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*Article*

# Impact of Socioeconomic Factors on Environmental Quality: A Panel Quintile Regression Method

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**Abstract:** Nowadays, determining the socioeconomic factors' influence on environmental quality is a crucial issue for policymakers. We aim to explore the impact of socioeconomic factors i.e., ethnic conflicts inform of ethnic fragmentation, institutions quality effectiveness, and energy consumption on environmental quality by testing the various hypotheses (Pollution Halo Hypothesis, IPAT, and EKC) in 40 selected Asian countries throughout 1993-2019. We also use a set of control variables which are gross domestic product per capita, foreign direct investment inflows, population growth to determine their impact on environmental quality. We use Panel Quintile Regression Method of 0.25, 0.5, and 0.75 to analyze the results. We find ethnic conflict negatively affects the environmental quality at all quantiles. The institution's variables regulatory quality and rule of law negatively influence the environmental quality. Our result supports Porter's hypothesis because the effect of direct foreign investment on the amount of CO2 emissions is negative and significant at 0.25, 0.5, and 0.75 quantiles which states that foreign direct investment in the host country supports environmental quality. Furthermore, our results support the IPAT hypothesis in selected Asian countries.

**Keywords:** Environmental quality; institutional quality; ethnic conflicts; socio-economic factors

## 1. Introduction

Recently, environmental quality has been a fundamental priority in the United Nations development program's millennium development goals (MDGs). Recently, it has been focusing on ways to improve environmental quality, such as reducing carbon dioxide (CO2) emissions, around the globe [1]. Human health and even the survival of life itself face severe dangers due to rising levels of CO2 in the atmosphere around the world, as well as the repercussions of environmental degradation. Because of this, public officials must take action to support sustainable development goals in light of these concerns. It is becoming increasingly difficult to conserve natural resources as the world's population grows geometrically. This challenge is particularly acute in Asian countries, which have a limited capacity to use green technologies to improve environmental quality [2,3]. As a result of political and social considerations, environmental policies in most countries are merely buzzwords. Environmental issues, on the other hand, are extremely complicated. As a result, human activities, such as intensive industrialization, have led to an increase in industrial waste. Fossil fuels and oil-based products are also a substantial source of energy consumption in both heavy industry and residential properties. Because of this, environmental degradation is greatly influenced by these causes.

However, environmental issues are also a problem in Asian countries. The economies of Asia's countries have been replaced by industrial and service economies. Carbon dioxide emissions due to fossil fuel combustion have skyrocketed as a result of these structural shifts in Asia. A recent International Energy Outlook research states that Asian CO2

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emissions will contribute to 23.7 billion metric tonnes in 2050, which is greater than the current level of emissions in 2018. Asian energy consumption will rise from 3600 Mtoe in 2015 to 6100 1.7 Mtoe in 2050, which is an increase of more than two-thirds according to the International Energy Outlook Report 2018 [4] For this reason, a well-balanced energy-induced CO2 emission model that benefits human well-being is now required. Furthermore, the EKC model is considered the baseline model in environmental economics literature for examining the relationship between economic growth and environmental degradation [5–8]. There is a wide range of empirical studies based on data from various places [6,8,9]. There is mixed evidence that the inverted U–shaped link for the EKC theory is invalidated by these investigations [10,11].

Our study contributes to the literature by assessing the impact of socio-economic factors on environmental quality in 40 selected Asian countries throughout 1993-2019. Because few empirical studies have focused solely on Asia, this study focuses on this region in particular [12–14]. Secondly, Recently, scholars have been looking into the issue of ethnic and cultural diversity. Several academic publications have linked ethnically diverse societies to social and economic advantages, such as high-quality public goods, economic growth, minimal corruption, and high-quality social capital. It is instead a hindrance to sustainable growth, causes conflict and mistrust between members of different groups, and diminishes the ability to communicate effectively in politics. Ethnic conflicts, policy regulatory concerns, and rule of law and order problems, which are key hazards in this region in the prior empirical studies, were not included in these studies. Consequently, these studies contain shortcomings [5,15]. To fully grasp environmental issues in Asia, policymakers must pay particular attention to these factors. Finally, Asian countries are home to diverse cultures and traditions. Asian ethnic groupings are diverse. However, the least priority in research has been done in Asian countries to study the link between CO2 emissions and ethnic culture. We find significant applications of the EKC hypothesis in a sample of Asian countries for the impact of demographic, political, and ethnic variables in the fourth phase of this work. In addition to political and ethnic factors, this study also supports IPAT's economic theory is also validated in Asia. We find regulatory institutions and laws and order are crucial. Further, we find support for a significant positive impact of energy generation on environmental quality. Finally, we find ethnic diversity inform of ethnic culture plays a significant supporting the evidence for environmental quality in Asian economies matters for sustainable development. This suggests that regulatory institutions, ethnic conflicts, and other socioeconomic factors are crucial for better environmental quality in Asia.

