How does Foreign Direct Investment Influence the Environment in China? Prior and During the Covid-19 Pandemic

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Abstract

This study revisits the recent widely ongoing debate over the effects of FDI on the environment in China. Analysis has shown that firms seek to operate in countries with lax environmental standards, namely the PHV. However, the PHL counterargument is also prevalent. This theory stipulates FDI will bring higher environmental management standards and cleaner technologies into the host country. Empirical literature is inconclusive and at times conflicting between some hypotheses therefore this study aims to provide additional clarity on the impact of FDI on the environment in China. This study concludes the existence of both PHV and PHL hypotheses which can be explained by the impact mechanisms of FDI; scale, structural, technique and income effects. The development levels of China using the EKC model hypothesis is used to explain the varying impacts of FDI on the environment. Reflecting on these interesting recent findings in this study, policy implications are discussed and suggestions are provided to improve the impact of FDI on the environment. The future for China is expected to embody an environmental focus in promoting FDI in renewable energy and greener technologies to improve environmental quality.

Highlights

- Confirms the existence of both the Pollution Haven and Pollution Halo hypotheses
- Explores the effect of impact mechanisms of FDI on the environment
- Investigates the linkage of environmental degradation and development using the EKC
- Recommends more stringent environmental regulation and enforcement

1. Introduction

With increased globalisation and growing economic ties between China and other nations, FDI inflows to China have grown massively. Positive spill over effects have been reaped which would partly explain the PHL hypothesis if it results in a reduction of pollution (Tobey, 1990). However, when initially considering the impacts of FDI upon the environment, the direct effects seem to be detrimental and unsustainable. Thus, there is an ongoing debate as suggested by Liu et al. (2018) over the PHV and PHL hypotheses that is explained and considered in this study. Section Two will focus on giving background information for FDI and the current conditions of the environment in China. Section Three will explore the main hypotheses, PHV and PHL, which explain the effects of FDI on the environment. The influences on these hypotheses are the scale, structural, technique and income effects. These are also explored to give an enhanced understanding as to what causes the PHV and PHL forces. Section Four focuses on the development of China and the impact this has on how FDI affects environmental quality. Finally, in Section Five results are discussed as well as policy implications and the effectiveness of more rigorous environmental regulations. The future for environmental policy regarding FDI is also discussed as well as future environmental predictions in China.

1.2 Purpose and Approach

This research aims to look into the relevant literature for the FDI effecting Chinese environmental quality and come to a conclusion on whether it has a positive or negative effect. Past literature, Ahmad et al. (2021), Zeng and Zhou (2021) and Xie et al. (2020) will be compared and discussed in order to get a full contemporaneous assessment of the topic area. Policy implications and conclusions will be drawn based on the outcome critique of the literature.

2. Background

2.1 FDI in China

In 2020, China was the largest recipient of FDI raking in $163 billion, surpassing the United States' FDI inflows of $134 billion (UCTAD, 2020). FDI net inflows have increased by more than 300% since 2000 in China (UNCTAD, 2020). This huge growth in FDI can be reflected in blue bars in Fig. 1 below, showing the growth in FDI over the past 30 years from 1990–2020.

Romer's (1998) recent economic growth theory presents the effects of FDI and investment which results in economic growth. Within the manufacturing sector, local firms benefit from the spill over effects when there are foreign firms operating, in terms of knowledge, management practices and productivity (Orlic et al., 2018). Thus, the increasing FDI inflows over the past 30 years undoubtedly provides financing to high-cost projects leading to positive effects on economic growth, technology and the development of China.

2.2 Impact of FDI on the environment

The majority of inward FDI in China has gone into pollution-intensive industries due to the loose environmental regulations and the need for regional development (Wang and Liu, 2019). The impacts on the environment span far and wide with effects on air pollution, soot, dust, wastewater and the ecology to name a few (Ahmad et al. 2021, Zeng and Zhou 2021, Xie et al. 2021, He, 2006, Liu et al. 2018). The environment is arguably priceless and largely severe once damaged.

