Zhang, S., Hong, J., Ma, L., & Zhao, N. (2024). Incentivizing emerging market suppliers for responsible international supply chain: Revenue-sharing and government subsidy. Computers and Industrial Engineering, 194, Article 110351. Advance online publication. https://doi.org/10.1016/j.cie.2024.110351

Incentivizing Emerging Market Suppliers for Responsible International Supply Chain: Revenue-sharing and Government Subsidy

Abstract

Many emerging market suppliers of multinational enterprises (MNEs) have been exposed to social responsibility controversies. These incidents significantly affect MNEs' operations and emerging economies' sustainable development. This paper considers a two-tier transnational supply chain model to explore the impact of different participants' corporate social responsibility (CSR) engagements on their profits and social welfare. We consider two incentive schemes that could enhance emerging market suppliers' CSR activities: revenue sharing from their buyers and subsidies from their governments. Using the supplier Stackelberg game, we find: 1) transnational operation costs hinder MNEs' incentive to invest in CSR; 2) suppliers' CSR activities have a larger impact on the demand for final products and emerging market welfare than MNEs' activities; 3) suppliers will voluntarily engage in CSR activities, but only at an insufficient level, whereas MNEs revenue-sharing with suppliers and government subsidies to suppliers can improve suppliers' CSR level; 4) government subsidy improves suppliers' CSR activities to a larger extent than MNEs' revenue-sharing. Our study fills the gap in CSR activities along the international supply chain. We also provide critical managerial implications to MNEs and their emerging market suppliers on reducing CSR risk, and policy implications to emerging market governments on realizing sustainable development.

Keywords: corporate social responsibility, multinational supply chain, emerging economies, supply chain coordination, revenue sharing contract, government subsidy

1. Introduction

Multinational enterprises (MNEs) procure inputs, produce products, and sell goods worldwide. They select their suppliers and manufacturing sites based on the cost-benefit analysis. During the past decade, the concept of social corporate responsibility (CSR) related to environment and social has been harnessing increasing attention from investors, consumers, governments, and non-governmental organizations. Thus, MNEs also start to consider these factors in their strategic decisions (Galagedera, 2019; Puggioni & Stefanou,2019; Gillan et al., 2021).

CSR refers to the actions that organizations take to fulfill their social and ethical obligations to their stakeholders (Schwartz & Carroll, 2003; Amir & Serafeim, 2018). These activities include initiatives to address environmental incidents, product quality and safety matters, human rights concerns, and employee and societal welfare issues. Regulators, investors, and the general public want large firms to contribute to the long-term development of the communities in which they operate (Jamali & Mirshak, 2007; Jamali & Carrol, 2017; van Hierden et al.,2021).

MNEs can enhance their reputations and public image by actively engaging in CSR activities, because these can boost consumers' willingness to buy their products, leading to a higher market share and economic benefits (Buell & Kalkanci, 2020; Heydari & Rafiei, 2020,; Su et al., 2021),then help firms to obtain competitive advantages in the global market, even leading to superior export performance (Barin Cruz et al., 2015; Boehe & Cruz, 2010; Xu et al., 2018).

However, MNEs do not always engage in CSR initiatives, especially in emerging markets, where public awareness and regulatory requirements are typically insufficient ((Muller & Kolk, 2009). As MNEs continue to expand globally, consistent CSR management on a global scale always faces challenges. Some irresponsible business activities conducted can have a detrimental influence on the local environment and society (Villena & Gioia, 2020). These behaviors are taking place in both sales and procurement sides, which will eventually erode MNEs' profits.

At the sales side, MNEs' differential treatment of overseas markets can also result in severe CSR risks. For example, Samsung, a Korean electronics giant, chose to discriminate against Chinese customers when recalling their product with combust hazards, NOTE 7, in 2016 (Zhang et al., 2021). The food brand, Orion, primarily uses healthier "pure cocoa butter" as the major ingredient in products sold in other countries but uses less healthful "cocoa butter substitute" in the Chinese market. These discriminatory actions have caused widespread anger and resistance from Chinese consumers, resulting in declining the brands' market shares in the Chinese market.[1]

At the procurement side, large MNEs typically purchase from countries with cheap production factors and less strict regulations to save costs (Clarke & Boersma, 2017). Frequently, we observe

[1] In 2022, OEION's sales in China decreased by 1.2 billion RMB. In the second quarter of 2023, Samsung's global market share for smartphones was 23.99%, while its market share in China was less than 1%. Data sources include IDC, Gartner, and other relevant financial news sources

negative news on these suppliers' socially irresponsible behaviors (Ha et al., 2022; Villena & Gioia, 2020). For instance, CSR issues occur frequently in Apple Inc.'s upstream companies. In the early days, its upstream partner Foxconn was exposed to significant human rights issues due to employee suicides (Bian et al., 2021; Clarke & Boersma, 2017). During the epidemic period, Wistron, another upstream supplier for Apple, suffered violent events of arson and looting in India because of CSR disputes.[2] These occurrences have had a detrimental impact on the corporate image and the stability of the surrounding community.

Currently, many advanced economies' governments have passed legislation that requires MNEs headquartered in their countries to pay attention to CSR issues along the global supply chain. For instance, Germany and the EU have passed regulations that require MNEs to conduct due diligence on CSR activities of their overseas suppliers (Krajewski et al., 2021; Patz, 2022).

As a result, large multinational corporations must prioritize CSR concerns in their global sales and procurement processes to avoid reputational damage and profit loss. For example, Apple collaborated with Foxconn to improve the employee experience. Furthermore, experts believe that extra supply chain coordination contracts, such as revenue-sharing contracts, that aim to increase CSR are highly valuable (Chen & Lee 2017; Bai et al., 2021; Raj et al., 2021).

Similarly, emerging economies' governments should also get involved in the process, because suppliers' CSR behaviors can directly help maintain the stability and welfare of the emerging countries (Bennett, 2002). The intermediate goods from emerging economies' suppliers tend to consume large amounts of natural resources and cheap labor in emerging countries (Ma et al., 2017; Villena & Gioia, 2020). Due to these circumstances, it is more likely to result in CSR risks (Van Tran, 2020; Golgeci & Demirbag, 2021; Jean, 2022; Krishnan et al., 2022). As profit-maximizing entities, MNEs are inherently constrained in solving these issues (Liao et al., 2018). Therefore, emerging economies' governments should also try to improve the CSR engagements of these suppliers in their borders (Guo et al., 2022; Huang et al., 2019). Similar to measures that encourage corporate exports (Brander & Spencer, 1985), emerging economies can employ some subsidies to enhance CSR. Nevertheless, the strategies to address CSR issues implemented by emerging economies show specific deficiencies, though they commonly face higher CSR hazards.

Hence, considering the aforementioned actual requirements, studying CSR issues along the global supply chain, especially those involving emerging markets, is highly valuable. However, the existing literature on this issue is insufficient.

First, there is a certain amount of negligence because multinational firms do not equivalent or consistently focus on CSR throughout all worldwide sales regions. While most existing models studying CSR sharing on the supply chain assumes that CSR would always increase a firm's value (Ma et al.,

[2] Source: The Times of India.

