4021	0.0273**
LGDP2	-2.8208	-2.4019	0.0273**
LPOP	7.8002	5.8164	0.0000***
TRADE	0.0056	1.7127	0.1039

Notes: *, ** and *** indicate significant at the 0.1, 0.05 and 0.01 marginal levels respectively.

Long Run Model

$$CO_{2t}=-357.1703+0.1721FDI_t+50.7928LGDP_t - 2.8208LGDP2_t +7.800LPOP_t$$

$$= (0.0008)^{***} (0.0097)^{***} (0.0273)^{**} (0.0273)^{**} (0.0000)^{***}$$

$$+0.0056Trade_t \quad (5)$$

$$(0.1039)$$

Notes: The probability values are showing in the brackets.

The long run elasticity are shown in Eq(5). The estimation of FDI is a positive sign and statistically significant at 1% significance level. This finding is consistent with Lau et al. (2014) and Jorgenson (2007). Foreign investment can lead to economic growth but can also lead to higher levels of industrial pollution. Some transnational corporations move their factories to developing countries in order to avoid the high environmental costs of advanced countries. This can lead to higher environmental levels in the recipient countries. Malaysia's economy has grown rapidly since the 1990s and therefore needs to be supported by huge foreign direct investment, yet it has always been labour-intensive. This has resulted in foreign companies often bringing in large numbers of labour-intensive industries and dirty technology, which has resulted in large carbon dioxide emissions in Malaysia.

The estimation of GDP is positive sign, which is also found that there is statistically significant at 5% significance level. The estimation of GDP2 is significant at 5% significance level, and it is negative sign, hence this is suggested there is an inverted U-shaped curve. This means that our paper's EKC hypothesis is valid, environmental quality deteriorates at low-income levels, but gradually improves as income levels increase. Hence this finding is consistent with Lau at al (2014), Pao and Tsai(2011) and Lamla(2009).

Looking for the trade, the coefficient is positive but that statistically insignificance. Hence, this is implied that the trade and co2 has no relationship, this finding is inconsistent with (Essandoh et al., 2020). This maybe is the

sample size restriction, because in this paper the sample size only have 30 years, hence it is possible that the effects of trade haven't manifested themselves yet.

For the population the coefficient is positive, not only that, that are statistically significant at 1% significance level. This finding is consistent with Shi(2001), which is mention that population is one the major issue to driving increase the carbon dioxide. As the population continues to grow, so does the demand for energy, especially in the home, industry, transport, and other areas. This leads to an increase in the consumption of fossil fuels and therefore an increase in carbon dioxide emissions. Not only that, population increase to urbanization, increase industrialization, transportation demand, consumption patterns, housing and infrastructure, agriculture practices, wasted generation, land use changes and infrastructure challenges, these are the reason why the population increase will lead the CO2 emissions.

Short Run Model

$$\Delta CO_2 = -212.0637 + 0.1078\Delta FDI_{t-I} - 0.0014\Delta TRADE_{t-i} + 29.7433\Delta GDP_{t-i}$$

$$= (0.0028)^{***} \quad (0.0017)^{***} \quad (0.7512) \quad (0.4120)$$

$$-1.6176\,\Delta GDP2_{t-i} + 16.2888\,\Delta POP_{t-i} - 0.593316ECT_{t-1} + \epsilon_t$$

$$(0.4310) \quad (0.1063) \quad (0.0028)^{***}$$

Notes: *, ** and *** are measuring significant at the 0.1, 0.05 and 0.01 marginal levels respectively.

Note: The probability values are showing in the brackets.

For the Foreign direct investment, the coefficient is positive and statistically significant at 1%, this is implied that FDI will cause the CO2 emission increase significantly in the short term. This finding is consistent with the (Essandoh et al., 2020). In the short term, when FDI comes to Malaysia, it usually invests in the manufacturing and industrial sectors, thus leading to the expansion of production facilities, which enhances energy consumption. Not only that, when FDI comes to Malaysia to set up factories, it brings with it a large amount of

transport, including some cross-border transport of goods or materials from foreign countries.