An indication of environmental pollution can be given by carbon dioxide (CO_2) emissions which have been increasing in China (Khan and Ozturk, 2020), shown using the orange line in Fig. 1, using data from Europa (expressed in metric tonnes of carbon dioxide equivalents). FDI inflows to China and the CO_2 emissions have rapidly increased from 2003–2011 and began to plateau from 2015. The recent effects of the Covid-19 external shock are also clear as well as the 2008 financial crisis. During 2008 and 2020 there is a sudden sharper increase in FDI inflows to China, which suggests government leniency in accepting as much FDI to relieve the economic shocks. In 2008, this is followed by a steeper increase in CO_2 emissions until 2011, which suggests the sharp increase in FDI in 2008 could have deeper ramifications on pollution levels. However, the increased FDI in 2020 more than CO_2 could suggest a more environmentally conscious approach towards production techniques or more stringent pollution regulations. The slower growth of CO_2 emissions could possibly indicate a reversal of pollution and a renewable energy focus in China that is discussed further in Sect. 5. Conversely, referring to previous trends in 2008, this growth in FDI could lead to a steeper increase in CO_2 in the future. Nonetheless, it is

clear from Fig. 1 there are close trends between the variables indicating some correlation. Hence, this study will explore the debate on whether the effects of FDI lead to a positive or negative effect on the environment in China.

3. Hypotheses

3.1 Pollution Haven hypothesis and Pollution Halo hypothesis

The PHV hypothesis, established by Copeland and Taylor (1994), maintains that the liberalisation with the ease of globalisation of trade and foreign investment rules will lead to polluting industries in countries with looser environmental regulations thus becomes a comparative advantage to the firm (He, 2006). Developing countries have welcomed FDI through loose environmental regulations, which has accelerated economic growth, created employment and developed local communities at the expense of the host country becoming a 'pollution haven' whereby there is increasing FDI as firms/individuals are able to exploit the environment (Adeel-Farooq et al., 2021).

Nonetheless, the counterargument is that PHL hypothesis initiated in the work of Tobey (1990), suggests that multinational firms which invest via FDI will be with more efficient techniques which improves energy consumption, and have cleaner technologies and higher environmental standards as well as. Therefore, the PHL hypothesis stipulates the benefits of FDI in terms of positive externalities as suggested by Zugravu-Soilita (2017), with greener technology transfers and management practices causing pollution levels to decrease in the host country.

Current literature is inconclusive between the PHV and PHL hypotheses, Liu et al. (2018) found that FDI deteriorates the environment, from 2003–2014 across 112 cities in China. Tang and Tan (2015) scrutinized environmental degradation impacts of energy consumption due to FDI and the causes on CO_2 emissions. They found FDI to be the key factor in CO_2 emissions. More recently, Lin and Xu (2019) concluded that China has borne the environmental damages in the Sino-Russian trade agreement, becoming a pollution haven since 2007. Therefore, these studies indicate correlation between CO_2 and FDI shown in Fig. 1.

On the other hand, Wei et al. (2016), and Zhang and Zhou (2016) found that FDI is positively associated with improved environmental development in China confirming the PHL hypothesis. More recently, Chen et al. (2021) find that FDI improves emission and environmental efficiency. This suggests FDI improves environmental development in China. With Sung et al. (2017) discover of no association between CO_2 emissions and FDI inflows.