2017; Panda et al., 2015, 2017; Peng et al.,2023). This result, unfortunately, does not always find support in the data and reality (Dai et al., 2020; Hong & Kacperczyk, 2009; Kim et al., 2018). Extant empirical work has shown that firms with a more complex transnational background tend to reduce their efforts on the CSR front (Beji et al., 2021; Liao et al., 2018). Tariffs and foreign regulations are complicating factors MNEs need to consider when designing their global supply chain (Hammami & Frein, 2014; Li et al., 2023). Meanwhile, CSR activities can incur substantial costs to MNEs and thus could have negative impact on MNEs' profitability. Hence, transnational costs exacerbate this negative impact, further damaging MNEs' incentives to improve the CSR performance along their supply chains. Our work seeks to formally model these issues.

Second, the CSR risks frequently occur in the production process of overseas suppliers (L. Chen & Lee, 2017; Ma et al., 2017; Villena & Gioia, 2020). Unfortunately, few studies have paid attention to the behaviors of these upstream enterprises. As these firms play a non-negligible role in building a responsible supply chain, studying their incentives and activities has great value. Our study fills this gap by considering these firms' activities in a game-theoretic framework.

Third, many emerging markets where MNEs' suppliers operate in are also major markets of MNEs' end product (Clarke & Boersma, 2017; Gereffi, 2019; Paul,2019). They are facing CSR issues on both the sales and procurement aspects, and the later is seriously jeopardizing social sustainability (Ha et al., 2022; Villena & Gioia, 2020). Thus, governments of emerging economies have incentives to induce their suppliers' socially responsible behaviors to enhance domestic social welfare and sustainable development, and subsidy is a policy tool frequently utilized by governments (Huang et al., 2019; Sinayi & Rasti-Barzoki, 2018; Yu et al., 2016). However, little work has been done to understand how emerging government behaviors, such as subsidies, may affect CSR sharing and social welfare under the international supply chain.

To summarize, this study fulfills the above gaps and address the following questions:

1) How do international operational costs affect CSR sharing along the global supply chain, and how does CSR investment affect the MNEs' profits?
2) How will suppliers' CSR engagements affect supply chain participants' profits and social welfare?
3) How will emerging economies' government subsidies to suppliers affect CSR sharing along the supply chain and social welfare?

This paper builds a two-tier international supply chain model and uses the game-theoretic framework to study the above problems. We will consider four scenarios. First, we consider the situation when only MNE assumes CSR responsibility. Second, we characterize equilibrium outcomes when the supplier voluntarily takes CSR responsibility. Third, we study the scenario when MNE shares revenue with the supplier to incentivize the latter to participate in CSR activities. Fourth, we pin down the equilibrium when the supplier's government subsidizes the supplier to engage in CSR. We also compare

these scenarios to establish optimal incentives for emerging market suppliers to enhance their CSR practices. Our work thus fills the knowledge gap on international supply chain CSR studies and provides managerial and policy insights on MNE operations and emerging market sustainable development.

The rest of the paper is organized as follows. Section 2 reviews the literature. Section 3 and 4 establishes and solves the model. Section 5 compares equilibriums under different scenarios and uses numerical methods to illustrate the optimal conditions. Section 6 gives conclusions.

2. Literature Review

2.1 CSR of Transnational Supply Chain

This paper focuses on the literature in the following two areas: CSR in international supply chains and government subsidies to increase supply chain sustainability. The former part can be further divided into three areas: multinational corporations and CSR, CSR decision-making, and CSR coordination contracts along the supply chain.

2.1.1 Multinational Firms and CSR

Extant work studying CSR issues of multinational enterprises focuses on the relationship between internationalization and social responsibility. However, in previous empirical studies, the relationship between CSR behavior and corporate performance is not always positive.

For instance, Boehe & Cruz (2010) document that CSR performance contributes positively to product differentiation in the international market and hence helps improve export performance. Newman et al. (2018) find that international trade flows can facilitate the transmission of socially responsible behaviors. Another direction under this theme explores the impact of CSR activity on MNEs' performances, including innovation (Chkir et al., 2021) and financial ones (Fourati & Dammak, 2021). These insights reveal the underlying motivations for the CSR initiation, which also constitute the foundational context and assumption for the present study. However, a number of scholars have pointed out that the impact of CSR on multinational enterprises is not always positive. Liao et al. (2018) find evidence that Chinese companies with foreign directors are less inclined to commit to social responsibility, while Beji et al. (2021) document that the presence of foreign directors is considerably negatively correlated with the overall CSR performance of listed firms in France. In this study, we will delve into the intrinsic mechanisms to explore the reasons behind this phenomenon.

Furthermore, the majority of current research on CSR in multinational supply chains is empirical in nature. Their goals are to determine how different elements affect CSR initiatives. Nevertheless, it is uncommon for these authors to start their analyses with a focus on mechanism design and incorporate the national element into the CSR-sharing game-theoretic model.

2.1.2 CSR decision-making along the Supply Chain

Increasing attention has been paid to how participants in the supply chain share CSR responsibilities. Ni & Li (2012) model the CSR decisions by suppliers and customers in a game-theoretic framework. The authors introduce CSR as an additional parameter into the demand function and consumer surplus

and discuss how this parameter alters the equilibrium. Based on the stakeholder theory, Panda (2014) embeds consumer surplus into a firm's profit function to represent its CSR consideration. He designs a revenue-sharing contract between the supplier and the manufacturer that can coordinate their CSR behaviours. A follow-up work (Panda et al., 2015) extends the model into a three-level supply chain composed of manufacturer, distributor, and retailer, with the manufacturer being socially responsible. They propose a contract-bargaining process that resolves the conflict among these players. In a similar vein, Panda et al. (2017) analyze how CSR functions in closed-loop supply chains and explore how CSR affects both centralized and decentralized optimal decisions. Modak et al. (2019) investigate CSR practices and channel coordination concerns in a two-stage closed-loop supply chain. Similarly, Peng et al. (2023) added a risk preference analysis into their model. However, the majority of these research have assumed that CSR initiatives frequently result in higher profit, which fails to account for the previously cited empirical findings. Consequently, this paper aims to refine the existing models to better explain these observed outcomes.

There are alternative ways to embed CSR engagement into supply chain models. For example, Guo et al. (2016) explore the cost-benefit trade off in an enterprise choosing between responsible and non-responsible suppliers. Chen et al. (2017) identify conditions under which suppliers and customers are better off when committing to each other and discuss the implications of their models on socially responsible operations. Considering three supply-chain power structures, Chen et al. (2017) analyze how power relationship affects decisions and the sustainability performance of the supply chain. Su et al. (2021) study the impact of social donations and green behaviors by formulating an economic production quantity model. Ha et al., (2023) delves into the intricacies of sharing CSR audit information across multi-tiered supply chain structures. However, most of these studies consider how the channel coordination influences business profitability, rather than the effects of overseas upstream firms' CSR on the long-term sustainability of MNEs and the nations in which they operate. For this, we will place a significant emphasis on the impact of upstream enterprises' CSR behaviors.