GDP, POP, TRADE all is insignificant, which means that there is no significant relationship with co2 emissions in the short term. For the population, this is possible that there is an increase in population but not much change in urbanisation within Malaysia, however urbanisation leads to an increase in the amount of energy used by the population, but urbanisation is not something that can be accomplished in the short term. Populations have a huge of uncertainties related to the human behaviour.

The ECT is negative coefficient and statistically significant at 1% level, this finding is consistent with the (Li & Shao, 2022). Which means that if there is a deviation from the equilibrium, about 59.33% of that deviation will be corrected in the next period assuming all variable remains constant.

4.5 Granger causality test and ECT

ECT is the system returns to its long-term equilibrium relationship following short-term deviations. When the error correction term is both negative and statistically significant, this signals that any deviations from the long-term equilibrium are rectified over time, suggesting a tendency for the system to converge back to its equilibrium state. In the ECT, our finding is negative coefficient and statistically significant at 1% significant level. On average, one-unit increase in the independent variable (FDI,GDP,POP,TRADE) is associated with a decrease of 0.59 units in the independent variable. This is due to that initially the host countries wanted more investment for their economic development, which led to the attraction of labor-intensive multinational corporations engaged in low-level production industries that resulted in large amounts of carbon dioxide emissions. As the host country's economy improves and its environmental policy improves, the host country will begin to attract mainly high-quality and green FDI, and then the host country's CO2 emissions will gradually return to their original level.

Table 5

Dependent variable	F-Statistics					
	Co2	**FDI**	**LGDP**	**LGDP2**	**LPOP**	**TRADE**
CO2	-	4.3156**	0.6223	0.6084	1.5228	3.5682**
FDI	0.8368	-	0.0563	0.0568	1.5943	1.3359
LGDP	0.0498	3.8246**	-	0.2827	1.3674	2.3598
LGDP2	0.0321	3.7931**	0.3215	-	1.4035	2.3918
LPOP	5.2164**	4.6410**	3.8384**	3.7589**	-	4.5083**
TRADE	0.8120	0.0628	0.7922	0.7588	3.7459**	-

Table 6

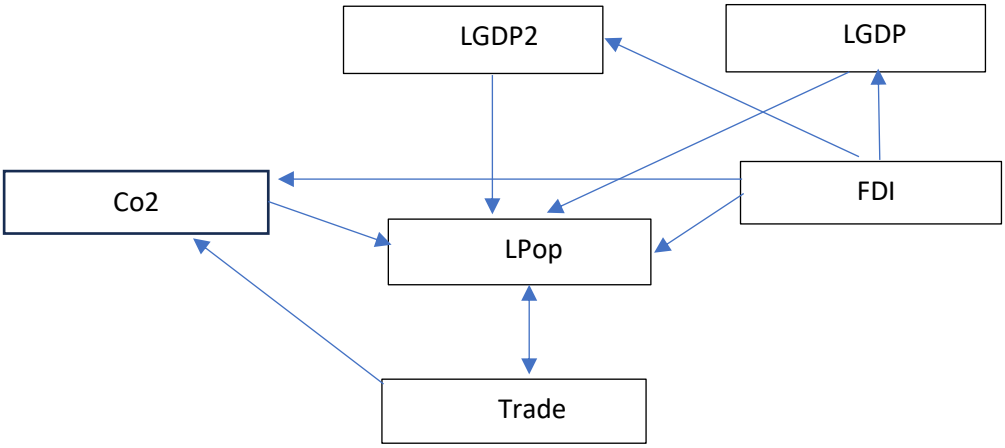
	ECT
CO2	-0.5933 (0.0028) ***
FDI	0.1078 (0.0017) ***
LGDP	29.7433 (0.4120)
LGDP2	-1.6176 (0.4310)
LPOP	16.2889 (0.1063)
TRADE	-0.0014 (0.7512)

Notes: *, ** and *** are measuring significant at the 0.1, 0.05 and 0.01 marginal levels respectively

Note: The probability values are showing in the brackets.

