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Determining the Impact of Government Intervention on Firm Decisions for Sustainable Production

We use a game theoretic approach to assess how the government can influence firms' CSR investment and production decisions to enhance social welfare, considering the negative externalities of unsustainable production and positive externalities from CSR investments. Using a Stackelberg duopoly as a base model and lump-sum tax as the government's decision variable, we find that when the government chooses not to intervene, it results in greater environmental damage as firms will underinvest in CSR and overproduce in quantity to achieve profit maximization. As such, the model extends to the assumption that the government acts as a benevolent dictator to model how firms will act under a regulated environment to achieve the optimal outcome. Ultimately, we show that firms have to be placed under a regulated environment to prevent them from exploiting resources and damaging the environment, thereby negatively affecting societal welfare.

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Policy Insights

Policy makers may consider the following recommendations to induce firms to integrate CSR into their business models:

1. **Implement mandated CSR policies for sustainable production.**

   The Pareto optimal outcome from the model utilized in this study is obtained when the government intervenes as a benevolent dictator that decides the firms' level of production and CSR investment. As a result, it can control firms' unsustainable production and underinvestment in CSR. Given this, policy makers may establish mandatory CSR policies to promote sustainability in the firms' production processes while maximizing the overall societal welfare.

2. **Impose taxes on unsustainable firm production.**

   The government may consider intervening through the imposition of taxes on carbon emissions from business operations and production for firms to internalize the cost of production externalities. Although this may be considered, the implementation of a lump sum tax may be deemed ineffective, as illustrated in the findings of the study. As this tax policy is not dependent on the cost of environmental damage that firms incur based on their production level, it may not necessarily reflect the cost of externalities incurred. Likewise, the imposition of a lump sum tax may result in a further decrease in social welfare. However, other forms of tax such as a per unit tax policy, may be effective.

Introduction

Over the years, it has been evident that the manufacturing sector has flourished; however, this has brought negative environmental externalities. These pollution-intensive industries have prompted firms and governments to reevaluate their perception of CSR, from a voluntary commitment to a necessary commitment, primarily due to its long-term impact, which may disrupt business transactions and activities, as well as significantly decrease social welfare (Allen & Craig, 2016). Nonetheless, several firms are still reluctant to invest in environmental CSR as it can be costly and risky in the short-run, specifically in the absence of an external force, which is the government (Chen & Hu, 2018). Therefore, the roles of the government as regulators and policy-makers are imperative in encouraging unwilling firms to integrate CSR into their business models to create and maintain a sustainable environment, especially in response to the ever-growing needs and demands of society (Akdoğu, 2017; Linton et al., 2007).

Model Specification and Results

This study applies a game theoretic approach to assess how the government can influence firms' CSR investment. This takes into account the negative externalities brought by unsustainable production and positive externalities brought by CSR investments. Unlike previous models, this game explores the behavior of firms under a Stackelberg duopoly concerning their levels of production and CSR investments. In addition, the government acts as a regulating body to maximize social welfare through the mitigation of negative environmental externalities.

Figure 1
Structure of the Game

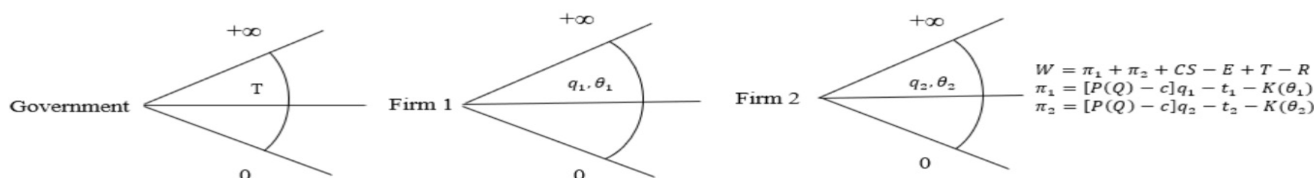

Figure 1 presents the structure of the game with three players being the government, the leader firm, and the follower firm. Following the Stackelberg game, Firm 1 (the leader) will consider the reaction function of Firm 2 (the follower) in determining its optimal output and CSR investment. The government intervenes by imposing lump-sum taxes to regulate firms.

The game has two stages: (a) in Stage 1, the government decides how much to intervene by determining the lump-sum tax, and (b) in Stage 2, firms will compete and determine how much quantity to produce and how much CSR to invest in. As the game results in zero lump-sum tax, government intervention is modeled by assuming that the government acts as a benevolent dictator who decides aggregate output and CSR investment. It is to be noted that the study results may have emanated from the specific assumptions and functional forms used.