The PHV and PHL hypotheses debate is still largely ongoing, as studies have found both effects to exist dependent on the development of the country, the industry and environmental regulation differences. Most recently, Ahmad et al. (2021), found the existence of both PHV and PHL effects, as did Zeng and Zhou (2021). FDI has been found to directly increase carbon emissions (Xie et al., 2020) while it was

simultaneously found FDI to indirectly reduce CO_2 through spillover effects of economic growth, confirming both hypotheses. In spite of this, the environmental indicators used in the majority of these studies, even recent research by Xie et al. (2020), were CO_2 or sulphur dioxide (SO_2) levels which are crude variables failing to demonstrate wider impact on the environment. Three types of pollution are observed in Zeng and Zhou (2021) as different indicators. FDI has a positive effect on regional wastewater proving the PHV. Whereas the effects on SO_2 and chemical oxygen demand are negative, confirming the PHL hypothesis. Although three types of pollution are observed in the research, this is minimal in comparison to the Environmental Performance Index (EPI) that gives a comprehensive number of indicators to depict more inclusive environmental conditions. The EPI, established by Yale University in 2002, uses 32 indicators that capture the sustainability of the environment for 180 countries. Figure 2 shows China currently ranks 120th with an EPI score of 37.3 in comparison to the UK that has an EPI of 81.3, ranking 4th place (EPI, 2020). Adeel-Farooq et al. (2021) use the EPI in their study, which shows a wider range of indicators that are examined rather than just CO_2 or SO_2 levels.

3.2 Scale, Structural, Technique and Income Effects

Ahmad et al. (2021), Zeng and Zhou (2021) and Xie et al. (2020) confirm the existence of both PHV and PHL hypotheses. They explore the influences of the two hypotheses and what causes each effect will have in providing deeper understanding of the impact on the environment. The association between economic development and environmental quality can be broken down into four effects. The scale, structural, technique and income effects are the impact mechanisms of FDI according to Grossman and Kruger (1995). These effects influence the effect of FDI on environmental sustainability that can be seen in Fig. 3.

The scale effect stipulates that ceteris paribus, a general ‘scale-up’ in production due to FDI will increase pollution (Grossman and Kruger, 1995). Generally, this is likely to cause an increase in pollution due to higher production levels. This appears on the left side of the curve in Fig. 3.There is also the structural effect whereby a change in production methods will lead to an increase or decrease in pollution (Liobikiene and Butkus, 2019). For example, FDI resulting in a firm becoming more capital or labour intensive will have different effects on the environment (Ahmad et al., 2020). This is seen on the right side of the curve in Fig. 3, which would suggest a change in production method to a process that is more sustainable and less damaging to the environment. However, it could also be seen as an effect increasing environmental degradation if the change in production leads to a decrease in environmental quality. The technique effect, which is closely related to the PHL, demonstrates that foreign firms will transfer better techniques into the host country when investing in FDI (Ahmad et al. 2021). This also promotes spill-over innovation in the local communities that have positive externalities effects inducing an improvement in environmental quality. Thus, it is on the right of the curve as the technique effect could result in the adoption of cleaner technologies, which would lead to a decrease in environmental degradation. Lastly, the income effect, associated with the EKC (Ongan et al. 2020) which is discussed in further depth following this section. This stipulates that as the host country becomes richer due to FDI being pumped into the economy, the host country becomes more developed and environmental protection awareness

increases. In turn, this will improve environmental quality as more stringent environmental laws are enforced (Ahmad et al., 2021).

4. Development Of China

4.1 China as a whole

The status of China as a developed or developing country is controversial and at times subjective, as the WTO leaves it for members to decide themselves. Despite China's recent economic growth, which is second to USA GDP (IMF, 2021). Under criteria used by development institutions, China still classifies as a developing country, as the FDI will affect the environment, whether it leads to a PHV or PHL effect. Therefore, China continues to benefit from leniency on international FDI commitments (The Center on Global Energy Policy, 2020).

The Human Development Index (HDI) established in 1990 that includes key factors, categorizes China as a developing nation, ranking 85th in 2020 (UNDP, 2020). However, it is important to acknowledge the development of China, this is significant as it can often be overlooked when investigating the PHV and PHL hypotheses. The level of development could impact the effects of FDI on environmental degradation which can be seen using the EKC.