2.1.3 CSR coordination contract along the Supply Chain

Another strand of literature studies the optimal contracting problem along the supply chain when considering CSR. Ma et al. (2017) design the optimal contract when information asymmetry exists between the manufacturer and the retailer, and the manufacturer can improve demand through CSR investment. In a setting similar to ours, where manufacturers source from emerging market suppliers, Chen & Lee (2017) model how manufacturers can adopt screening mechanisms and incentive schemes to mitigate supplier responsibility risks. Raj et al. (2021) consider the greening effort and CSR investment simultaneously and develop optimal contracts when there exists information asymmetry regarding buyer's marginal production cost. Orsdemir et al. (2019) find that CSR can drive firms to engage in vertical integration. Bai et al. (2021) craft a revenue and cost-sharing contract to facilitate the coordination of emission reduction technology within a decentralized framework. In a three-tier supply

chain model, Huang et al. (2022) analyze the equilibrium allocation of each participating firm's CSR effort and suggest that external stakeholders can be critical in improving suppliers' responsibility.

However, these studies have primarily focused on coordination contracts, with a striking lack of investigation into the behavior and impact of subsidies from 'external stakeholders'. Furthermore, these articles have not been contextualized within specific national frameworks, nor have they considered cross-national variables. In this article, we will put our focus to the CSR within emerging economies, and conduct an independent analysis of the impact of external subsidies on CSR practices and their subsequent effects on social welfare.

2.2 Government Subsidies to Improve Supply Chain Sustainability

Governments worldwide have endeavored to devise policies to boost supply chain sustainability, and many researchers have investigated these policies' impacts. Mitra & Webster (2008) model the competition between manufacturers and re-manufacturers and analyze how government subsidies affect this interaction. On the other hand, Steurer (2010) categorizes CSR policies across Europe and reveals why governments care about social responsibility. He further discusses the influence of CSR, government policy and regulatory mode on the government-business nexus.

With the surging consumer awareness of environmental protection over the last decade, many scholars have studied how these policies affect consumer behaviors. For example, Yu et al. (2016) study how government subsidy affects manufacturers' profitability through consumers' increasing demand for environmental protection. In contrast, Shao et al. (2017) focus on how different subsidy schemes can influence consumers' buying behaviors. Others have investigated these policies' impacts on corporate production behaviors, including green technology adoption (Cohen et al., 2015), sustainable innovation (Chen et al., 2019), green supply chain development (Sinayi & Rasti-Barzoki, 2018). Many studies also attempt to identify the most efficient form of green subsidies under various scenarios (Li et al., 2020; Tsao et al., 2021).

While most existing research evaluates the implications of CSR in terms of business profitability, this paper takes a different approach. This study intends to improve social welfare in emerging economies by developing varied government subsidy policies, providing a thorough enlargement of the existing research area.

2.3 Summary

Upon reviewing the literature, it is evident that a significant amount of work has not been done on the specifics of CSR decision-making in global supply chains. In order to fully address these shortcomings, this study aims to construct a two-level Stackelberg model to investigate the potential effects of various supply chain participants' CSR on the social welfare of emerging economies and the profitability of businesses.

Firstly, the model setting in this paper closely blends the theoretical background with reality, resolving the existing shortfall of research on CSR of transnational supply chains. In this paper, we

introduce cross-national considerations into both the assumptions and the substantive model, thereby enriching the existing discourse on the distribution of CSR behavior along the supply chains within the global context. Second, by confirming that the models are consistent with the findings of the empirical study conducted by Beji et al. (2021) and Liao et al. (2018), this paper further refines the models developed by Panda et al. (2015, 2017) and Raj et al. (2021). Furthermore, we want to improve social welfare rather than merely maximize business profits, which is a departure from previous studies. Therefore, we will also discuss the optimal revenue-sharing contract among chain members and the emerging government subsidies to incentivize CSR engagement in this transnational supply chain setting.

3. Model Setting

We consider a two-tier cross-country supply chain consisting of a manufacturer (M) and a supplier (S) from different countries. The manufacturer is a large multinational company from country A that purchases and sells products worldwide. The supplier comes from country B, where the production cost is low. In our model, the manufacturer purchases intermediate goods from supplier S and sells the final products globally, including in country B. Some examples of this model include HP and Dell, two American computer brands that source and produce intermediate products from suppliers in China (Distelhorst et al., 2015), and sell final products internationally. At this point, China also serves as a significant market for the brand.[3] Consequently, it is imperative for the main suppliers to exhibit greater CSR for these domestic consumers. Similarly, Samsung, a Korean electronic producer, procures most of its components from Vietnam and sells final products worldwide, including Vietnam (Lee & Jung, 2015; Tien & Ngoc, 2019), also holding a significant market share there.[4] For this, We simplify the setting to "supplier from B → manufacturer from A →consumers from B" to capture the impact of supply chain coordination and government subsidy on emerging market suppliers' incentives to engage in CSR activities.

In our setting, the production process passes through two customs, leading to two import costs. We make the following assumptions:

Assumption 1. For each unit of intermediate good from S, M pays the wholesale price w and the import cost δ ($\delta > 0$). The import cost includes expenses for iceberg transportation and the import tax. Let p be the market price of the final product, M's revenue from selling each unit of final product is $(p - w - \delta)$.

Assumption 2. Following Felbermayr et al. (2015), consumers from country B pays an *ad*

[3] In the first quarter of 2023, HP's global market share was 13.4%, with a 10.2% share in the Chinese market; Dell's global market share was 13.1%, with an 8.5% share in the Chinese market. The data is from market research firms Counterpoint Research and Canalys.

[4] In the first quarter of 2023, Samsung had an impressive 30% market share in the Vietnamese market, ranking first. The data also comes from Counterpoint Research.

valorem tax s $(0 < s < 1)$ for each unit of final product imported. The demand for the final product is characterized by the following linear demand function:

$$q = a - bp(1 + s) \tag{1}$$

Let p_{max} be the maximum retention price that consumers will tolerate:

$$p_{max} = p|_{q\,=\,0} = \frac{a}{b(1+s)} \tag{2}$$

The consumer surplus of country B's customers is therefore captured by:

$$CS = \int_{p}^{p_{max}} (a - b(1 + s)x)\, dx = \frac{(a-bp(1+s))^2}{2b(1+s)} \tag{3}$$

This variable captures the utility of the purchasing behavior. Consumers are vital stakeholders of the MNEs (Schwartz & Carroll, 2003). A consumer's decision to purchase from a particular brand is influenced by their overall perception of the brand, including product quality and brand reputation. We assume that this perception stems from the level of attention a company attaches to CSR. The negligence behaviors such as environmental pollution will directly damage the welfare of consumers, and the resulting bad reputation will also reduce their willingness to consume. Therefore, based on the stakeholder theory (Donaldson & Preston, 1995; Jamali, 2008), a firm's cost of CSR investment is equivalent to its concern over consumer welfare and is captured by a proportion of the consumer surplus (Panda, 2014; Panda et al., 2015, 2017; Raj et al., 2021).