The remaining study is organized as follows. Section 2 discusses a review of the literature. Section 3 is about data and methodology the econometric methodology. Section 4 describes the empirical results and discussion. Finally, Section 5 discusses the conclusion and policy implications.

## 2. Review of Literature

Economic performance, inflows of foreign direct investment, political institutions, ethnic polarization, and population growth have all been linked to environmental quality in past empirical research. These studies are discussed in this section. In general, numerous hypotheses critical to environmental quality were explored critically in this section.

After the work of Kuznets [16] great attention has been made to the connection between economic performance and environmental quality. Generally, there are three perspectives: positive, negative, and insignificant results regarding the EKC hypothesis. The positive perspective discusses those findings, which support the EKC theory. For example, the study of Grossman and Krueger [17] evaluated 71 countries' cross-sectional data on sulfur dioxide emission. They concluded and validate the EKC hypothesis in a specific group of countries. Using cross-section data set, research also supported similar results [7,18]. However, the recent investigations verified an EKC theory after examining cross-section data set in different countries. However, the recent studies in Asia Pacific countries also verified the EKC concept. Similar nature of outcomes for verifying EKC

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Hypothesis reported specific to Asia pacific region include; the study of for Malaysia [19,20] and study for China [21,22]. In addition to this a positive and inverted U–shaped link for emerging economies. In contrast to the above-mentioned debate, the negative link or no confirmation of the EKC hypothesis is also observed in other investigations [23]. The study EKC hypothesis has not been supported after analysis of SSA countries' data set [13]. However, the third perspective is that it is insignificant or neither EKC hypothesis nor an inverted U-shaped link between GDP per capita and environmental quality indicators The studies also evaluated the insignificant association between economic performance and environmental quality indices [24]. As a result, the EKC hypothesis has been shown correctly in the vast majority of studies that have relied on cross-sectional data. In these studies, the socio-political context of environmental quality in Asian countries was mostly ignored.

*H1. There is an inverted U-shaped relationship between CO2 emissions and capita income in the context of Asia.*

For a long time, economists have investigated the link between foreign direct investment (FDI) and carbon dioxide emissions (CO2). In the "Pollution Haven Hypothesis" (PHH), this is addressed about. People throughout the world are debating this idea at the moment. It makes the case that pollution from polluting industries is a significant contributor to the state of the environment. data from countries with varying economic levels supports the PHH theory [25]. Similarly, a review of the relevant literature to the PPH hypothesis to perform this analysis. The PHH hypothesis was confirmed in the Asia-Pacific region by later research findings [26–29].

According to several studies, foreign direct investment (FDI) has no impact on the environment. China's air pollution has been affected by foreign direct investment (FDI), as demonstrated. A complex relationship between FDI and environmental quality. FDI outflows also had a positive impact on global CO2 emissions, but a negative impact on local pollution. It appears that FDI inflows do not affect environmental quality, according to the followings studies [30–33]. It was concluded that the PHH theory had some merit in the discussion that was just described. An investigation into the relationship between environmental quality and FDI inflows in various countries. Foreign Direct Investment (FDI) is a beneficial move since it minimizes pollution through technology and knowledge transfer. Foreign technology brought in through FDI may enhance production, reduce emissions, and enhance energy efficiency in the host country. The pollution halo theory states that foreign direct investment (FDI) encourages advanced technologies in developing countries to achieve growth and environmental quality. Foreign Direct Investment (FDI) has a positive effect on the economy, but it also hurts the environment. As it is found that the pollution haven hypothesis is more strongly valid in low- and middle-income countries, while "the pollution halo hypothesis" exists in high-income countries. The pollution halo theory is supported by several research that reveals positive benefits [34,35]. Baseline models in the field of Asian studies remained highly debated. When ethics and political factors are taken into account, the PHH and pollution halo hypothesis require further investigation [36,37]. Re-examining the PHH theory in light of ethical and political issues faced by selected Asian countries covers growing demand.

*H2. FDI inflows increases CO2 emissions in Asia.*

An economic theory known as the IPAT hypothesis relates population growth to CO2 emissions. On the other hand, the growth in the human population and the resulting increase in CO2 emissions are proven to have a complex relationship [38]. The IPAT hypothesis is supported by the following findings. Population growth and other factors decrease environmental quality all over the world [39]. The population growth in India and Brazil, in contrast to the claims of, has a significant impact on CO2 emissions, although the effect in China and Indonesia is insignificant, as shown by a panel data set analysis of these nations [40,41]. CO2 emissions rise as the population grows; however, this association is not clear-cut. Many socio-political variables were employed to test the IPAT hypothesis in the Asian region studied in this study [42,43].