4.2 Environmental Kuznets Curve

The EKC concept of an inverted U-shape arose in Grossman and Krueger's work (1991) to show the relationship between economic development and environmental degradation. It stipulates that damage to the environment will initially increase as the country industrialises, this suggests a potential trade-off between economic growth and environmental degradation. However, as the economic growth of a country reaches a particular point of peak pollution, environmental degradation will start to decline. This is shown in Fig. 4, environmental quality eventually improves due to the increased environmental protection awareness that drives industries to use cleaner production methods that accounts for more sustainable environment, as recently the EKC hypothesis has been confirmed for China by Sarkodie and Strezov (2019).

Cole (2004) had found a linkage between the PHV hypothesis and the EKC concept as in Fig. 4. This finding suggests a close association between the economic development level of PHV and PHL hypotheses with Grossman and Krueger's (1995) scale, structural and technique effects. A major research gap by Zeng and Zhou (2021) is they avoid investigating the EKC's impact on the PHV and PHL hypotheses after having found they exist which this study addresses.

Xie et al. (2020) confirm the EKC hypothesis finding an association between CO_2 emissions and economic growth. However, they do not associate this to the scale, structural and technique effects. Most recently, Ahmad et al. (2021), covering the scale, structural and technique effects with the EKC analysis, found income generally induced environmental sustainability, which validates the EKC hypothesis. The

association between the PHV and PHL hypotheses with the EKC is vital as it acknowledges pollution levels can be related to the development of the host country.

5. Policy Implications

5.1 Discussion

Xie et al. (2020) find the existence of PHV and PHL effects and endorses the EKC hypothesis as does Ahmad et al. (2021). Moreover, considering the effects of FDI on the environment across different sectoral levels on PHV and PHL hypotheses with the EKC is virtually non-existent (Ahmad et al., 2021). Dean et al. (2005) suggest the sector that a firm belongs to, being high or low technology; will influence how the firm effectively responds to general regulation of the host country. With more knowledge on the impact of FDI on the environment dependent on the industry, more surgical precision-targeted policy can be more effective.

The Chinese government to lessen the effects of FDI on the environment can use environmental regulation. Tougher environmental policy reduces the number of FDI inflows to high-polluting industries (Ge et al., 2020). Stricter environmental regulation with higher financial fines would lead firms to reduce negative externalities and use innovative sustainable methods. This will make firms filter away their environmental degradation equipment and capitalize in more eco-friendly technology along the inflow of their FDI, especially from higher polluting industries where abatement costs will become higher (Dean et al., 2005). However, the PHV hypothesis assumes a different outcome for firms that utilise high technology, as these firms are more likely to invest in research and development. It would be easier for high technology firms to adapt their practices to mirror those of greener multinational companies in order to comply with regulations (Dean et al., 2005). Thus, a stricter environmental policy is more effective for the industry of the firm.

Adeel-Farooq et al. (2021) find the origin country of the FDI to be a significant factor; therefore, stricter implementation of environmental regulations for the source of FDI may improve domestic sustainability. Haibo et al. (2019), Ahmad et al. (2021) and Xie et al. (2020) are in favour of tougher enforcement by the government at both national and regional levels to maintain standards across the board. The quality of FDI source of inflows to China should be monitored to ensure firms are not taking advantage of looser regulations which would induce a pollution haven effect.

5.2 Past, Present and Future: FDI Environmental Policy in China

Linkages between environmental regulation and FDI have been found, the constraints of regulation are likely to affect the role of FDI on green total factor productivity that is beneficial for green economic growth (Qui et al., 2021). Thus, environmental policy will increase the environmental threshold of FDI inflows to China and is likely to decrease environmental degradation. As well, increased environmental standards will induce higher demand for skilled labour by firms that will increase innovation and cleaner production methods (Wang et al., 2021). This is beneficial for the workforce and the environment in China as it will enhance skills, innovation and environmental quality. For environmental regulation to be

successful there needs to be proper enforcement of the policy to ensure standards are being met nationally (Bao et al., 2021). Nevertheless, too strict environmental regulations could reduce green innovation that will limit pollution reduction in the long-run (Pan et al., 2021). Thus, China's environmental policy needs to be carefully set. Additionally, the effectiveness of environmental regulations could also depend if the firm is a locally state-owned enterprise as implementation of these stricter regulations is more likely to be taken on board due to their close link with the government (Pan et al., 2021). Thus, past environmental policy has been effective in improving green total factor productivity that has led to increases in green growth.