In our model, each firm maximizes its utility, U, as a function of its profit, π, and a proportion of consumer surplus, CS. The utility is given by $U = \pi + kCS$, where $k \in [0,1)$ captures to what extent a firm values social responsibility. This implies that there exists a tradeoff between the profit and the CSR investment for MNEs. This additive separable feature differs from Panda (2014) and others by isolating social responsibility from profit. CSR commitment are costs incurred to MNEs, and would erode their profitability, at least in the short run (Prior et al., 2008; Sprinkle & Maines, 2010). However, these activities can potentially generate positive long-run benefits to MNEs, and we capture these benefits by the improvement of their utilities. In other words, our functional form allows us to separately measure the benefits and costs associated with firms' CSR activities.

This assumption is similar to Peng et al. (2023), but their paper still focuses on the final utility, does not explore the change in profit alone, nor give a detail explanation, which is essentially consistent with what analyzed in Panda (2014). In our paper, members make decisions by maximizing the utility function to represent the trade-off between CSR cost and profit, as we examine how these individuals balance the pursuit of profit against the enhancement of their reputation.

Then, we make the following assumptions to parametrize how much a firm care about CSR:

Assumption 3. Let $\alpha \in (0,1)$ capture manufacturer's sensitivity to socially responsible behavior. As a multinational enterprise, M cares about its brand image and reputation, and thus it always engages in CSR to some extent ($\alpha > 0$). Its utility is therefore $U_M = \pi_M + \alpha CS$.

Assumption 4. Let $\beta \in [0,1)$ be supplier's sensitivity to socially responsible behavior. We allow them to have the option to not engage in CSR activities ($\beta = 0$). Supplier's utility function can be expressed as $U_S = \pi_S + \beta CS$.

Assumption 5. M and S make independent decisions of α and β based on their own market conditions. It is possible to have $\alpha + \beta > 1$.

Figure 1 depicts the CSR sharing model under our setting.

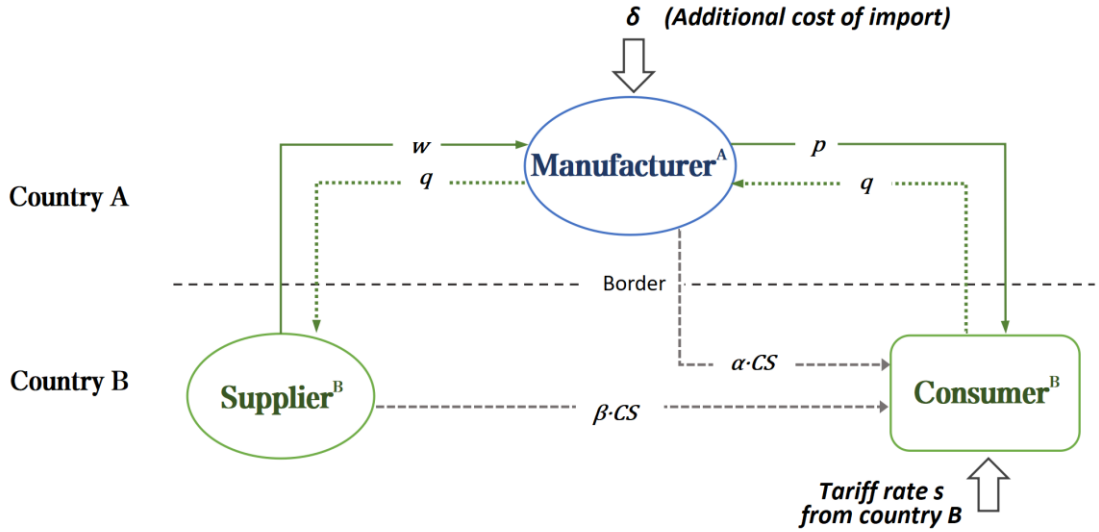

Figure 1. The CSR sharing mode of the transnational supply chain

We make further assumptions on the incentive schemes for CSR involvement in this transnational supply chain.

Assumption 6. M can construct a revenue-sharing contract to incentivize the CSR contribution of upstream firms while simultaneously reducing the wholesale price. Following Cachon & Lariviere (2005), we use $\tau \in (0,1)$ to represent the sharing parameter along the supply chain. Therefore, M retains τ proportion of its revenue and the rest $(1 - \tau)$ goes to the supplier.

Assumption 7. The government of country B provides incentive for S to engage in CSR activities to boost export volume and improve quality of local community. Specifically, for each unit production cost faced by S, government of B provides subsidy to the proportion $\varphi \in (0,1)$ (Tsao et al., 2021).

This paper discusses four scenarios of this transnational supply chain: 1) only M undertakes CSR ($\beta = 0$); 2) S actively participates in CSR sharing ($\beta > 0$); 3) S participates CSR sharing under the incentive provided by M ($\tau > 0$); and 4) S participates CSR sharing under the incentive provided by government of country B ($\varphi > 0$). We summarize the parameters in this paper in Table 1.

Table 1 Parameters and Descriptions

Abbreviation	
CSR	Corporate social responsibility

CS	Consumer surplus
SW	Social welfare
S	Supplier from country B
M	Manufacturer from country A
Decision variables	
p	Final product market price from manufacturer
w	Intermediate commodity wholesale price
Parameters	
α	The proportion of the consumer benefits that the manufacturer chooses to undertake
β	The proportion of the consumer benefits that the supplier chooses to undertake
c	Unit production cost of the supplier
a	Market capacity of country B
b	Demand sensitivity to the price
s	Import tax rate of country B
δ	Additional cost of import when the manufacturer buys the intermediate products from overseas supplier
τ	Contract sharing parameters
φ	Government subsidy rate for production cost of suppliers in country B

4. Model Construction and Analysis (Equilibrium under Multiple Scenarios)

We use four variants of the Stackelberg game to model the above four scenarios. In all these models, manufacturer M is the leader. It determines p and then places order with S according to the market demand. Next, supplier S sets the wholesale price w based on market demand and manufacturer's price. We characterize the equilibrium under all four scenarios below. All proof is provided in the Appendix.

4.1 Only Manufacturer M assumes CSR activities (Model I)

This scenario is represented by Figure 1 where $0 < \alpha < 1$ and $\beta = 0$. Therefore, M maximizes U_M whereas S maximizes $U_S = \pi_S$. The profit functions of firms are:

$$\pi_M = (p - w - \delta)(a - bp(1 + s)) \quad (4)$$

$$\pi_S = (w - c)(a - bp(1 + s)) \quad (5)$$

The optimization problems of firms are:

$$max_{\ p} \ \ U_M = \pi_M + \alpha CS = (p - w - \delta)(a - bp(1 + s)) + \alpha \frac{(a - bp(1+s))^2}{2b(1+s)}$$

$$max_{\ w} \ \ \pi_S = (w - c)(a - bp(1 + s))$$

Solving the model with backward induction, we have the following result:

Theorem 1. *The optimal decisions of the transnational supply chain members in model I are:*

$p^{I*} = \frac{a(3-\alpha)+b(1+s)(c+\delta)}{b(1+s)(4-\alpha)}$, $w^{I*} = \frac{a-b(1+s)(c(-3+\alpha)+\delta)}{b(1+s)(4-\alpha)}$.

