How Inflation and Carbon Emissions Influence Renewable Energy in Indonesia: Evidence from VECM

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Abstract

The purpose of this investigation was to examine how rising prices and carbon emissions affect the spread of renewable energy sources in Indonesia. The range of 1997-2020 was derived using data collected from the World Bank. Inflation, carbon emissions, and renewable energy sources are the independent variables put through the VECM's paces. Based on the findings of this research, it can be concluded that higher rates of inflation in the past have contributed to a rise in Indonesia's carbon emissions. But a positive connection and link between REN and INF exists, and it's a fascinating one to consider. Carbon emissions and renewable energy, on the other hand, cancel each other out. When emissions of carbon dioxide rise, renewable energy sources suffer, and vice versa. There needs to be a greater push from policymakers to rein in inflation. Carbon emissions can be mitigated by the implementation of renewable energy sources.

Keyword : Inflasi, CO2 Emissions, and Renewable Energy
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Background

Generally speaking, inflation is a rise in prices across the board for consumer goods and services. The yearly percentage change in the consumer price index (CPI), which measures changes in the average cost of goods and services purchased by consumers, is used to quantify this phenomenon. The buying power of money, the real worth of salaries, corporate profitability, and the balance of trade between countries are all impacted by inflation. There are several potential triggers for inflation, including supply shocks, demand pull, cost push, monetary expansion, fiscal imbalance, depreciation of the currency rate, and so on. The government should utilise fiscal and monetary measures to moderate aggregate demand and stabilise production and employment if they are concerned about inflation, which can occur when demand is higher than supply (Widarni, Irawan, Harnani, Rusminingsih, & Alim, 2022; Prabowo, Sasongko, & Damayanti, 2022).

The growing cost of energy is a potential contributor to inflation since it has an impact on economic activity (including the production and consumption of goods and services). Energy is a crucial resource for several industries and consumer spheres. This means that shifts in energy prices or availability can have far-reaching effects on the economy as a whole and on inflation rates. Policymakers, corporations, consumers, and society as a whole all have vested interests in the outcomes of economic concerns like inflation and renewable energy. There is no static, one-to-one correlation between inflation and renewable energy. Therefore, additional study is required to comprehend the intricate relationships between inflation and renewable energy under various scenarios. Carbon returns are linearly affected by inflation, albeit the direction of this effect can change. China's carbon market and environmental quality are both significantly impacted by the country's high inflation rate. Carbon returns in Beijing are positively correlated with inflation, indicating that as inflation rises, carbon prices rise and

emissions fall. Specifically, rising inflation results in lower carbon pricing and higher emissions in the cities of Shenzhen and Guangdong (Xu, Li, Xuan, & Zhang, 2023).

Increased economic activity results in greater pollution because it drives up demand for both energy and transportation, both of which are fueled by carbon emissions. Since inflation is a major factor affecting environmental quality in Asia, regional disparities and the nonlinear impacts of inflation should be taken into account by policymakers when formulating climate policies (Ahmad, Ullah, Ozturk, & Majeed, 2021). while inflation slows, the price of building rises even while the price of raw materials falls. Users may be swayed by the partnership's seeming benefits, but it really creates a serious problem with CO2 emissions. The effect has a detrimental impact on environmental sustainability as a result of the carbon dioxide (CO2) emissions it creates, making it incompatible with the greenhouse effect. A search for a tool to estimate the CO2 emissions produced by the monetary worth of Malaysia's construction projects revealed that none existed. In light of this, we design the basic components of a carbon dioxide emission calculator that may assist both construction industry participants and policymakers (Musarat, Alaloul, Liew, Maqsoom, & Qureshi, 2021)

The greenhouse effect, or the trapping of heat in the Earth's atmosphere by specific gases, is mostly caused by human-caused CO2 emissions. Human activities that release carbon dioxide into the atmosphere include the combustion of fossil fuels, the clearing of forests, farming, and manufacturing. Emissions of carbon dioxide have serious consequences for the climate, the environment, and human health. Warming, flooding, acidification of the oceans, droughts, floods, heat waves, loss of biodiversity, hunger, disease, and armed conflict are all possible outcomes of excessive CO2 emissions. Because carbon pricing has such a negative effect on CO2 emissions, it leads to lower emissions as prices rise. Carbon pricing is the most effective and economical policy option for reducing CO2 emissions and avoiding inflationary pressure. Carbon pricing should be combined with measures like energy efficiency requirements and innovation subsidies to address market failures and distributional problems (Moessner, 2022). Increases in inflation exacerbate environmental degradation since it increases both long- and short-term carbon emissions. Since the growth of the financial sector has a permanent depressing effect on carbon emissions, better financial systems can help bring about a cut in these emissions. Financial progress may be crucial in mitigating the adverse environmental implications of economic growth, and inflation is a major role in determining carbon emissions in Asia (Rahman et.al, 2022).

