

ENVIRONMENT COOPERATION BETWEEN OIL EXPORTING AND IMPORTING COUNTRIES FOR CLIMATE CHANGE

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Overview

Regulatory tools for climate change are being focused on demand side whether it would be carbon tax or carbon credit. Oil exporting countries claim that these tools would mitigate their revenues by reducing demand of oil and by transferring rents from oil producing countries to oil importing countries. Demand side tools are not completely effective considering the fact that the tools' impact on decision making of oil and gas exploration is indirect and limited.

The demand side regulation might increase oil production with a short-term view in case of low profitability of long-term oil industry due to dominant renewable energy in future energy market. It would increase security concerns on supply of oil by mitigating incentives to explore new oil and gas fields or enhanced oil recovery.

Therefore, it is important to study the impact of regulatory tools for climate change on incentives of oil exploration and production in oil exporting countries.

This paper employs a dynamic optimization and differential game model to analyze trajectory of exploration and production of oil by climate regulation. It also considers technology improvement in both oil industry and backstop renewable technology. The basic Hotelling rule has been modified to incorporate carbon regulation and technology improvement in oil industry to analyze incentives of oil exporting countries.

It is shown that under certain conditions, climate regulation of demand side would accelerate or advance production of oil, which results in increase of carbon emission. The conditions for preventing acceleration of oil production have been derived.

It is also shown that the speed of technology change both in oil industry and renewable energy industry (backstop technology) are critical for preventing advanced carbon emission considering cost competition of the industries. Declining price of backstop technology (renewable energy) is incorporated in the model. It is found that controlling relative speed of technology change is critical for security of long-term energy supply.

Therefore, technical cooperation in the field of oil production and refining is important to manage speed of technology innovation in parallel with development of renewable energy to secure long term energy supply.

The paper is organized as follows: After the introduction, the second section gives a brief overview about the climate regulation and oil exploration. The third section addresses the model of dynamic optimization for oil exploration and production. In section four, model analysis, simulation study and derived results are summarized. In the final section policy implications and future agenda will be addressed.

Methods

Dynamic optimization
Differential game theory
Simulation study

Results

First, it is shown that climate tools would accelerate or advance production of oil which results in increase of carbon emission under certain conditions and the conditions for preventing acceleration of oil production have been derived.

Second, it is shown that the speed of technology change both in oil industry and renewable energy industry (backstop technology) are critical for preventing advanced carbon emission. Declining backstop energy price of renewable energy is incorporated in the model and it is found that controlling relative speed of technology change is critical for security of long-term energy supply.

Third, it is shown that technical cooperations between oil exporting country and oil importing country in terms of oil industry and renewable energy industry is important to manage relative speed of technology innovation for long-term energy security.

Conclusions

Regulation of Green House Gas emission by carbon tax or carbon credit is primarily focused on demand side of oil and gas industry and did not fully considers incentives of supply side of the oil and gas industry. Under certain conditions, there might be accelerating GHG gas emission or increase of concerns on supply security of energy.

With dynamic optimization differential game model of oil exploration to analyze impact of climate regulation on oil and gas industry, it is critical to manage the relative speed of technology change in oil industry and renewable energy to secure energy supply in the transient era toward a low carbon economy.

For that purpose, it is important to enhance technical cooperation between oil exporting countries and oil importing countries to manage smooth transition of energy portfolio.

References

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