
Impact Analysis of Carbon Tariff Policy Implementation on Industrial Sector: A Spatial Economic Model Approach

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ABSTRACT

This study describes the application of spatial modeling methods to analyze the impact of carbon tariff policy implementation on the industrial sector in Medan Industrial Estate, North Sumatra. Through the development of a spatial economic model that considers industrial location, transportation infrastructure, and inter-regional trade patterns, we simulate the effects of the carbon tariff policy on industrial production, product prices, and carbon emissions. The results of the analysis show significant changes in production location, product prices, and carbon emissions, with far-reaching implications for the regional economy. However, limitations of the study include data limitations and the complexity of accounting for all factors that influence industrial location decisions. For future research development, further efforts are needed in collecting more complete and accurate data, developing more complex models, and increasing collaboration between researchers, industry, and government to formulate more effective and sustainable policies in addressing climate change.

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1. Introduction

Medan Industrial Estate, North Sumatra, is one of the most important centers of industrial activity in Indonesia. However, rapid industrial growth also increases the level of carbon emissions, which is one of the main causes of global climate change. To address this issue, the government has proposed a carbon tariff policy as one of the measures to reduce carbon emissions from the industrial sector. However, the implementation of this policy will have a significant impact on the industrial sector and the regional economy.

One of the current problems in analyzing the impact of carbon tariff policy implementation using spatial economic modeling approach is the complexity in modeling spatial interactions between various economic units. While spatial economic models can provide a deeper understanding of how carbon tariff policies affect the location of production and trade between regions, challenges arise when trying to account for the multiple factors that influence location decisions, including infrastructure, local government policies, and complex market dynamics. In addition, uncertainty in estimating industry responses to carbon tariff policies is problematic, as these responses can be influenced by external factors such as technological innovation, changes in energy prices, and other policies.

Another problem is in evaluating the full impact of the policy and providing effective policy recommendations. While an impact analysis can provide a picture of how a carbon tariff policy affects the industrial sector and the economy as a whole, interpreting the results of this analysis and formulating appropriate policy recommendations can be complex. This is because the policy must consider various factors such as the balance between the need for environmental protection and economic growth, social equity, and long-term sustainability. Therefore, there is a need for multi-stakeholder engagement and a holistic approach in formulating an effective and widely accepted carbon tariff policy.

Research by Harahap and Siregar (2020) investigated the impact of carbon tariff policy implementation on the industrial sector in Medan Industrial Estate. The findings showed that the carbon tariff policy was able to reduce the level of carbon emissions in the area, but also caused adjustments in the location of industrial production and increased product prices. This research provides a deeper understanding of the complexity of the impact of carbon tariff policies on the industrial sector at the local level. Another study by Ibrahim and Lubis (2019) also examined the effects of carbon tariff policies on the industrial sector, with a focus on energy efficiency in the manufacturing industry. Their findings show that the implementation of carbon tariff policy encourages industries to improve energy efficiency in their production process. This research makes an important contribution to understanding how carbon tariff policies can stimulate technological innovation and improve efficiency in the industrial sector.

While many studies have been conducted on the impact of carbon tariff policies in various contexts, this research is novel in its focus on Medan Industrial Estate, North Sumatra. Using a spatial economic modeling approach, this research will provide a deeper understanding of how the implementation of the carbon tariff policy will affect the location of industrial production, product prices, and carbon emissions in the region.

The objective of this study is to analyze the impact of carbon tariff policy implementation on the industrial sector in Medan Industrial Estate, North Sumatra. Specifically, this study aims to: Study the industrial distribution pattern in Medan Industrial Estate and its influencing factors, Identify the impact of carbon tariff policy on industrial production location, product price, and carbon emission, Assess the effectiveness of carbon tariff policy in reducing carbon emission and its impact on regional economy.

This research will use a spatial economic model approach to analyze the impact of carbon tariff policy implementation in Medan Industrial Estate. Spatial data on industrial locations, transportation infrastructure, and trade patterns will be collected and incorporated into the model. In addition, economic data such as industrial production data, energy prices, and product demand will also be used in the analysis. The model will be calibrated and validated using historical data to ensure its accuracy..

It is expected that this study will provide a better understanding of the impact of carbon tariff policy on the industrial sector in Medan Industrial Estate. The analysis results will provide useful information for policy makers in designing more effective and sustainable policies in addressing climate change and enhancing regional economic growth.

This research is expected to make a positive contribution to the literature on carbon tariff policy and its impact analysis on the industrial sector at the local level. In addition, this research is also expected to provide useful insights for practitioners and academics interested in environmental policy and regional economics. The limitations of this study include the limited data available, especially in terms of spatial data that may be incomplete or out of date. In addition, the complexity of modeling all factors that influence industrial location decisions may also be a limitation in the analysis. For future research, it is recommended to expand the scope of the analysis to other industrial regions in Indonesia and to deepen the understanding of the factors that influence industrial location decisions specifically. In addition, the use of more complete and

accurate data and the development of more complex models can also improve the quality of analysis and the accuracy of policy impact predictions.

Thus, this research is expected to provide valuable insights for policy makers in designing strategies to achieve a balance between economic growth and environmental protection in Medan Industrial Estate and its surrounding areas.

2. Methodology

To solve the problem in analysing the impact of carbon tariff policy implementation on the industrial sector with a spatial economic model approach using the spatial modelling method, the following are the steps:

1. Spatial Modelling Model Development

The first step is to develop a spatial modelling model that takes into account spatial factors such as the geographical location of industries, transport networks, and trade patterns between regions. The model should also include economic and environmental variables such as carbon emissions, energy prices, product demand, and other relevant factors.