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*H3. The rapid increase in population growth is significantly associate with the increasing CO2 emissions.*

Keeping the environment in consideration, energy conservation is a controversial subject. Energy consumption and environmental quality are studied in the following research studies [44–46]. When it comes to carbon emissions, both the usage of energy consumption and environmental quality in the Middle East and North Africa (MENA) region contributes to the problem [47–49]. According to the findings of some studies, both renewable and non-energy sources contribute to CO2 emissions. According to their findings, there was an especially strong correlation between CO2 emissions and energy use in Asian countries. As a result, CO2 emissions will increase if we raise our energy consumption. However, from the perspective of Asia, it is critical to examine energy consumption in terms of environmental quality and social and political factors [33]. Energy conservation is a widely debated issue when it comes to protecting our planet's resources. These studies examine how much energy is consumed and whether or not we should convert to more environmentally friendly forms of energy production. Nonrenewable and renewable energy use in the Middle East and North Africa (MENA) region adds to increased CO2 emissions [49]. As a result of their energy use, EU countries have been found. CO2 emissions are caused by both renewable and nonrenewable energy sources. Earlier studies on CO2 emissions and energy use were shown to be particularly closely linked in Asian countries. As a result, as we increase our use of energy, CO2 emissions will rise. The environmental quality and social/political aspects of energy use are crucially significant to Asians [50–52].

*H4. Higher energy consumption deteriorates increase CO2 emissions in Asia.*

Only a few empirical research have been conducted on the impact of ethnic conflict on environmental quality in Asia-Pacific countries. There has not been enough research on the significance of ethnic strife, for example. In the literature, the impact of ethnic conflicts on public goods like better environmental quality is uncertain. Public policy is negatively impacted by ethnic conflict because it undermines the political and legal system, according to certain studies [53,54]. While ethnic leaders can utilize the political and legal system to their advantage at the expense of other parties, political-ethnic conflicts are often a prominent element of the division in political society. Ethnic tensions, according to sociopolitical theory, impact the ability of political leaders to reason and reach agreements on a variety of issues. increasing the number of people participating in talks and debates decreases the likelihood of attaining policy consensus. Ethnic fractionalization has been linked to government instability, with a high level of political instability directly linked to ethnic fractionalization [55]. Ethnic conflicts appear to have little impact on public policy impacting air and water quality, according to research. It may not make sense to focus on political activities while ignoring the local difficulties of those people unless there is a large geographic concentration of people, such as India, and ethnic fragmentation. In geographically diverse countries, such groups have a limited impact on public policy.

*H5. The political institutions' quality deteriorates the CO2 emissions in Asia.*

*H6. The ethnic polarization increases CO2 emissions in Asia.*

In conclusion from literature, Energy use, energy production, and per capita income in Asia as a whole all support the environmental hypothesis from earlier empirical studies. Prior research on Asia also only looked at a small number of characteristics that could be systematically accounted for. A simple EKC equation and other control variables like energy consumption, urbanization, and openness to trade are used in these studies; however, social and cultural issues are ignored. This study can be used in a variety of ways as an empirical study. Even though the EKC theory has been thoroughly tested, there is still an unknown territory in the field of study. Earlier research in Asian countries tended to focus on air pollution, energy consumption, and trade liberalization. While previous studies have focused on ethnic conflict, this one includes the EKC model in its analysis, which is a departure from previous research. FDI inflows and institutional factors have been used to test the Pollution Haven Hypothesis (PHH) in Asian countries. The PHH hypothesis cannot be tested empirically in Asia due to a lack of data on FDI inflows, institutional

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and ethnic characteristics. This study contributes to the EKC model by incorporating energy consumption in the EKC model with institutional and ethnic culture to support energy consumption generated CO2 emissions in Asia, whereas the previous research included energy consumption and energy demand components [56]. Finally, Asian countries are home to a wide range of cultures. There is a wide range of ethnic groups in Asia. CO2 emissions and ethnic culture have been examined in some Asian countries in recent years. Fourth, the EKC model in Asian countries will be examined in terms of demographic, political, and ethnic aspects. That is why the IPAT theory, along with other political and ethnic dimensions, is validated by this study.

## 3. Materials and Methods

### *3.1. Model and Data*

The present study used a different set of variables to identify the impact of institutional, energy consumption, ethnic factors on environmental quality in the panel of selected Asian Countries. A stratified random sampling technique is used in the selection of Asian Countries from the World Bank data set. The panel of 40 Asian countries are selected randomly for the time of 1993–2019. The present study used per capita growth factors after considering per capita CO2 emission for environmental quality, FDI inflows, GDP per Capita, Population growth. For institutional factors, the present study used regulatory quality, political stability, and rules of laws, however, ethnic conflict for ethnic factors. The present study used ethnic Power Relations, politically relevant ethnic groups. The variable description is provided in Table 1.