In terms of types of policies to be implemented, economic incentives and governmental screening and monitoring have been found to be the most successful in encouraging firms to upgrade infrastructure to be more green efficient and environmentally friendly (Yu and Wang, 2021). This will ensure firms operate with cleaner production techniques and actively try to reduce pollution levels – whether that is in terms of waste, water, air quality etc.

5.3 Future for the environment in China

Renewable energy is vital for environmental sustainability and current Chinese investments into clean energy are the highest in the world (Wong, 2021). This suggests a turning point for environmental degradation in China and could mean the 'peak pollution' level is soon to be reached. Thus, the EKC model would predict a reduction in pollution in the near future for China. Chinese policymakers have incorporated sustainability targets in the Five-Year Plans since 2001. The signing of the Paris Agreement by China in 2016 endorses China's acknowledgement of the importance of climate change (Holzmann and Grunberg, 2021). There has been an increasing focus on energy transition and efficiency and policy has directly promoted sustainability in China. However, recent statistics from UNCTAD (2020) and the European Commission suggest otherwise; FDI inflows increased massively, this is likely to be trailed by sharp rises in CO_2 emissions as seen in 2008 after the financial crisis. Thus, although China has claimed to enforce stricter environmental regulation, future data will be able to reflect whether this is the case. Conversely, despite increasing levels of CO_2 emissions, it is clear that investments into wind turbines in China has also increased massively. In 2020, China built more windfarm capacity in comparison to the whole world combined (BloombergNEF, 2021). Thus, it is clear China is already leading the way in windfarm power and there has recently been a focus towards renewable wind energy. However, the use of coal and levels of pollution are not falling either therefore, it will be interesting to see whether renewable energy will replace non-renewable sources China's future.

6. Conclusion

Overall, most recent aforementioned literature confirms the existence of both the PHV and PHL effects in China. A wide range of indicators have been tested and used to prove both these hypotheses, such as the EPI indicator in Adeel-Farooq et al. (2021) which gives multidimensional effects of FDI on the environment. With supporting literature settling the existence of these hypotheses, the severity of these impacts and the influences on them have also been analysed.

The four impact mechanisms; scale, structural, technique and income effects have been found to influence the effect of FDI on the environment as they stimulate the PHV or PHL effects (Grossman and Kruger, 1995). There is also a clear link between the PHV and PHL effects and the EKC, most recently confirmed by Ahmad et al. (2021). Thus, the development of China will impact the extent of the PHV or PHL effects.

Development levels should be examined as causes for different environmental degradation levels across China with further scrutiny into the effects of FDI on the environment depending on the industry is also required, as Ahmad et al. (2021), Xie et al. (2020) and Zeng and Zhou (2021) do not explore this. Studies, such as Orlic et al. (2018), have focussed on the manufacturing sector, however there is little literature comparing the impact of FDI on the environment among different sector. Technology levels are expected to sway the environmental effects of FDI which was broadly assessed by Dean et al. (2005), however the impact by more specific sectors has not been considered. In order for targeted policy to be effective, further analysis into sectoral influences must be investigated.

There is a clear consensus from Adeel-Farooq et al. (2021), Ahmad et al. (2021), Xie et al. (2020) and Zheng and Sheng (2017) that environmental policy should be stricter in China in order to limit ‘dirty’ industries and environmental degradation. This is recommended no matter the development level of China (Ahmad et al., 2021). Stricter regulation will alleviate the negative impacts of FDI on the environment and prompt the EKC to descend more rapidly, inducing the PHL positive effect. Firmer enforcement and stricter regulations in China will also encourage cleaner technologies and positive spill-over effects to local communities that will reduce environmental degradation. In addition to law-based constraints and government monitoring, market-oriented incentives have been found to be the most effective type of policy to enhance environmental quality (Yu and Wang, 2021). It is important that enforcement is consistently maintained to ensure firms are adhering to the environmental policies.