Substituting these equilibrium prices into equations (1) to (5), we have:

$q^{I*} = \frac{a-b(1+s)(c+\delta)}{4-\alpha}$, $CS^{I*} = \frac{(a-b(1+s)(c+\delta))^2}{2b(1+s)(4-\alpha)^2}$,

$\pi_M^{I*} = \frac{(2-\alpha)(a-b(1+s)(c+\delta))^2}{b(1+s)(4-\alpha)^2}$, $\pi_S^{I*} = \frac{(a-b(1+s)(c+\delta))^2}{b(1+s)(4-\alpha)^2}$, $U_M^{I*} = \frac{(a-b(1+s)(c+\delta))^2}{2b(1+s)(4-\alpha)}$.

Therefore, members will only participate if and only if $a > b(1+s)(c+\delta)$.

Based on this equilibrium, some comparative static results are obtained.

Corollary 1.1*.* δ *and* s *negatively affect the market demand and the profits of each member. They have a larger impact on M:*

$\frac{\partial q^{I*}}{\partial s} < 0$, $\frac{\partial q^{I*}}{\partial \delta} < 0$; $\frac{\partial p^{I*}}{\partial s} < 0$, $\frac{\partial p^{I*}}{\partial \delta} > 0$; $\frac{\partial \pi_M^{I*}}{\partial s} < 0$, $\frac{\partial \pi_M^{I*}}{\partial \delta} < 0$; $\frac{\partial \pi_S^{I*}}{\partial s} < 0$, $\frac{\partial \pi_S^{I*}}{\partial \delta} < 0$.

Part of the costs incurred by importing and exporting will be passed on to consumers, leading to a decline in demand. Therefore, we have $\frac{\partial q^{I*}}{\partial s} < 0$ *and* $\frac{\partial q^{I*}}{\partial \delta} < 0$. In addition, δ and s will reduce the revenues of M and S. On the one hand, a higher s will result in both lower price and demand, and consequently a negative profit ($\frac{\partial p^{I*}}{\partial s} < 0$). When a tax is levied on end consumers, and the tax rate increases, the price faced by consumers, denoted as $p(1+s)$, also rises. At this juncture, the price must be adjusted downward to maintain stability in the final price. On the other hand, a higher δ will lead to a higher price ($\frac{\partial p^{I*}}{\partial \delta} > 0$), which in turn causes the demand to drop and reduces the profit. This suggests that the additional iceberg costs in the middle are passed on to the end consumers.

Therefore, for transnational supply chain members, an increase in import and export costs negatively affect their earnings. However, since manufacturers face other costs such as labor and tax expenses, whether to choose suppliers from another country or domestically is a result of the overall cost-benefit analysis. For many manufacturers, it is optimal for them to engage in cross-border operations (Kouvelis & Rosenblatt, 2002; Melo et al., 2009) as the benefit of cost-saving outweighs the costs. As a result, many large manufacturers choose to develop a global supply chain network.

Moreover, we have $\frac{\partial \pi_M^{I*}}{\partial s} = (2-\alpha)\frac{\partial \pi_S^{I*}}{\partial s}$ and $\frac{\partial \pi_M^{I*}}{\partial \delta} = (2-\alpha)\frac{\partial \pi_S^{I*}}{\partial \delta}$. Since $\alpha > 0$, we have $2 - \alpha > 1$. Therefore, even all the importing and exporting costs can be transferred to upstream suppliers, s and δ are still going to negatively affect the equilibrium profit of the manufacturer more than them

on the profit of the supplier. This result implies that the transnational operating costs are mostly borne by the manufacturer. However, this gap between how much manufacturer and supplier bear the costs will shrink as α goes up.

Corollary 1.2. *An increase in M's CSR attention level α will raise market demand, reduce market price, increase wholesale price, increase S's profit, reduce M's profit, and increase M's overall utility:*

$\frac{\partial p^{I*}}{\partial \alpha} < 0, \frac{\partial w^{I*}}{\partial \alpha} > 0, \frac{\partial q^{I*}}{\partial \alpha} > 0; \frac{\partial \pi_M^{I*}}{\partial \alpha} < 0, \frac{\partial \pi_S^{I*}}{\partial \alpha} > 0; \frac{\partial U_M^{I*}}{\partial \alpha} > 0.$

Parameter α measures how much manufacturer M cares about social responsibility. As CSR activity incurs costs to M, a higher level of α implies that M is more willing to sacrifice its profit (i.e., $\frac{\partial \pi_M^{I*}}{\partial \alpha} < 0$). In our setting, this sacrifice can be manifested through M's lower price when cares more about social responsibility ($\frac{\partial p^{I*}}{\partial \alpha} < 0$). However, as M cares about social responsibility, its overall utility does not necessarily lower when it charges a lower price. In fact, the above Corollary suggests that the overall utility increases when M has a higher level of social awareness ($\frac{\partial U_M^{I*}}{\partial \alpha} > 0$). The overall equilibrium utility of M will increase by $\frac{\alpha(a-b(1+s)(c+\delta))^2}{8b(1+s)(4-\alpha)}$ than when it does not undertake CSR. This increase suggests that the benefits of CSR behavior will be returned to M in forms other than direct sales profit, such as investor confidence, brand effect, among others. In addition, M's commitment to social responsibility increases market demand ($\frac{\partial q^{I*}}{\partial \alpha} > 0$), a result consistent with Amaeshi et al. (2008) who find that a higher level of CSR performance boosts export performance. These findings imply higher utility and demand can be incentives for multinational firms to actively engage in CSR. However, since CSR expenditures will erode profits, M need to weigh its CSR investment against the profit.

On the other hand, the supplier will charge a higher wholesale price when the manufacturer cares more about social responsibility ($\frac{\partial w^{I*}}{\partial \alpha} > 0$), coupled with the overall market demand, will eventually increase the profit of suppliers. As a result, the supplier will also have a higher profit ($\frac{\partial \pi_S^{I*}}{\partial \alpha} > 0$). Moreover, we also observe that $\left|\frac{\partial \pi_S^{I*}}{\partial \alpha}\right| = 2\left|\frac{\partial \pi_M^{I*}}{\partial \alpha}\right|$, suggesting supplier's profit is more sensitive to changes in α than that of the manufacturer.

Corollary 1.3. *Export tariff and import procurement expense will reduce the CSR awareness of MNEs:*

$\frac{\partial \alpha}{\partial \delta} =< 0; \frac{\partial \alpha}{\partial s} =< 0; \frac{\partial^2 U_M^{I*}}{\partial \alpha \partial s} < 0, \frac{\partial^2 U_M^{I*}}{\partial \alpha \partial \delta} < 0.$

The above result shows that the escalation of multinational operational expenditures will diminish the degree to which core corporations engage in proactive CSR initiatives ($\frac{\partial \alpha}{\partial \delta} < 0, \frac{\partial \alpha}{\partial s} < 0$). Specifically, an increase in either s or δ erodes the positive impact of M's CSR awareness on its whole utility. Due to the advantages that CSR can provide for MNEs (recall that $\frac{\partial U_M^{I*}}{\partial \alpha} > 0$), they will

voluntarily conduct part of CSR. However, the costs associated with multinational supply chain operations may offset these advantages ($\frac{\partial^2 U_M^{I*}}{\partial\alpha\partial\delta} < 0, \frac{\partial^2 U_M^{I*}}{\partial\alpha\partial s} < 0$). Since multinational enterprises face distinct tariff and trading costs in different countries, these results provide a potential explanation that these enterprises engage in different levels of CSR across different markets (e.g., Samsung and Orion's discriminatory treatment of the Chinese market). Therefore, even though CSR behaviors may lead to demand expansion and revenue boost, complex transnational transaction costs may still hinder multinational enterprises' incentives to engage in CSR activities (Beji et al., 2021; Liao et al., 2018).