**Table 1.** Variables Description.

| Variable | Abbreviation | Description | Data Source | References |
|---|---|---|---|---|
| Environment Quality | CO2 | Log of per capita carbon emission | WDI | [56] |
| Economic Condition | GDP | Log of per capita Gross Domestic Product | WDI | [34,35] |
| Foreign Direct Investment | FDI | Log of foreign Direct investment net inflows | WDI | [34,35] |
| Population Growth | POPG | Log of population growth | WDI | [42,43] |
| Energy Consumption | EC | Log per capita energy consumption | WDI | [47,48] |
| Political Risk Index | POL | An index comprising regulatory quality, political stability, and rules of laws | WDI | [56] |
| Regulatory Quality | RQ | Regulatory Quality Index | WDI | [56] |
| Rules of Law | LO | Law and Order Index | WDI | [53,54] |
| Ethnic Power Relation | EPR | Measured with politically relevant ethnic groups | WDI | [36,37] |

Note: Log of per capita carbon emission ($CO_2$), Log per capita energy consumption (EC), Ethnic powers Relations (EPR ), Regulatory quality Institutions (RQ), Law and order (LO), Log of per capita Gross Domestic Product (GDP), Log of population growth (POPG), Log of foreign Direct investment net inflows (FDI), Political risk index (POL).

For dependent variables, CO2 emissions per capita are used. The data of all indicators are taken from the World Development Indicators (WDI) data source. The GDP per capita and CO2 emissions per capita relationship are positive initially and as economic performance rise, a negative relationship is observed in GDP square. It supports the EKC hypothesis. The positive relationship between FDI inflows and CO2 emissions supports the PPH hypothesis. In the same line of action, massive population growth impacts CO2 emission. This is for the IPAT hypothesis. The increase in energy consumption induced CO2

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emissions. The institutional factors' impact is checked on CO2 emission. The ethnic conflict impact is checked on CO2 emission.

The empirical model specification is designed heroically based on the sequence of the hypothesis tested in the present study. In below mention equation (1), EQ represents CO2 emission per capita, GDP is for GDP per capita (constant 2010 US$), GDP2 is the square of GDP per capita (constant 2010 US$). The equation (1) indicated is used to test the EKC hypothesis, as expected $^{\alpha}> 0$, $^{\alpha} < 0$ 1 that shows the inverted U-shaped relationship between CO2 emissions and GDP per capital.

$$EQ = \alpha_0 + \alpha_1 \ln GDP + \alpha_2 \ln GDP^2 + \varepsilon\, it \quad (1)$$

We further extend equation (1) to test the hypothesis after the addition of FDI net inflows. Thus, the equation (2) is given such as

$$EQ = \alpha_0 + \alpha_1 \ln GDP + \alpha_2 \ln GDP^2\, it + \alpha_3 \ln FDI + \varepsilon\, it \quad (2)$$

The equation (3) as mentioned included the annual percentage of population growth to test the IPAT hypothesis, having some additional variables from FDI inflows and GDP per capita and GDP per capita square. So, the present equation can be written such as

$$EQ = \alpha_0 + \alpha_1 \ln GDP + \alpha_2 \ln GDP^2\, it + \alpha_3 \ln FDI + \alpha_4 \ln POPG + \varepsilon\, it \quad (3)$$

The equation 4 include EC for energy use to test the energy-induced CO2 emission hypothesis. However, equation 4 also includes POPG as an annual percentage of population growth to test the IPAT hypothesis along with some additional variables FDI inflows and GDP per capita, and GDP per capita square. Equation 4 can be specified such as:

$$EQ = \alpha_0 + \alpha_1 \ln GDP + \alpha_2 \ln GDP^2\, it + \alpha_3 \ln FDI + \alpha_4 \ln POPG + \alpha_5 \ln EC + \varepsilon\, it \quad (4)$$

Equation 5 include INSQ, where INSQ is for political institutional quality to test institutions quality.

$$EQ = \alpha_0 + \alpha_1 \ln GDP + \alpha_2 \ln GDP^2\, it + \alpha_3 \ln FDI + \alpha_4 \ln POPG + \alpha_5 \ln EC + \alpha_6 \ln INSQ + \varepsilon\, it \quad (5)$$

Finally, EPR is for ethnic power relation added in equation (5) to test EPR induced CO2 emission in Asian Countries. Thus, the final form of the panel model for Asia is specified such as after heroical inclusion of a different variable in the baseline EKC model. Equation 6 is given such for empirical estimation.

$$EQ = \alpha_0 + \alpha_1 \ln GDP + \alpha_2 \ln GDP^2\, it + \alpha_3 \ln FDI + \alpha_4 \ln POPG + \alpha_5 \ln EC + \alpha_6 \ln INSQ + \alpha_7 \ln EPR\, t + \varepsilon\, it \quad (6)$$

*3.2. Method*

Our panel data set are likely to have some peaks in statistical distribution, whereas the least square method provides biased results. It is related to the heteroskedasticity issue. There are numerous approaches to estimate dynamic panel models to deal with heteroskedasticity difficulties. It is usually regarded that quantile regression methodology is the most preferred method which divides the conditional distribution of dependent variables into disaggregated quantiles portions. Following recent studies support on panel quantile approach to attain a precision of parameters in case of no normal distribution [57,58]. This method is most appropriate in our case because our data keeps heterogeneity and outliers' issues as discussed in the literature [59]. Panel quintile analysis is based on the latest environmental science. In addition, we use panel quantile regression to evaluate for interregional variation. At different quantile levels, we also estimate different influencing factors on CO2 emission.