Acronyms

FDI: Foreign direct investment

GDP: Gross domestic product

CO_2: Carbon dioxide

SO_2: Sulphur dioxide

EKC: Environmental Kuznets Curve

PHL: Pollution Halo

PHV: Pollution Haven

WTO: World Trade Organisation

Declarations

—Disclosure of potential conflicts of interest—ethical and financial—

I, Dr Sultan SALEM as the corresponding author, declare on behalf of us as three authors (**Sultan Salem[1*], Sanda Kam[2] & Nicole Lee[3]**) that non-have any **Conflict of Interest: (i.e.** the authors declare that they have no conflict of interest.**)**

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Figures

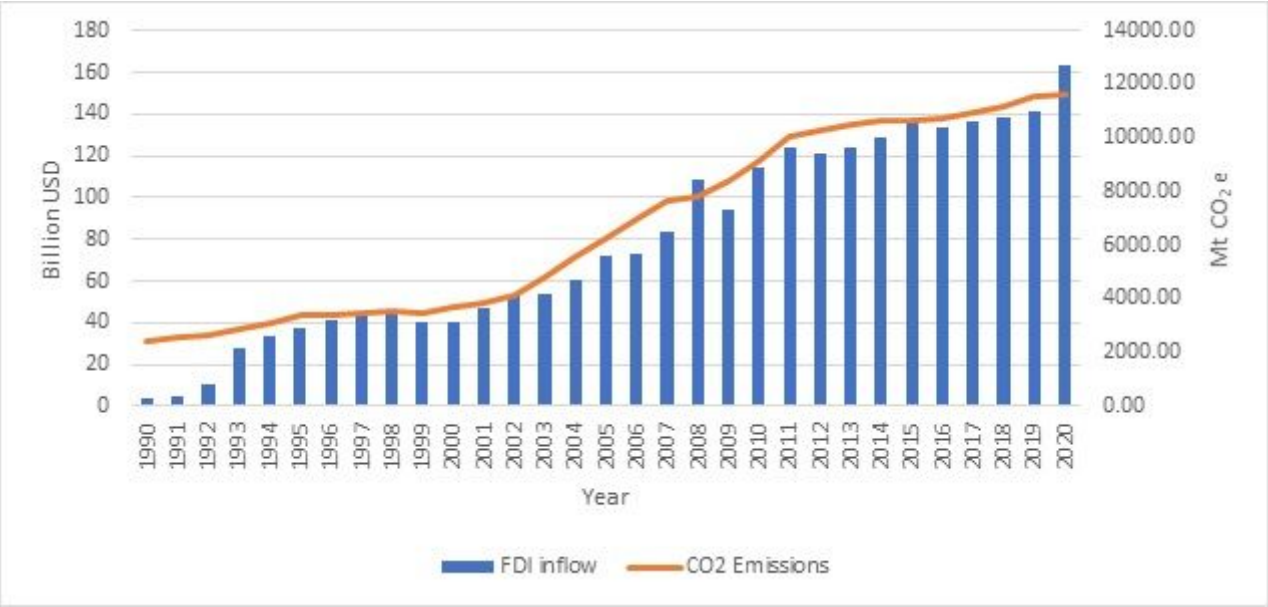

Figure 1

FDI Inflow and CO2 Emissions in China, 1990 – 2020 Source: Using data from UNCTAD and the European Commission, 2020. Note: Higher levels of FDI inflow in 2008 and 2020 reflecting the impact of external shocks, the financial crisis and Covid-19 pandemic, on FDI and CO2 levels.