Based on Table 3, the Granger causality test result indicates that Co2 has a unidirectional causality to LPOP. FDI has a unidirectional to all variables except Trade. LGDP2 and LGDP have a unidirectional to the LPOP. Also, Trade has a unidirectional to the Co2 and have a bidirectional to the LPOP. The linkage of the variables is showing at below figure 1.

Figure 1



Chap 5 Conclusion

5.1 Summary and policy implications

The present paper examines the short run and long run relationships between Malaysia's carbon emissions and FDI inflows. Besides, the determinants of carbon dioxide emissions namely GDP, trade and population are also being examined.

Bound test, ARDL level relations, and Granger Causality test are used to examine that if the EKC hypothesis of the relationship between carbon emissions and FDI inflows is valid in Malaysia with a sample size from 1990 to 2020. Our results shows that Malaysia's FDI inflows plays an important role in the increase of carbon emissions, while trade, and population have their influence on the carbon emissions in Malaysia in the long run. However, in the short run only population influence carbon emissions in Malaysia. There are also indirect effects from GDP per capita to carbon emissions. Meanwhile, our empirical results shows that there is a unidirectional short run casual effects from population to Malaysia's carbon emissions and from carbon emissions to trade and FDI inflows. Besides, there is also bidirectional causality from trade to population.

Although Malaysia's efforts to reduce carbon emissions have shown significant results by following the principles of United Nations Framework Convention on Climate Change (UNFCCC), it still seems to be insufficient. In order to further reduce carbon emissions, policies on FDI, GDP per capita, trade and population are proposed. First, FDI has been known for its ability to improve economic growth but its effect for the environment quality has been neglected. Therefore, government are encouraged to focus on attracting FDI that promotes green energy and environmentally sustainable practices. This objective can be attained by implementing a combination of incentives, legislation, and collaborations with global firms that prioritise sustainable development. Similarly, to FDI, trade also boosts economic growth where it then speeds up carbon emissions. However, international trade between countries can result in higher emissions due to the increase distance of movement from transporting goods. It is suggested for governments to actively

press for trade agreements that integrate environmental considerations, foster the use of low-carbon transportation alternatives, and provide support for sectors with reduced carbon footprints. Carbon pricing methods are also suggested for assisting in absorbing the environmental costs associated with trade.

As FDI and trade benefits from higher economic growth which can be measured by GDP per capita, it is advisable to implement policies on decoupling economic growth from carbon emissions. For example, investing in sectors such as renewable energy as substitutes of fossil fuels. A balance is required between environment sustainability and economic growth for reducing carbon emissions while maintaining or improving GDP per capita. The government is also advised to work with local groups such as non-government organizations or local educational institutions to further reduce carbon emissions. This can be done through promoting sustainable consumption patterns among people or raise awareness about environmental impacts of the increasing carbon emissions in educational institutions or even the public.

5.2 Limitations and recommendations for future studies

In general, every research endeavor has its limitations, as continuous exploration often uncovers varied challenges. One notable limitation in our study is the small sample size. Our data, sourced from the World Bank, spans only from 1990 to 2020, resulting in just 30 observations. Due to this limited sample size, the robustness and applicability of our findings might be compromised. Also, the small sample size has restricted our research method, because the sample size that we implied is only suitable for the ARDL model, but most studies are using panel data because it can combine cross-sectional and time series variations. In general, the researcher will combine the ARDL model and panel data to analyse the relationship across both entities and time while accounting for potential non-stationarity in the variables of interest.

Besides, the reduced degrees of freedom resulting from our limited sample size pose additional constraints on the precision and reliability of our statistical analyses. With fewer degrees of freedom, our ability to confidently detect and validate significant effects or relationships within the data is compromised. This

limitation impacts our ability to thoroughly explore complex relationships among variables and increases the susceptibility to spurious findings. As a result, our findings may lack the necessary robustness to withstand rigorous scrutiny and may not provide a comprehensive understanding of the underlying patterns in the data.

For recommendations for future studies, when selecting a dependent variable or independent variable, the future researchers can consider selecting a bigger sample size rather than smaller sample size, because the greater sample sizes can lead to more precise average values and allowing for increased accuracy in measurements. Also, a larger sample can help researchers in pinpointing outliers within datasets and result in narrower margins of error.

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