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Title	Design of taxation to promote electric vehicles in Singapore
Sub Title	シンガポールにおける電気自動車普及のための税制設計と影響評価
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Abstract	Global warming due to rising carbon dioxide levels in the Earth's atmosphere has prompted governments all over the world to take action to reduce carbon dioxide emissions. In Singapore, the promoting of green vehicles such as electric vehicles has been identified as one of the ways that Singapore can take to reduce its carbon dioxide emissions through an improvement in energy efficiency of the transport sector. However, the prohibitive high cost of electric vehicles makes electric vehicles an economically unattractive option for consumers and taxation policies from the government would be needed to increase the penetration of electric vehicles. Meanwhile, the promotion of electric vehicles, while bringing forth environmental benefits, will cause a decrease in GDP due to a reduced output in the petroleum industry. Therefore, the tradeoff between positive environmental impact and negative economic impact as a result of taxation will have to be balanced. In this paper, the effects of tax rebate and carbon tax will be investigated. Singapore as a subject of study has not yet been performed in conventional studies, and there has not been previous research on the use of both macro and micro modeling approaches in taxation design and comparison of the effects of tax rebate and carbon tax on the promoting of electric vehicles. We first develop a consumer vehicular preference model based on a logit model with two attributes, namely lifecycle cost of ownership and previous year's share, to predict growth in share of electric vehicles upon introduction of taxation. Secondly, the effects on the economy will be analyzed using Input-Output analysis and the reduction in carbon dioxide emissions calculated as well. Thirdly, the optimal tax rate needed to minimize adverse economic impact and maximize reduction in carbon dioxide will be determined using multi-objective optimization. Results indicate that a tax rebate would minimize the negative impact on the economy at a low penetration of electric vehicles, whereas at a high penetration of above 60%, a carbon tax would be give a less negative GDP. In addition, a carbon tax leads to a greater reduction in carbon dioxide emissions at all penetration rates. When economic and environment impacts were given weights of 0.6 and 0.4 respectively, for instance, a tax rebate of 45% of Open Market Value or a carbon tax of SGD 3.485/kg CO2 was found to be the optimal tax rate.
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Master's Dissertation 2011

Design of Taxation to Promote Electric Vehicles in Singapore

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SUMMARY OF MASTER'S DISSERTATION

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Title

Design of Taxation to Promote Electric Vehicles in Singapore

Abstract

Global warming due to rising carbon dioxide levels in the Earth's atmosphere has prompted governments all over the world to take action to reduce carbon dioxide emissions. In Singapore, the promoting of green vehicles such as electric vehicles has been identified as one of the ways that Singapore can take to reduce its carbon dioxide emissions through an improvement in energy efficiency of the transport sector. However, the prohibitive high cost of electric vehicles makes electric vehicles an economically unattractive option for consumers and taxation policies from the government would be needed to increase the penetration of electric vehicles. Meanwhile, the promotion of electric vehicles, while bringing forth environmental benefits, will cause a decrease in GDP due to a reduced output in the petroleum industry. Therefore, the tradeoff between positive environmental impact and negative economic impact as a result of taxation will have to be balanced.

In this paper, the effects of tax rebate and carbon tax will be investigated. Singapore as a subject of study has not yet been performed in conventional studies, and there has not been previous research on the use of both macro and micro modeling approaches in taxation design and comparison of the effects of tax rebate and carbon tax on the promoting of electric vehicles. We first develop a consumer vehicular preference model based on a logit model with two attributes, namely lifecycle cost of ownership and previous year's share, to predict growth in share of electric vehicles upon introduction of taxation. Secondly, the effects on the economy will be analyzed using Input-Output analysis and the reduction in carbon dioxide emissions calculated as well. Thirdly, the optimal tax rate needed to minimize adverse economic impact and maximize reduction in carbon dioxide will be determined using multi-objective optimization.

Results indicate that a tax rebate would minimize the negative impact on the economy at a low penetration of electric vehicles, whereas at a high penetration of above 60%, a carbon tax would be give a less negative GDP. In addition, a carbon tax leads to a greater reduction in carbon dioxide emissions at all penetration rates. When economic and environment impacts were given weights of 0.6 and 0.4 respectively, for instance, a tax rebate of 45% of Open Market Value or a carbon tax of SGD 3.485/kg CO2 was found to be the optimal tax rate.

Keywords

Electric Vehicles, Logit Model, Input-Output Analysis, Multi-Objective Optimization, Tax