## 4. Results

Descriptive detail can be obtained from Table 2. There is a lot of room for improvement when it comes to carbon emissions (CO2) in our sample of Asian economies having a mean value of 4.23 and a standard deviation of 103.1. As a result, a strategy aimed at mitigating carbon emission concerns and conserving natural resources is urgently needed in these countries. There is a lot of ethnic fragmentation in the developing world since the

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ethnic power relation (EPR) has a mean value of 0.16. Ethnicity and fragmentation in Asian countries tend to be overlooked, thus this is not surprising. Economic conditions in the Asian world are essential, yet they have been given little attention to the environment because of their low average GDP of 0.057 standard deviations of 0.04. Asia has a significant amount of money that can be allocated toward mitigating the effects of climate change. The law and order situation (LO) with the mean value is 0.56 and the standard deviation is 0.17. Regulatory Quality (RQ), the mean value is 0.49 and the standard deviation is 0.64, which indicates that the political environment in these countries is an essential factor for the environment. As a result, the economies of these countries are heavily influenced by institutional issues. Population growth (POPG) has a standard deviation of 0.16 and a mean value of 0.46. Finally, FDI has a mean value of 0.31 and a standard deviation of 1.06 for foreign direct investment.

**Table 2.** Summary Statistics.

| Variable | Observations | Mean | Median | Q1 | Q3 | Maximum | Minimum | Standard deviation |
|---|---|---|---|---|---|---|---|---|
| CO2 | 1,044 | 4.23017 | 4.3698 | 1.5778 | 4.789 | 6.3873 | 0.1496 | 108.88 |
| GDP | 1,126 | 0.0569 | 0.0318 | 0.2249 | 0.6640 | 0.8823 | 0.001 | 0.075 |
| FDI | 1,101 | 0.3134 | 0.2969 | -0.0135 | 1.930 | 2.7722 | -0.974 | 0.2261 |
| POPG | 1,184 | 0.4663 | 0.4339 | 0.2156 | 0.8824 | 1.0167 | 0.0697 | 0.1696 |
| EC | 963 | -0.491 | -0.383 | -0.9933 | 0.6734 | 0.9421 | -1.999 | 0.6418 |
| POL | 623 | 0.5679 | 0.576 | 0.3245 | 0.6358 | 0.792 | 0.1650 | 0.1701 |
| RQ | 609 | -0.491 | -0.383 | -0.9963 | 0.4563 | 0.9260 | -1.6043 | 0.6418 |
| LO | 609 | 0.2979 | 0.276 | 0.2014 | 0.3806 | 0.4592 | 0.165 | 0.1701 |
| EPR | 1,187 | 0.1654 | 0.1532 | 0.0935 | 0.8340 | 0.9765 | 0.0108 | 0.0749 |

Note: Log of per capita carbon emission ($CO_2$), Log per capita energy consumption (EC), Ethnic powers Relations (EPR), Regulatory quality Institutions (RQ), Law and order (LO), Log of per capita Gross Domestic Product (GDP), Log of population growth (POPG), Log of foreign Direct investment net inflows (FDI), Political risk index (POL).

There is a pairwise Pearson correlation matrix of the variables in Table 3. Multicollinearity is not a major issue in our panel regression analysis because of the low correlations between the independent variables.

**Table 3.** Correlation Matrix.

| S.No | CO2 | GDP | FDI | POPG | EC | POL | RQ | LO | EPR |
|---|---|---|---|---|---|---|---|---|---|
| **CO2** | 1 | | | | | | | | |
| **GDP** | 0.5973*** | 1 | | | | | | | |
| **FDI** | -0.0128 | 0.0347 | 1 | | | | | | |
| **POPG** | 0.5515*** | 0.5349*** | 0.0144 | 1 | | | | | |
| **EC** | 0.5556*** | 0.5951*** | -0.0084 | 0.5416*** | 1 | | | | |
| **POL** | 0.2181* | 0.2710** | 0.1447* | 0.1344* | 0.1874* | 1 | | | |
| **RQ** | -0.2158** | 0.5670*** | 0.0908 | 0.2859** | 0.3978** | 0.2491* | 1 | | |
| **LO** | 0.4275** | 0.5248*** | 0.1309* | 0.1835* | 0.4643** | 0.4066** | 0.3698** | 1 | |
| **EPR** | 0.3622** | 0.2161** | -0.1527* | 0.4467** | 0.3825** | 0.0058 | 0.0748 | 0.0902 | 1 |

Note: Log of per capita carbon emission ($CO_2$), Log per capita energy consumption (EC), Ethnic powers Relations (EPR), Regulatory quality Institutions (RQ), Law and order (LO), Log of per capita Gross Domestic Product (GDP), Log of population growth (POPG), Log of foreign Direct investment net inflows (FDI), political risk index (POL).