4.2 Supplier S voluntarily assumes CSR activities without external incentives (Model II)

When the supplier voluntarily takes on social responsibility without external incentives, we have $0 < \beta < 1$. This model can also be represented by Figure 1. The CSR sharing mechanism under this scenario resembles that studied in Panda & Modak (2016), with M and S undertakes α and β of the overall consumer surplus. Recall that we do not require $\alpha + \beta < 1$. The optimization problems for both parties are as below:

$$max_p \;\; U_M = \pi_M + \alpha CS = (p - w - \delta)(a - bp(1+s)) + \alpha\frac{(a-bp(1+s))^2}{2b(1+s)}$$

$$max_w \;\; U_S = \pi_S + \beta CS = (w - c)(a - b(p+s)) + \beta\frac{(a-bp(1+s))^2}{2b(1+s)}$$

with Theorem 2 characterizing the equilibrium conditions. Notice that our purpose is to understand how manufacturer's profit (π_M) and supplier's profit (π_S) respond to supply chain members' CSR engagements and incentives. Thus, in the following models we concentrate our discussions on profits instead of company utility.

Theorem 2. *The optimal decisions of the transnational supply chain members in model II are:*

$$p^{II*} = \frac{a(3-\alpha-2\beta)+b(1+s)(c+\delta)}{b(1+s)(4-\alpha-2\beta)}, w^{II*} = \frac{a(1-\beta)-b(1+s)(c(-3+\alpha+\beta)+(1-\beta)\delta)}{b(1+s)(4-\alpha-2\beta)}.$$

Substituting these equilibrium prices into equations (1) to (5), we have:

$$q^{II*} = \frac{a-b(1+s)(c+\delta)}{4-\alpha-2\beta}, CS^{II*} = \frac{(a-b(1+s)(c+\delta))^2}{2b(1+s)(4-\alpha-2\beta)^2},$$

$$\pi_M^{II*} = \frac{(2-\alpha-\beta)(a-b(1+s)(c+\delta))^2}{b(1+s)(4-\alpha-2\beta)^2}, \pi_S^{II*} = \frac{(1-\beta)(a-b(1+s)(c+\delta))^2}{b(1+s)(4-\alpha-2\beta)^2}.$$

Therefore, members will participate in the game if and only if $a > b(1+s)(c+\delta)$.

Based on this equilibrium, some comparative static analyses are obtained.

Corollary 2.1. *Supplier's CSR activity has a larger impact on demand and consumer welfare than that of the manufacturer. Specifically, we have:*

$$\frac{\partial q^{II*}}{\partial\alpha} > 0, \;\; \frac{\partial q^{II*}}{\partial\beta} > 0; \frac{\partial CS^{II*}}{\partial\alpha} > 0, \;\; \frac{\partial CS^{II*}}{\partial\beta} > 0.$$

The above result shows that for both the supplier and the manufacturer, a higher level of CSR engagement leads to an increase in market demand and consumer surplus. First, notice that we have $2\frac{\partial q^{II*}}{\partial \alpha} = \frac{\partial q^{II*}}{\partial \beta}$, implying that supplier's CSR engagement has a larger impact than the manufacturer's engagement (Villena & Gioia, 2020). Therefore, it would be beneficial to the manufacturer if the supplier could assume more social responsibility as it would boost the market demand for its products.

Second, we also observe that $2\frac{\partial CS^{II*}}{\partial \alpha} = \frac{\partial CS^{II*}}{\partial \beta}$, meaning that compared to changes in manufacturer's CSR activity, consumer surplus is more sensitive to changes in the supplier's CSR engagement. This result implies that supplier's CSR activity has a more significant impact on the sustainable development of emerging countries. From this perspective, governments from the emerging markets would have incentive to stimulate domestic exporting suppliers to assume a higher level of social responsibility.

Corollary 2.2. *Under certain conditions, the supplier's profit reacts positively to its CSR engagement level. And the supplier also have an optimal level of CSR concerning. Moreover, supplier's CSR engagement can also improve manufacturer's profit. Specifically, we have:*

$\frac{\partial \pi_M^{II*}}{\partial \beta} > 0$, $\frac{\partial \pi_S^{II*}}{\partial \beta} > 0$; $\frac{\partial^2 \pi_S^{II*}}{\partial \beta^2} < 0$, $\frac{\partial^2 \pi_M^{II*}}{\partial \alpha \partial \beta} < 0$.

First, if α and β satisfy $\left(0 < \alpha \leq \frac{2}{3} \wedge 0 < \beta < 1\right) \vee \left(\frac{2}{3} < \alpha < 1 \wedge 0 < \beta < \frac{1}{2}(4 - 3\alpha)\right)$, we have $4 - 3\alpha - 2\beta > 0$ and therefore $\frac{\partial \pi_M^{II*}}{\partial \beta} > 0$. This result means that under most circumstances, an increase in supplier's CSR attention β will raise manufacturer's profit. In fact, only when both α and β are close to 1, the manufacturer's profit would react negatively to α. This is because both firms' CSR engagements would lead to an expansion in demand and reduction in price. When both firms care highly about CSR, for the manufacturer, the positive influence from demand expansion no longer outweighs the negative impact of price reduction. Thus, the manufacturer faces a net effect of profit decline.

Second, as $\frac{\partial \pi_M^{II*}}{\partial \alpha} < 0$, $\frac{\partial^2 \pi_M^{II*}}{\partial \alpha \partial \beta} < 0$ means that a higher level of supplier CSR activity mitigates the negative impact of manufacturer's CSR activity (α) on its profit (π_M^*). Therefore, when the manufacturer engages in a fixed level of CSR activities, any additional CSR contribution from the supplier reduces manufacturer's CSR and boosts its profit. As a result, the manufacturer would find it beneficial to engage the supplier in CSR activities.