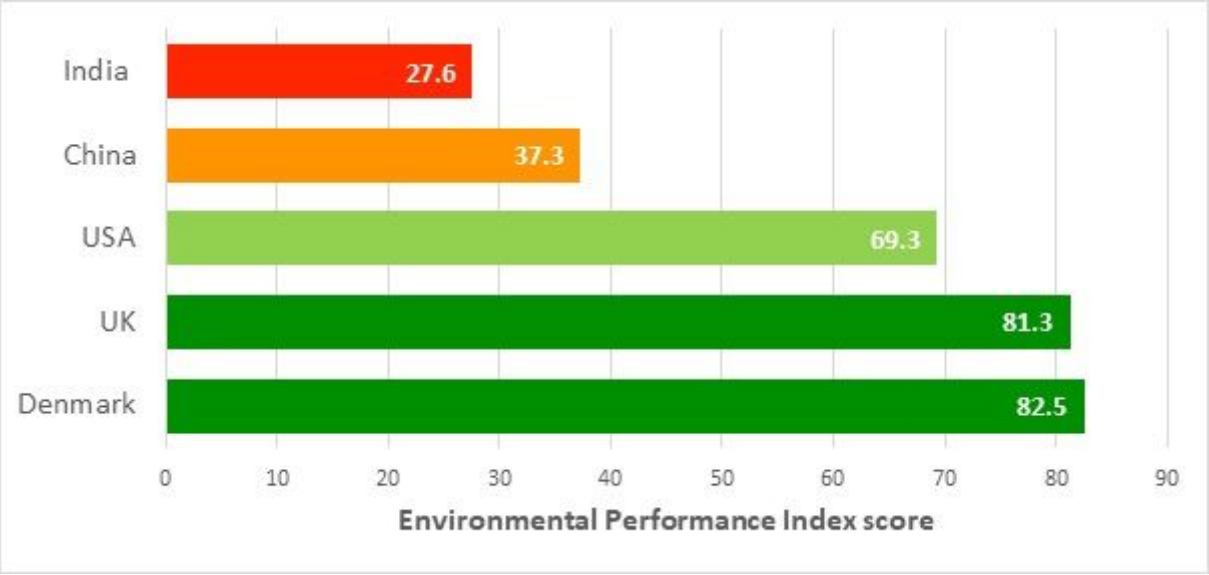

Figure 2

Environmental Performance Index scores 2020 Source: Using data from Yale University, EPI 2020. Note: EPI out of 100 which captures 32 indicators measuring environmental quality out of 180 countries. India with 27.6 at the lower end and Denmark the highest scoring with 82.5.

