[*A COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS OF ENERGY TAX REFORM FOR CARBON MITIGATION IN JAPAN*]

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Overview

Climate change has become a matter of global importance, requiring the attention of the entire international community. The effectiveness of carbon pricing as a means of addressing climate change is becoming widely acknowledged, with many regions introducing carbon pricing mechanisms, such as emissions trading schemes and carbon taxes. As carbon pricing becomes more prevalent, it has become common practice to evaluate the intensity of climate change policies in a region by the level of the carbon price. The main indicator of this price is the price of allowances in emissions trading schemes and the tax rate in carbon taxes. These are referred to as "explicit carbon prices". However, it has been proposed that the level of carbon pricing should not be assessed solely on the basis of the explicit carbon price. This is because there are additional factors that play a role analogous to that of the carbon price, beyond the explicit carbon price itself.

Specifically, there are taxes imposed on fossil fuels, and these energy taxes have a similar effect to the explicit carbon price because they have the effect of increasing the taxed price of fossil fuels. In addition to the explicit carbon price, the carbon price that includes taxes on fossil fuels is called the effective carbon rate (OECD, 2023). Taxes on fossil fuels have been introduced in many regions, and some regions have high taxes on fossil fuels even though explicit carbon prices do not exist or are at very low levels. For example, according to OECD (2023), Japan has a very low explicit carbon price but a reasonably high effective carbon rate due to its high level of energy taxes.

As described above, not only the explicit carbon price but also taxation on energy is important when assessing the current state of climate change policies. Furthermore, energy taxation is also important in the planning of future climate change policies. This is because how to treat existing energy taxes will be an important policy option when introducing an explicit carbon price in the future.

In Japan, existing energy taxes have been introduced not for climate change mitigation but to finance specific policies. For example, the "Gasoline Tax," "Gas Oil Delivery Tax," and "LPG Tax" were introduced to finance road maintenance, the "Aviation Fuel Tax" to finance airport development, and the "Promotion of Power-Resources Development Tax" to finance measures for diversification of power sources. The "Petroleum and Coal Tax" was introduced to finance energy conservation measures and oil substitution measures.[1] As described above, existing energy taxes have been introduced for different purposes than climate change policies, and thus have very different tax rates per unit of CO_2 emissions. Applying different carbon tax rates to different emission sources leads to divergence in marginal abatement costs among emission sources, which is a source of inefficiency (Böhringer and Rutherford, 2012). Therefore, the existing energy taxes are an inefficient policy in terms of CO_2 reduction, and it is more efficient to apply the same tax rate per unit of CO_2 to all energy sources in terms of CO_2 reduction.

Methods

This study analyzes the effects of tax reform in Japan by replacing the existing energy taxes with a carbon tax through simulations based on a computable general equilibrium (CGE) model. In order to construct a CGE model that accurately incorporates existing energy taxes, we use data from the National Tax Agency and the Ministry of Internal Affairs and Communications, in addition to data from the input-output table. Our data incorporates "Gasoline Tax", "Gas Oil Delivery Tax", "LPG Tax", "Aviation Fuel Tax", "Petroleum and Coal Tax", "Promotion of Power-Resources Development Tax", and "Tax for Climate Change Mitigation". In addition, we modify the data in the input-output table so that tax exemptions could be appropriately taken into account. Using the above CGE model, we conduct policy simulations to replace the existing energy taxes with a carbon tax and quantitatively

[1] The material on the following page provides a detailed explanation of how the existing energy taxes were introduced: https://www.env.go.jp/council/16pol-ear/y162-16.html

clarify their economic and environmental effects. Specifically, we analyze the impact on the Japanese economy as a whole (on CO2 emissions, carbon tax rate, tax revenue, GDP, and welfare) as well as on individual goods and sectors.

Using the CGE model described above, the following scenarios were analyzed: 1) eliminate the existing energy tax (ELM scenario), 2) replace the energy tax with a carbon tax under the condition that CO2 emissions are kept constant (CES scenario), 3) replace the energy tax with a carbon tax under the condition that tax revenues are kept constant (CTR scenario), and 4) CES scenario + applying tax exemptions to some sectors, and 5) CTR scenario + applying tax exemptions to some sectors.

Results

Key findings from the analysis are as follows. First, under the CES scenario, tax revenues would decrease, but GDP and welfare would increase. Second, under the CTR scenario, GDP and welfare rose while tax revenues remained constant and CO2 emissions were reduced. These two results suggest that a carbon tax is preferable to the existing energy tax in terms of economy-wide efficiency. Third, the policy of applying tax exemptions to some sectors had little effect on GDP or welfare.

Fourth, the effect on the price of goods varies greatly depending on the type of goods and the users of those goods, but in particular, we found that the price of petroleum-based energy tends to decrease while the price of coal-based energy tends to increase. This is due to the characteristic that existing energy taxes in Japan are very heavy on petroleum-based energy, especially that used for transportation.

Finally, with regard to the impact on the output of the individual sectors, it was found that the output of petroleum products and the road and air transportation sectors tends to increase, while the output of coal products, gas, and the iron-and-steel sector tends to decrease. We also found that the introduction of tax exemptions had the effect of considerably reducing the negative impact on production in the exempted sectors.

Macroeconomic impacts.

	BME	ELM	CES	CTR	CESE	CTRE
CO2 (MtCO2)	1,222	1,332	1,222	1,048	1,222	1,071
CO2	0.00	8.99	0.00	-14.27	0.00	-12.37
Carbon tax rate (yen/ton)	0	0	791	4,514	992	4,919
Energy tax revenue (billion yen)	4,731	0	0	0	0	0
Carbon tax revenue (billion yen)	0	0	967	4,731	1,212	4,731
GDP	0	0.280	0.260	0.114	0.256	0.113
Welfare	0	0.279	0.258	0.086	0.256	0.091

Conclusions

Our analysis indicates that replacing the existing energy taxes with a carbon tax enhances GDP and welfare while maintaining constant tax revenues and reducing CO2 emissions. This finding suggests that a carbon tax is preferable to the existing energy taxes for both environmental and economic reasons. Furthermore, the transition to a carbon tax would decrease the price of petroleum-based energy taxes, leading to increased production of petroleum products and sectors that use these products. This is attributed to the current structure of the energy tax, which imposes a heavy burden on petroleum-based energy. Finally, an analysis of a scenario where the iron-and-steel and cement sectors are exempted from the carbon tax reveals that such an exemption has minimal impact on the overall economic efficiency but significantly alleviates the burden on the exempted sectors.

References

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