Renewable energy is the energy that is derived from natural sources that are replenished constantly, such as solar, wind, hydro, biomass, geothermal, and ocean. Renewable energy has various advantages over fossil fuels, such as reducing greenhouse gas emissions, enhancing energy security, diversifying energy supply, creating jobs, and promoting rural development. Renewable energy also faces various challenges, such as high costs, intermittency, variability, storage, integration, and policy barriers. Renewable energy has several advantages over conventional fossil fuels, such as lower greenhouse gas emissions, greater energy security, and reduced dependence on foreign oil. However, renewable energy also faces some challenges, such as high initial costs, intermittency, variability, and integration issues with existing power grids. Therefore, the development and adoption of renewable energy depends on various factors, such as technological innovation, policy support, market incentives, and consumer preferences (Islam, Alharthi, Murad, 2021). In the long run, an increase in the usage of renewable energy causes an increase in the value of a country's currency. As a result, higher rates of exchange and inflation are associated with increased adoption of renewable energy sources over the long term. Promoting the usage of renewable energy sources is recommended since doing so may assist lower greenhouse gas emissions and boost the value of a country's

currency (Deka, Cavusoglu, & Dube, 2022). It is also recommended that the Mexican government adopt laws that encourage the use of renewable energy sources as a means of enhancing economic stability and decreasing environmental degradation. Increasing the usage of renewable energy can help strengthen the Mexican peso because of the negative and considerable influence it has on currency rates in the long term (Deka & Dube, 2021). This research intends to investigate how price increases affect carbon emissions and how this impacts the adoption of renewable energy sources.

Research Method

The purpose of this research is to verify and analyse inflation's effect on carbon emissions and to investigate its connection to renewable energy utilisation. Information from the World Bank was gathered for the time period 1997-2020. The Vector Error Correction Model (VECM) will be used to analyse inflation, carbon dioxide emissions, and renewable energy, with the equation model:

$$INFt = \beta0 + \beta1COEt1 + \beta2RENt2 + et$$
$$COEt = \beta0 + \beta1INFt1 + \beta2RENt2 + et$$
$$RENt = \beta0 + \beta1INFt1 + \beta2COEt2 + et$$

Information:
INF = Inflation
COE = CO2 Emissions
REN = Renewable Energy
β = Konstanta
e = Error term
t = Time Period

Result and Discussion

Data stationarity needs to be achieved in research. Stationary test via unit root test in table 1.

Table 1. Unit Root Test INF, COE, and REN.

Variable	Level		First Difference	
	Prob.	Description	Prob.	Description
INF	0.0090	Not Fulfil	0.0000	Fulfil
COE	0.7588	Not Fulfil	0.0004	Fulfil
REN	0.0258	Fulfil	0.0000	Fulfil

The unit root test results in table 1 indicate that there are no issues with data stationarity. The best latency test, shown in table 2, comes up next;

Table 2. Lag Optimum Test Result

Lag	LogL.	LR	FPE	AIC	SC	HQ
0	-231.4276	NA	997515.9	22.32644	22.47566	22.35882
1	-196.7593	56.12959*	87758.11*	19.88184*	20.47871*	20.01138*

As can be seen from Table 2, the best latency for this investigation was 1. The cointegration test in Table 3 can be used to determine if the VECM model can be used.

Table 3. Cointegration Test

Hypothesized	Eigenvalue	Trace Statistic	0,05 Critical Value	Probability
None *	0.726942	32.22396	29.79707	0.0258
At most 1	0.307678	7.560620	15.49471	0.5135
At most 2	0.029771	0.574243	3.841466	0.4486

According to the results of the cointegration test presented in Table 3, the VECM model may be implemented.

Table 4. VECM Test Result

	D(INF)	D(COE)	D(REN)
D(INF(-1))	-0.868961	0.005997	-208.6343
	(0.45453)	(0.00292)	(70.1719)
	[-1.91178]	[2.05336]	[-2.97319]
D(COE(-1))	-78.85598	0.245040	-13451.69
	(49.2934)	(0.31673)	(7610.09)
	[-1.59973]	[0.77366]	[-1.76761]
D(REN(-1))	0.001998	-1.93E-05	0.778663
	(0.00169)	(1.1E-05)	(0.26080)
	[1.18290]	[-1.77990]	[2.98562]
C	0.057297	-0.012134	0.084066
	(0.04564)	(0.00502)	(0.17050)
	[1.25528]	[-2.41728]	[0.49307]

The outcomes of the VECM tests are shown in table 4. D(INF(-1)) and D(COE) with a t-statistic of [2.05336] have a substantial effect, indicating that inflation in the past will have a sizeable positive influence on carbon emissions. Moreover, the t-statistic value [-2.97319] is significantly impacted negatively by D(INF(-1)) and D(REN), suggesting that inflation in the past will have a detrimental influence on the adoption of renewable energy sources. D(COE(-1)) and D(REN) exhibit a substantial inverse impact with a t-statistic value of [-1.76761], meaning that higher historical carbon emissions will lead to less reliance on renewable energy sources in the present and future. Both D(REN(-1)) and D(INF) significantly increase the t-statistic [1.18290]. The intended t-statistic is also negatively impacted by D(REN(-1)) and D(COE) (-1.77990).