Because of the non-normal distribution of the variables, the least-squares approach may lead to inaccurate conclusions. Panel quantile regression is the best way to analyze the data. We must do a normal distribution test on the data before running the panel quantile regression model for Asia connected to the environmental quality, FDI inflows, GDP per capita, and population growth of the region. Shapiro-Wilk and Shapiro-Francia

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test results are shown in Table 4. This heterogeneity affects the statistical distribution of the variables in different regions. We can study the distribution of observation values in Asian countries because we have a complete sample. To test the null hypothesis in both Shapiro-Wilk and Shapiro-Francia tests, it is necessary to assume normal distributions for the data. Model variables do not follow a normal distribution, as can be shown by the small p-values.

**Table 4.** Normal Distribution Test.

| Variable | Shapiro-Wilk test | Shapiro-Francia test |
|---|---|---|
| CO2 | 0.971*** | 0.980*** |
| GDP | 0.717*** | 0.715*** |
| FDI | 0.730*** | 0.732*** |
| POPG | 0.955*** | 0.954*** |
| EC | 0.667*** | 0.666*** |
| POL | 0.991*** | 0.992*** |
| RQ | 0.961*** | 0.961*** |
| LO | 0.395*** | 0.390*** |
| EPR | 0.901*** | 0.91*** |

Note: Log of per capita carbon emission ($CO_2$), Log per capita energy consumption (EC), Ethnic powers Relations (EPR), Regulatory quality Institutions (RQ), Law and order (LO), Log of per capita Gross Domestic Product (GDP), Log of population growth (POPG), Log of foreign Direct investment net inflows (FDI), political risk index (POL).

Per capita, CO2 emissions have a substantial and negative coefficient value in the Pooled OLS estimation for Asia. However, in the 25th and 75th quantiles, the lagged per capita CO2 emissions coefficients are large and negative. It shows that in a sample of Asian countries, per capita CO2 emissions supported the EKC hypothesis. The environmental quality begins to improve while CO2 emissions decline significantly as Asian countries mature over time in the context of economic development. Initially, when Asian economies attain the degree of economic development, CO2 emissions begin to rise. Economies in Asia have a primitive technical framework and use manual technology in many industries, which is the economic rationale for this However, these economies have serious challenges in terms of economic growth and prosperity. As a result, unless a certain level of economic growth is achieved, it will be impossible for Asian economies to finance environmentally friendly advanced technology. Asia is heavily reliant on archaic technology. Secondly, changes in the coefficients of economic growth at the 50th quantile imply that economic development effectiveness is greater at this quantile level. As a result, Asians in the 50th percentile are more likely to be concerned about environmental and economic issues. Asian countries' policymakers will benefit from our findings that support the EKC concept. Environmental quality is a primary emphasis of Asia's sustainable policies to get the most out of economic growth at various stages of development. Several subsequent investigations, however, support our findings [5,7,60].

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**Table 5.** Analysis for Environment Quality In Asia.

| Variable | Pooled OLS | 25th (Q1) | 50th (Q2) | 75th (Q3) |
|---|---|---|---|---|
| LGDP | 0.0102* | 0.0003 | 0.0005 | -.0020 |
| | (.0014) | (.002) | (.001) | (.0020) |
| LGDP2 | -0.198*** | -0.2210*** | -0.204*** | -0.124*** |
| | (0.0203) | (0.0207) | (0.0145) | (0.0202) |
| LFDI | -0.0030 | 0.0010 | -0.0040* | -0.0080** |
| | (.003) | (.004) | (.002) | (.003) |
| POPG | 0.0100* | 0.0020* | -0.0020 | 0.0010 |
| | (.003) | (.0030) | (.0020) | (.003) |
| EC | 0.0360 | 0.1540*** | 0.0170 | 0.0900** |
| | (.037) | (.0430) | (.0260) | (.036) |
| POL | 0.0306 | 0.0103 | 0.0253*** | 0.0347*** |
| | (.00707) | (.00909) | (.0055) | (.0080) |
| RQ | -0.0723** | -0.0161 | -.0416** | -0.0676** |
| | (.0252) | (.0294) | (.0175) | (.02326) |
| LO | 0.0070 | 0.0107 | -0.0024** | -0.0081 |
| | (.0065) | (.0076) | (.0045) | (.00601) |
| EPR | 0.0346 | 0.0131 | 0.0283*** | 0.0357*** |
| | (.0075) | (.0093) | (.0059) | (.00856) |
| Constant | 0.0936 | -0.1205 | 0.1357 | 0.3920 |
| | (.28451) | (.33273) | (.1979) | (.2629) |
| Country Fixed Effect | Yes | Yes | Yes | Yes |
| Year Fixed Effect | Yes | Yes | Yes | Yes |
| $R^2$/ Pseudo $R^2$ | 0.0290 | 0.012 | 0.012 | 0.042 |
| Obs. | 1,044 | 1,126 | 1,101 | 1,184 |

Note: Log of per capita carbon emission ($CO_2$), Log per capita energy consumption (EC), Ethnic powers Relations (EPR ), Regulatory quality Institutions (RQ), Law and order (LO), Log of per capita Gross Domestic Product (GDP), Log of population growth (POPG), Log of foreign Direct investment net inflows (FDI), Political risk index (POL).