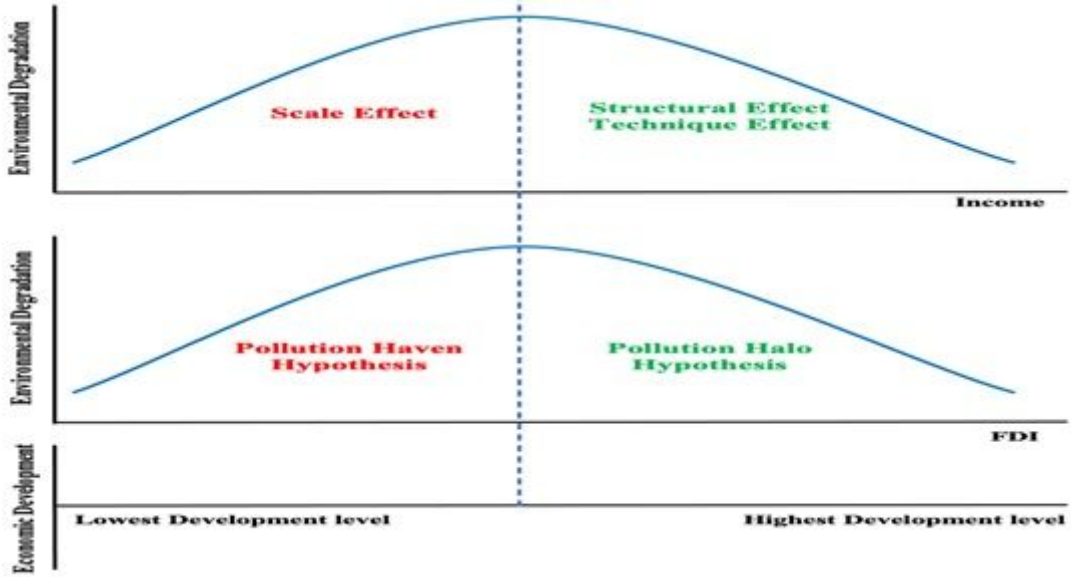

Figure 3

PHV/PHL effects and impact mechanisms influencing the EKC PHV/PHL effects and impact mechanisms influencing the EKC. Note: The scale effect suggests FDI results in a ‘scaling up’ of production, causing more pollution. Structural effects involve a change in production method and technique effects suggest cleaner technologies are utilised. PHV hypothesises an increase in FDI causing higher environmental degradation. Conversely, the PHL suggests better techniques and cleaner production will be a result of FDI inflows.

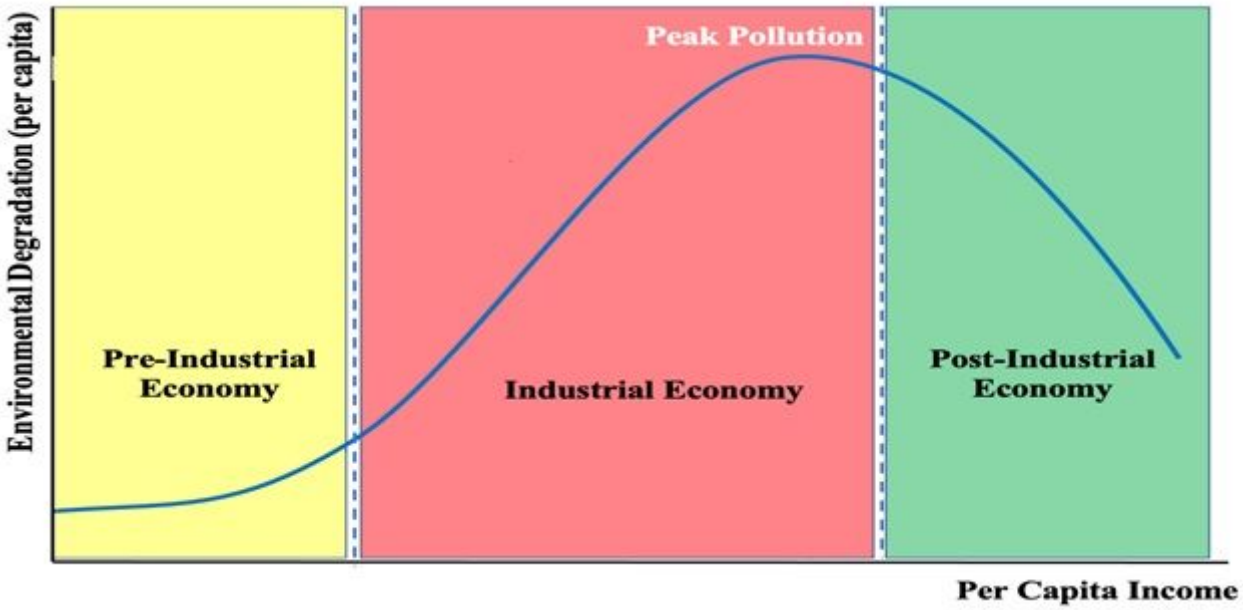

Figure 4

Environmental Kuznets Curve. Source: Grossman and Krueger (1991) Note: EKC explaining the relationship between economic growth and environmental degradation. Environmental degradation increases initially but peaks and falls as income rises.