Third, when $\beta = \frac{\alpha}{2}$, the supplier achieves the maximum level of profit. In fact, we have $\frac{\partial \pi_S^{II*}}{\partial \beta} > 0$ when $\beta < \frac{\alpha}{2}$ and $\frac{\partial \pi_S^{II*}}{\partial \beta} < 0$ when $\beta > \frac{\alpha}{2}$, namely the impact of supplier's CSR engagement on its profit is hump-shaped. This fact suggests that the supplier has some incentives to voluntarily engage in

CSR, but too much of the CSR activities would erode its own profit. This result is consistent with what we observe in the real world. In most transnational supply chains, emerging market suppliers export intermediary goods that are inexpensive, thus their incentives to engage in CSR activities are limited due to cost constraints. Moreover, multinational manufacturers are large firms with high market powers and can push down their purchasing prices (Ma et al., 2017). This fact exacerbates the cost pressure faced by emerging market suppliers and thus reduces their incentives to engage in CSR. Therefore, emerging market suppliers are unlikely to have incentive to voluntarily engage in CSR activities as manufacturers are. As a result, we observe that most CSR disasters occur with upstream overseas suppliers of multinational companies (Villena & Gioia, 2020; Ha et al.,20223).

4.3 Supplier S assumes CSR activities under the revenue-sharing scheme by M (Model III)

The above two models highlight the importance of devising external incentives for emerging market suppliers to engage in CSR activities. We first consider, in this subsection, a revenue-sharing mechanism provided by the multinational manufacturer. We follow the setting of Cachon & Lariviere (2005), where in addition to the wholesale price, the manufacturer pays (1- τ) proportion of the revenue to the supplier to incentivize the latter to conduct CSR activities. Figure 2 depicts this revised setting.

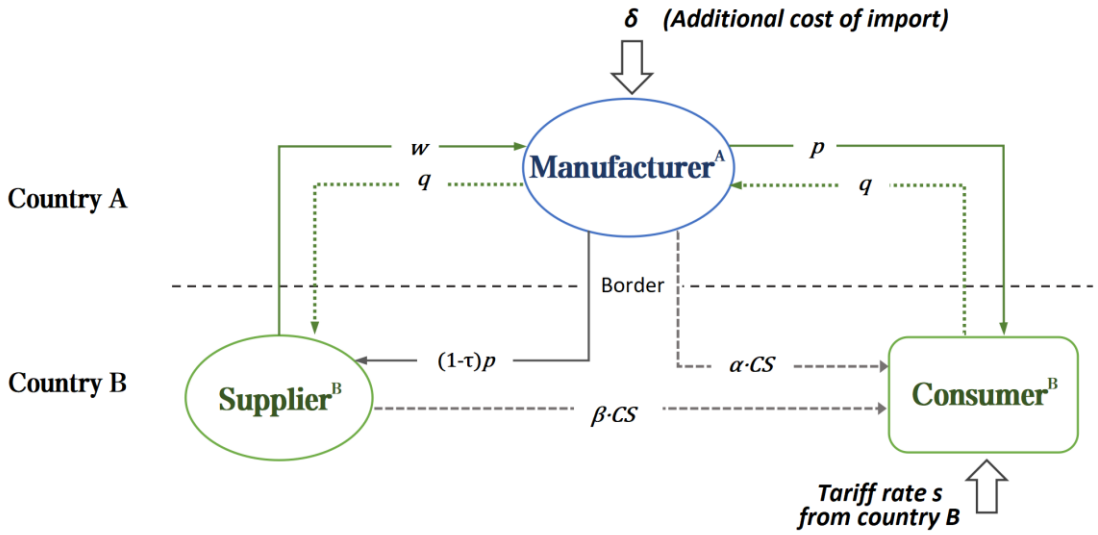

Figure 2 The CSR sharing mode under revenue-sharing contract

Under this model, the profit functions of the manufacture and the supplier are:

$$\pi_M^{III} = (\tau p - w - \delta)q \quad (6)$$

$$\pi_S^{III} = (w - c + (1 - \tau)p)q \quad (7)$$

The maximization problems of the two parties are:

$$max_p \;\; U_M = \pi_M^{III} + \alpha CS = (\tau p - w - \delta)q + \alpha \frac{(a - bp(1+s))^2}{2b(1+s)}$$

$$max_w \;\; U_S = \pi_S^{III} + \beta CS = (w - c + (1 - \tau)p)q + \beta \frac{(a - bp(1+s))^2}{2b(1+s)}$$

Using backward induction, we have the following result.

Theorem 3. *Under the revenue sharing contract, suppliers and manufacturers jointly conduct CSR, the optimal pricing decisions are:*

$p^{III*} = \frac{a(5-\alpha-2\beta-2\tau)+b(1+s)(c+\delta)}{b(1+s)(6-\alpha-2(\beta+\tau))}$, $w^{III*} = \frac{a(\tau(6-a-2(\beta+\tau))-3+\alpha+\beta)-b(1+s)(c(-3+\alpha+\beta)+(3-\beta-2\tau)\delta)}{b(1+s)(6-\alpha-2(\beta+\tau))}$.

We assume that $a(\tau(6-a-2(\beta+\tau))-3+\alpha+\beta) > b(1+s)(c(-3+\alpha+\beta)+(3-\beta-2\tau)\delta)$, *there is no negative wholesale price. Substituting* p^{III*} *and* w^{III*} *into formulas (1), (3), (6), (7), we obtain equilibrium outcomes as follow:*

$q^{III*} = \frac{a-b(1+s)(c+\delta)}{6-\alpha-2(\beta+\tau)}$, $CS^{III*} = \frac{(a-b(1+s)(c+\delta))^2}{2b(1+s)(6-\alpha-2(\beta+\tau))^2}$,

$\pi_M^{III*} = \frac{(3-\alpha-\beta-\tau)(a-b(1+s)(c+\delta))^2}{b(1+s)(6-\alpha-2(\beta+\tau))^2}$, $\pi_S^{III*} = \frac{(2-\beta-\tau)\left(a-b(1+s)(c+\delta)\right)^2}{b(1+s)(6-\alpha-2(\beta+\tau))^2}$.

Therefore, members will participate in the game if and only if $a > b(1+s)(c+\delta)$.

The following comparative static results follow from the above theorem.

Corollary 3.1. *The manufacturer's revenue-sharing with the supplier increases the level of CSR engagement of the latter.*

Notice that $\frac{\partial \pi_S^{III*}}{\partial \beta} = \frac{(a-b(1+s)(c+\delta))^2(\alpha-2(\beta+\tau-1))}{b(1+s)(6-\alpha-2(\beta+\tau))^3}$ and hence we have $\frac{\partial \pi_S^{III*}}{\partial \beta} > 0$ when $\beta < 1-\tau+\frac{\alpha}{2}$ whereas $\frac{\partial \pi_S^{III*}}{\partial \beta} < 0$ when $\beta < 1-\tau+\frac{\alpha}{2}$. Supplier's profit reaches the maximum when $\beta = 1-\tau+\frac{\alpha}{2}$, a value larger than the one in the Corollary 2.2 ($\beta = \frac{\alpha}{2}$). Therefore, when the manufacturer is willing to share its revenue with the supplier, the supplier will increase its CSR engagement.

Corollary 3.2. *An increase in supplier's revenue-sharing proportion (*$1-\tau$*) will increase final product price and reduce market demand. Under certain conditions, there is an optimal contract sharing mechanism* τ^* *that maximizes the profit of the manufacturer. The comparative static result of equilibrium conditions with respect to* τ *are as follow:*

$\frac{\partial p^{III*}}{\partial \tau} < 0$, $\frac{\partial q^{III*}}{\partial \tau} > 0$, $\frac{\partial \pi_S^{III*}}{\partial \tau} < 0$; $\frac{\partial^2 \pi_M^{III*}}{\partial \tau^2} = \frac{8\left(a-b(1+s)(c+\delta)\right)^2(3-2\alpha-\beta-\tau)}{b(1+s)(6-\alpha-2(\beta+\tau))^4}$.