Pooled OLS estimates demonstrate that FDI has substantial and negative values at the 50 percentile and 75 percentiles in Asia as shown in Table 5. CO2 emissions are shown to be a result of FDI inflows from Asian countries. FDI inflows have a strong beneficial influence on CO2 emissions in Asian countries, confirming the Pollution halo hypothesis. FDI inflows are part of green policies in Asian countries, which aids in the promotion of cleaner technology. Most FDI inflows to Asia are in the manufacturing and industrial sectors, hence this is a major contributing factor. While these investments are good for the environment, they have the unintended consequence of raising CO2 emissions in Asian countries. To keep Asia clean, policymakers in Asian countries should prioritize greener FDI inflows from the industrialized world. a foreign company's investment conduct in the host country is important. Investors from outside the Asian world often have an eye out for ways to minimize costs. The real options theory explains why foreign investors are so concerned about the host country's many types of risk and uncertainty [61]. Investors from outside the country are also influenced by the relative affordability of risky technologies in these countries. As a result of this, the investment in sustainable technologies that are affordable in Asian nations has become a new paradigm of investor attraction. Our findings show that identifying the relevant components of FDI is essential if we are to fully comprehend the Pollution halo hypothesis in Asian nations. Studies that support our findings are listed [62].

In Asia, Pooled OLS estimation shows that, per capita, energy consumption has a significant and negative coefficient value. per capita, energy consumption coefficients in the 25th and 75th percentiles are positively connected. Table 5 shows how Asian countries' energy usage contributes to CO2 emissions. The economic rationale for this is that coal

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and other fossil fuels account for the majority of Asian countries' electricity usage. Since it does not benefit the environment, it does not fight for better environmental quality. Electric generation businesses in Asia, in addition, only consider economic profitability when deciding on expansion. Fossil fuels, primary oil, are used by the majority of power plants in Asia's economies. Because of the high cost of fossil fuels and other expenses, these countries' economies are also struggling financially [51,63,64].

In most Asian firms, coal is used as a raw resource and consequently has no regard for environmental requirements. Energy consumption has a direct effect on fossil fuel and coal utilization because of this, which limits the advancement of environmental standards. Expanded industry, modernized agriculture, expanded commerce, and improved transportation has led to an increase in energy consumption in these countries. Another reason why energy imports are increasing is the absence of investment in the country's natural gas and resources. the use of energy in some Asian countries contributes to the emission of CO2. Most Asian economies, including Pakistan, India, China, and so on, have a pressing need to modernize their energy systems. Coal-fired power facilities can no longer be built by these governments due to environmental concerns. For a variety of reasons, it is proposed that the publicly owned oil and gas firms be privatized. State-owned utilities and independent power producers (IPPs) are both ramping up production to meet rising demand. However, the rise in energy consumption has made environmental quality a problem. Asia's thermal energy mix, which comprises imported coal, indigenous coal, RLNG, and natural gas, has been dropping over the past few years. Due to low natural gas reserves and the introduction of LNG for improved environmental quality, Asian countries' total dependence on natural gas in the overall energy mix is decreasing. The percentage of renewable energy in the overall energy mix must continuously rise over time. Hydel and nuclear energy must also be increased in the energy mix by the government. The following list of studies is in favour of our results arguments [51,64].

POPG increases CO2 emissions in Asian countries, confirming the IPAT hypothesis that a rise in the IPAT population generated emissions of carbon dioxide. It is a matter of economics: China and India, the world's most populous countries, are putting a lot of pressure on their cities and the natural environment. There are also economic reasons for this, such as the relatively high level of real estate investment in certain Asian countries, which leads to high levels of environmental pressure due to the conversion of wood and agricultural land into cities and residential colonies, among other things. To reduce CO2 emissions, it is necessary to solve these problems caused by Asia's rapid population expansion. In underdeveloped countries, population increase has a negative impact on sustainable development. More people in Asian countries use more natural resources, which causes unsustainable consumption habits. This is supported by the findings [51,63]. Natural resources are also undervalued in many countries because of a lack of education among the general public regarding their importance. It is a fundamental factor in these countries that population pressures and reliance on basic natural resources are disrupting sustainable agenda achievements. The population affluence technology (IPAT) theory, or population-based deterioration, is supported by this study's findings. Our IPAT hypothesis is supported by the results of current research [65].