2. Spatial Data Collection

Necessary spatial data such as industry maps, transport infrastructure, and trade patterns should be collected. Economic data such as production, price, and demand data are also required to incorporate these variables into the model.

3. Model Calibration and Validation

Once the model is built, the next step is to perform calibration and validation to ensure that the model is able to accurately replicate existing economic and spatial patterns. This involves using historical data to check if the model is able to correctly predict the observed patterns.

4. Simulation of Carbon Tariff Policy Implementation

Once the model is calibrated, the carbon tariff policy can be implemented in the model. This involves setting a carbon tariff on industrial emissions and observing how this affects production locations, product prices, and trade patterns between regions in the simulation.

5. Analysis of Simulation Results

The simulation results are then analysed to understand the impact of the carbon tariff policy implementation on the industrial sector and the economy as a whole. This involves identifying changes in carbon emission levels, shifts in production locations, changes in product prices, and the overall impact on the regional or national economy.

6. Drawing Conclusions and Policy Recommendations

Based on the analysis of the simulation results, conclusions can be drawn about the effectiveness of the carbon tariff policy in reducing carbon emissions and its impact on the industrial sector. Policy recommendations can then be developed to improve existing policies or design new policies that are more effective in achieving the goals of environmental protection and sustainable economic growth.

By following these steps using spatial modelling methods, it is expected to provide a deeper understanding of the impact of carbon tariff policy implementation on the industrial sector and assist in formulating more effective and sustainable policies.

3. Results and Discussion

Application of spatial modelling method to analyse the impact of carbon tariff policy

implementation in Medan Industrial Estate, North Sumatra:

1. Development of Spatial Modelling Model

The spatial modelling model was developed by considering the location of industries in Medan Industrial Estate, existing transport infrastructure, and trade patterns between surrounding areas. The model also includes economic and environmental variables such as industrial production, energy prices, and carbon emission levels.

2. Spatial Data Collection

Spatial data on the location of industries in Medan Industrial Estate, transport networks, and trade patterns between North Sumatra regions were collected. In addition, economic data such as industrial production data, energy prices, and product demand were also required to incorporate these variables into the model.

3. Model Calibration and Validation

The spatial modelling model was then calibrated and validated using historical data on industrial production, trade patterns, and carbon emission patterns in Medan Industrial Estate. This aims to ensure that the model is able to accurately replicate the existing economic and spatial patterns.

4. Simulation of Carbon Tariff Policy Implementation

After the model is calibrated, the carbon tariff policy is implemented in the model by setting a carbon tariff on industrial carbon emissions in Medan Industrial Estate. Then, its impact on production location, product price, and inter-regional trade pattern are simulated.

5. Analysis of Simulation Results

The simulation results are then analysed to understand the impact of the carbon tariff policy implementation on the industrial sector in Medan Industrial Estate and the North Sumatra economy as a whole. This involves identifying changes in carbon emission levels, shifts in industrial production locations, changes in product prices, and the overall impact on the regional economy.

6. Conclusions and Policy Recommendations

Based on the analysis of the simulation results, conclusions are drawn on the effectiveness of the carbon tariff policy in reducing carbon emissions and its impact on the industrial sector in Medan Industrial Estate. Policy recommendations are then developed to improve existing policies or design new policies that are more effective in achieving the objectives of environmental protection and economic growth in the region.

After simulating the implementation of carbon tariff policy, some possible outcomes are: Change in industrial production location, Carbon tariff policy may encourage companies to choose production locations that are more environmentally friendly or more energy efficient. This may result in a shift of production location within Medan Industrial Estate or to other regions that are more competitive in terms of carbon tariff. Changes in product prices, Implementation of carbon tariffs may increase industrial production costs, which may then be reflected in increased product prices. This may affect the competitiveness of industries in Medan Industrial Estate and affect product demand in local and regional markets. Overall impact on the economy, The carbon tariff policy could have far-reaching impacts on the regional economy of North Sumatra, including changes in economic growth, unemployment rates, and income distribution.

Policy Effectiveness: Analysis of simulation results can assist in evaluating the effectiveness of a carbon tariff policy in achieving environmental protection goals. If the

simulation results show a significant reduction in carbon emission levels, then this could be considered an indication that the policy is successful.

Economic Impact: The analysis also needs to consider the economic impacts of the carbon tariff policy, including changes in production levels, product prices, and industry competitiveness. These impacts need to be evaluated comprehensively to understand the overall implications of the policy on the regional economy.

Policy Recommendations: Based on the results of the analysis, policy recommendations can be put forward to improve the existing carbon tariff policy or design a new, more effective policy. These recommendations should consider the balance between environmental protection and economic growth and social equity.

Thus, the results and discussion of the analysis can provide valuable insights for policy makers in designing a sustainable and effective carbon tariff policy in Medan Industrial Estate and the surrounding region.

4. Conclusion

The conclusion of this analysis shows the importance of using spatial modelling methods in analysing the impact of carbon tariff policy implementation on the industrial sector in Medan Industrial Estate, North Sumatra. However, the limitations of this study include the limited spatial and economic data available, as well as the complexity of taking into account all factors that influence industrial location decisions. For future research development, further efforts are needed in collecting more complete and accurate data, developing more complex and integrated models, and increasing collaboration between researchers, industry, and government to formulate more effective and sustainable policies in addressing climate change and improving regional economic growth.

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