Past price spikes have encouraged more carbon output in Indonesia. The adoption of renewable energy sources is inversely related to inflation. On the other hand, REN and INF have a fascinatingly strong positive association and relationship. Conversely, renewable energy and reduced carbon emissions have a mutually destructive effect. Increasing fossil fuel consumption will decrease renewable resources, and vice versa.

Table 6. Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Prob.
COE does not Granger Cause INF	23	0.06807	0.7968
INF does not Granger Cause COE		4.43758	0.0480
REN does not Granger Cause INF	21	1.60538	0.2213
INF does not Granger Cause REN		12.6168	0.0023

REN does not Granger Cause COE	21	3.16933	0.0919
COE does not Granger Cause REN		2.54555	0.1280

Table 6 is Granger causality which aims to see the causal relationship between research variables. INF and COE have a one-way causal relationship with a probability value of 0.0480. This means that inflation has an effect on carbon emissions, while carbon emissions have no effect on inflation. INF and REN have a one-way causal relationship with a probability value of 0.0023. Thus, inflation affects renewable energy while renewable energy does not affect inflation.

Conclusion

Inflationary pressures of the past will lead to more fossil fuel use in Indonesia. Nonetheless, REN and INF have a fascinatingly strong positive correlation and association. However, renewable energy and reduced carbon emissions cancel each other out. Renewable energy capacity will decrease as carbon emissions rise and vice versa. Increased attempts to curb inflation through policy and other means should be a top priority for policymakers. To further mitigate the effects of carbon emissions, the implementation of renewable energy sources is essential.

References

Ahmad, W., Ullah, S., Ozturk, I., & Majeed, M. T. (2021). Does Inflation Instability Affect Environmental Pollution? Fresh Evidence from Asian Economies. *Energy & Environment, 32(7),* 1275-1291.

Deka, A., & Dube, S. (2021). Analyzing The Causal Relationship Between Exchange Rate, Renewable Energy and Inflation of Mexico (1990–2019) with ARDL Bounds Test Approach. *Renewable Energy Focus, 37*, 78-83.

Deka, A., Cavusoglu, B., & Dube, S. (2022). Does Renewable Energy Use Enhance Exchange Rate Appreciation and Stable Rate of Inflation*?*. *Environmental Science and Pollution Research*, 1-10.

Islam, M. M., Alharthi, M., & Murad, M. W. (2021). The Effects of Carbon Emissions, Rainfall, Temperature, Inflation, Population, and Unemployment on Economic Growth in Saudi Arabia: An ARDL Investigation. Plos one, 16(4), e0248743.

Moessner, R. (2022). Evidence on Climate Policy, Carbon Dioxide Emissions and Inflation. *International Journal of Global Warming, 28(2),* 136-151.

Musarat, M. A., Alaloul, W. S., Liew, M. S., Maqsoom, A., & Qureshi, A. H. (2021). The Effect of Inflation Rate on CO2 Emission: A Framework for Malaysian Construction Industry. *Sustainability, 13(3)*, 1562.

Prabowo, B. H., Sasongko, B., & Damayanti, L. (2022). Economic Challenges And The Potential Threat Of A Debt Trap In Asia: English. *Tamansiswa Accounting Journal International*, *5*(1), 53-63.

Rahman, S. U., Faisal, F., Sami, F., Ali, A., Chander, R., & Amin, M. Y. (2022). Investigating the Nexus Between Inflation, Financial Development, and Carbon Emission: Empirical Evidence from FARDL and Frequency Domain Approach. *Journal of the Knowledge Economy*, 1-27.

Widarni, E. L., Irawan, C. B., Harnani, S., Rusminingsih, D., & Alim, M. B. (2022). Human capital and internet literacy impact on economic growth in Indonesia. *Journal of Management, Economics, and Industrial Organization, 6 (3),* 101-112.

Xu, Y., Li, X., Yuan, P., & Zhang, Y. (2023). Trade-Off Between Environment and Economy: The Relationship Between Carbon and Inflation. *Frontiers in Environmental Science*, 11, 334.