CO2 emissions in Asian countries are affected in a variety of ways by the results of studies on institutional quality. CO2 emissions in Asian countries rose as a result of better regulations. Asian countries appear to be the most affected by this. Regulatory attributes important to CO2 emission control policies may have shortcomings. Because the legal and judicial systems in some Asian countries, particularly those in the South Asian region, are so poor, it is impossible to see the proper consequences of environmentally friendly laws. The regulatory framework in these countries does not prioritize clean technology, which is critical for reducing GHG emissions, as another political argument. This argument's proponents in Asia point to several types of research. However, the results show that regulatory quality and laws and order enhance the environmental quality in selected Asian countries by reducing CO2 emissions. In Asian countries, regulatory quality and laws and order are highly responsive to environmental quality, and this is supported by economic

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rationale. Environmental regulations have been implemented in several Asian countries like China, Korea, Malaysia, Indonesia, and so on, while regulatory quality and laws and order improvements in Asian countries have a direct positive impact on environmental quality. It appears that the arguments and results are supported by the following studies [27,51].

According to the findings of the current study, ethnic conflicts are examined from the perspective of ethnic political diversity in Asian countries. Ethnic wars in Asia, as measured by CO2 emissions, appear to have a meaningful correlation. Conflicts between distinct ethnic groups affected long-term viability, according to earlier research. Justification for these claims can be found in the literature [66]. Ethnic political conflict has little effect on the provision of public goods like environmental quality improvements because of the authoritarian system in these countries. Many of the Asian nations included in our sample, such as India and Pakistan in South Asia, are similar in many ways. Even in so-called democracies, these economies remained under the control of authoritarian administrations. However, Asian countries such as China, India, and the like exhibit a great degree of ethnic variety. The economic reason is that despite issues, the significant level of ethnic fragmentation in Asian countries causes ethnic groups to narrow their focus to national issues, for example, the environment. Ethnic fragmentation in selected Asian economies has a major impact on CO2 emissions, according to the results of this study. It is observed that in Asia there is a lack of conflicts that arise from ethnic fractionalization including coups, interethnic unrest, civil and hybrid wars, and external military conflicts is relatively high in Asian economies. Conflict-torn states are more likely to have a low level of environmental quality, a lack of investment, and a loss of control over the use of violence. Due to these factors, environmental quality control improvement become tough for these Asian economies.

## 5. Conclusions

Environment quality is the primary target of United Nations millennium development goals. Environment quality issue is a central concern. However, all economic and environmental approaches require some new concern for their practical application inform of socioeconomic factors belonging to Asian regions to be evaluated. It is more crucial to take ethnic fragmentation factors in more explicit ways while discussing regional global targets. This study contributes to the frontier of knowledge and the gaps in the existing literature through a deeper exploration of linkages of socio-economic factors relevant to governance and regulation and ethnic factor which are relevant to the cultural diversity of Asian economies. The main focus of this study remains the role of different ethnic, cultural, and governance factors for environment quality based on economic sustainability inform of adjusted net savings, environmental quality informs CO2 emission.

This study mainly focuses on the following major objectives relevant to Asia; firstly, it evaluates the quantitatively distinctive contribution of different Socio-economic indicators for environment three major dimensions ethnic and cultural dimensions. Secondly, governance and institutions dimension based on regulatory quality and law enforcement for environmental pollutants. Thirdly, economic variables dimensions include FDI and population. Regulatory institutions and laws matter for the environment for Asian regions. Regulatory performance is better for sustainable economic development in the Asian region relative to another region. Government stability and rules of law are the most significant factors in Asia where it generates the greatest impact on the environment. An improvement in regulatory performance, a field of public administration can play a significant role in the process of natural resource improvement. Thus, all governance and administrative policies should narrow focus such programs which are critically relevant to regulations and enforcement of laws.

The following policy recommendations are based on the findings of this research. For the sake of the environment, government and law enforcement must be given top priority. To achieve this goal, the regulatory framework must be rethought in spatial and Asian contexts. In this context, Asia lacks an effective enforcement mechanism for

environmental improvement. This region's environmental policymakers are urgently in need of comprehensive solutions to improve the effectiveness of their policies. However, in the Asian region, environmental fees and various forms of punishment may be an option. Better environmental quality and the formation of effective governance institutions are said to be hampered by ethnic fractionalization. Inter-ethnic hostilities frequently lead to a strategy of limiting competition to other groups. Policy-making institutions, on the other hand, often lead to conflicts between ethnic divisions and environmental betterment. To improve ethnic fractalization efficiency in the context of the environment, it is necessary to construct such a smart policy combination.

But in Asia, an energy mix strategy, as well as foreign investment policies, as well as liberalization policies, are essential for the environment. However, population control criteria are not only beneficial to the economy, but they also improve the environment in these locations, which is a double advantage. Our research is constrained by the fact that it takes into account both environmental and socioeconomic elements, but it may potentially be expanded to include data from several countries. Multidimensional data, including cultural, religious, and regional variability, could be used to extend the analysis. The second benefit of our work is that it opens up new avenues for exploring and testing the socio-cultural index's notions and constructions. Further empirical testing of alternative hypotheses might also be done using the model.

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