This study generates three key findings: (a) a proposition on firm behavior under an unregulated Stackelberg duopoly, (b) a proposition on firm behavior under a regulated environment where the government acts as a benevolent dictator, and finally, (c) a proposition on the impact of firm production on the environment.

1. **Stackelberg Duopoly under an Unregulated Market**
   The findings follow the Stackelberg conditions where the quantity produced by the leader firm is greater than that of the follower firm due to Firm 1's market share and first-mover advantage. As CSR positively influences consumer demand, Firm 2 invests in a relatively higher level of CSR than Firm 1 to maximize its profit and further differentiate itself from the leading firm. However, Firm 1 still generates the largest profits as it keeps its dominant market share. Nonetheless, this does not lead to a Pareto optimal outcome.

2. **Firm Behavior under a Regulated Market**

   The findings show that when the government acts as a benevolent dictator, aggregate output is lower and aggregate investment in CSR is higher. This shows that leaving firms to decide how to conduct their own

operations will induce them to choose the option that will ultimately benefit them more by incurring the least possible cost and the highest possible profit, considering their nature as a profit-maximizing firm. Given this, they may independently choose to overproduce in quantity, which allows them to increase profits and underinvest in CSR, which allows them to reduce the cost that they bear.

3. **Impact of Firm Production on the Environment**

   This study finds that when firms underinvest in CSR and overproduce in quantity under an unregulated corporate environment, the environmental damage may be further aggravated. Therefore, when the government intervenes as a benevolent dictator, it can mitigate environmental damage from the production of the firms.

Conclusion and Recommendation

Findings in this study emphasize the importance of CSR as a business strategy and as a tool to improve social welfare and the importance of government intervention to control firm behavior and minimize environmental damage to society.

As a form of intervention, the government may implement mandatory CSR policies to ensure that they do not excessively harm the environment. This has been implemented in various countries, which resulted in favorable outcomes. For instance, India, one of the first countries to implement a mandatory regime for CSR, required firms with a net worth of at least US$ 70 million to allot at least 2% of their profit for three consecutive years for CSR investments to protect the environment (Talukder, 2020). Consequently, the country has seen an increase in companies complying with the requirements of the law as CSR expenditure of top Indian companies in 2018 was recorded to be 47% higher than the law's first implementation in 2014 (Tandon, 2018). Moreover, India's CSR Reporting Survey in 2019 by KPMG shows that 76% of the companies spend 2% or more on CSR initiatives (KPMG, 2020).

Although this policy may seem rigid, it can be said that it was carried out well in India as more firms have been integrating CSR into their operations, with some exceeding beyond expectations. However, several criticisms remain as this policy tends to counter the desired effects. For instance, firms that spend more than the required amount previously may opt to decrease their CSR investment to minimize cost while still legally complying with the law (Guha, 2020). Therefore, it is still imperative to closely look into varying situations in each country and examine other factors that may hinder the achievement of the desired objectives.

Likewise, the government may also impose a tax policy on the unsustainable practices of firms. While this study finds that imposing lump sum tax on firms may be ineffective in maximizing social welfare, policy-makers may still opt to adopt varying tax schemes, such as a per unit tax policy, which has been adopted by countries such as British Columbia and Singapore.

British Columbia experienced certain benefits in implementing its carbon tax rates in 2008, resulting in reduced consumption of all taxable fuel types by 17.4% per capita (Elgie & McClay, 2013). Upon initial introduction in 2008, the tax was set at C$10 per tonne of carbon dioxide equivalent, which increased by C$5 a year until 2012, when it reached C$30 per tonne. Being a "revenue neutral" law, the policy also required the reduction of revenue from other tax sources. Corollary, its citizens experienced both the benefit of lower personal and corporate income taxes and lower carbon emissions.

Meanwhile, Singapore has also taken the first initiative in Southeast Asia to implement a carbon price tax in 2019 wherein entities are taxed at S$5 per tonne of greenhouse gas emissions. The government aims to utilize such policy as a means to incentivize firms to reduce carbon emissions and aid in the shift to a low-carbon economy. Given this, Singapore may act as a benchmark for other countries in enacting similar environmental regulations (National Environment Agency, 2021).

The implementation of these existing policies has resulted in enhanced corporate behavior towards sustainable production in certain countries, which is also parallel to the results of this study, suggesting that the government may play a significant role in encouraging firms to invest in CSR to reduce their negative impact on the environment. Future researchers and policymakers must carefully analyze the circumstances of each country to determine specific policies that would best fit their respective economic landscapes to ensure compliance, effectiveness, and maximum benefits for society.

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