The condition $\frac{\partial q^{III*}}{\partial \tau} > 0$ means that the equilibrium demand would decline when the supplier's proportion of revenue-sharing $(1-\tau)$ increases. This is a result of the increased price ($\frac{\partial p^{III*}}{\partial \tau} < 0$). Supplier's profit also increases as its shared revenue goes up ($\frac{\partial \pi_S^{III*}}{\partial \tau} < 0$). For the manufacturer, when the tuple (α, β, τ) satisfies the condition that $(\frac{1}{2} < \beta < 1) \wedge (\frac{1}{3}(4-2\beta) < \alpha < 1) \wedge (\frac{1}{2}(6-3\alpha-2\beta) < \tau < 1)$, its profit increases with $(1-\tau)$. Under this condition, forgo some of the revenue $(1-\tau)$ to the supplier will still increase the manufacturer's profit. Therefore, the revenue-sharing model is

a Pareto improvement from the voluntary engagement model.

In addition, when the tuple (α, β, τ) satisfies $(\frac{2-\beta}{2} < \alpha < 1) \wedge (3 - 2\alpha - \beta < \tau < 1)$, we have $\frac{\partial^2 \pi_M^{III*}}{\partial \tau^2} < 0$. Under this condition, there exists an optimal revenue sharing parameter $\tau^* = \frac{1}{2}(6 - 3\alpha - 2\beta)$ such that the manufacturer achieves maximized profit. Therefore, the manufacturer can select an appropriate level of revenue-sharing with the supplier according to consumer's awareness about CSR issues as well as the sensitivity of supplier's CSR level with respect to its profit.

4.4 Supplier S assumes CSR activities under the subsidy provided by government B (Model IV)

In our model, the intermediate product supplier and final product buyers are from the same nation, B. As a result, the supplier from B is more obliged to assume its domestic social responsibility. According to Corollary 2.2, the supplier's participation in CSR has valuable impact on the sustainable development of society in country B. Therefore, the government of country B has an incentive to help its supplier to engage in CSR activities to help build a sustainable society and prevent CSR disasters such as air pollution and "toxic apples". This subsection discusses whether and to what extent government subsidy can boost the supplier's CSR engagement. We follow the approach of Tsao et al. (2021) to model government subsidy as a proportion, φ, to the supplier's unit production cost. The model is depicted in Figure 3.

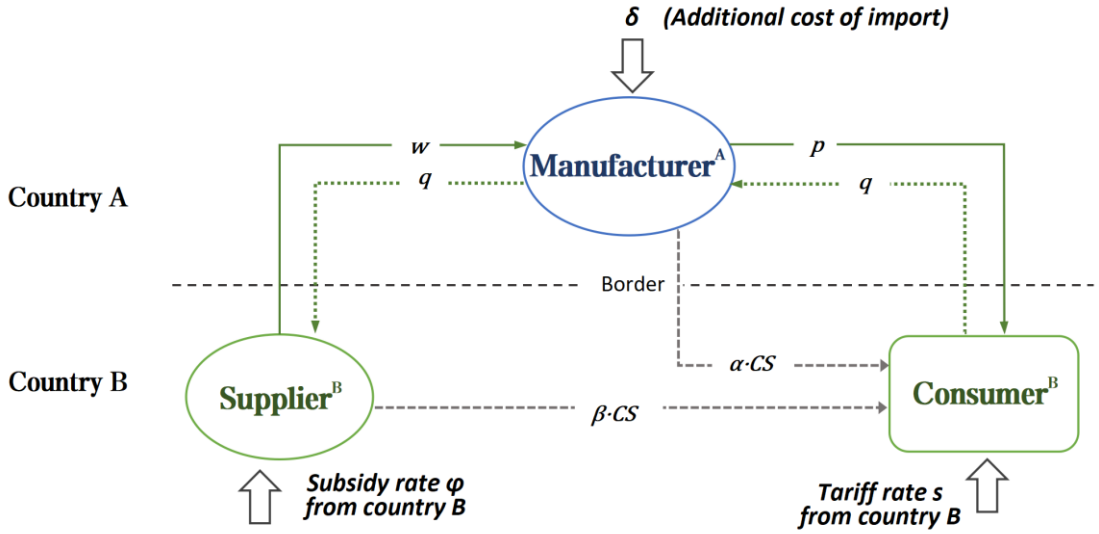

Figure 3 The CSR sharing mode under country B's government subsidy

In this model, the manufacturer's profit function is the same as from model III. The supplier's profit function is:

$$\pi_S^{IV} = (w - c(1 - \varphi))(a - bp(1 + s)) \quad (8)$$

The optimization problems of the manufacturer and the supplier are:

$$max_p \;\; U_M = \pi_M + \alpha CS = (p - w - \delta)(a - bp(1 + s)) + \alpha \frac{(a - bp(1+s))^2}{2b(1+s)},$$

$max_w \ \ U_S = \pi_S + \beta CS = \big(w - c(1-\varphi)\big)\big(a - bp(1+s)\big) + \beta \frac{\left(a-bp(1+s)\right)^2}{2b(1+s)}$.

Solving the problem with backward induction, we obtain Theorem 4.

Theorem 4. *Under government subsidy from the supplier's government, suppliers and manufacturers jointly conduct CSR，the optimal pricing decisions are:*

$p^{IV*} = \frac{a(3-\alpha-2\beta)+b(1+s)(c-\varphi c+\delta)}{b(1+s)(4-\alpha-2\beta)}$, $w^{IV*} = \frac{a(1-\beta)-b(1+s)(c(-3+\alpha+\beta)(1-\varphi)+(1-\beta)\delta)}{b(1+s)(4-\alpha-2\beta)}$

Substituting equilibrium prices into (1), (3), (5) and (8), we have:

$q^{IV*} = \frac{a-b(1+s)(c-\varphi c+\delta)}{4-\alpha-2\beta}$, $CS^{IV*} = \frac{(a-b(1+s)(c-\varphi c+\delta))^2}{2b(1+s)(4-\alpha-2\beta)^2}$,

$\pi_M^{IV*} = \frac{(2-\alpha-\beta)(a-b(1+s)(c-\varphi c+\delta))^2}{b(1+s)(4-\alpha-2\beta)^2}$, $\pi_S^{IV*} = \frac{(1-\beta)(a-b(1+s)(c-\varphi c+\delta))^2}{b(1+s)(4-\alpha-2\beta)^2}$.

Members would participate in the game if and only if $a > b(1+s)(c-\varphi c+\delta)$*. The social welfare in country B, represented by* $SW_B = \pi_S + CS$*, is:*

$SW_B^{IV*} = \frac{(3-2\beta)(a-b(1+s)(c-\varphi c+\delta))^2}{2b(1+s)(4-\alpha-2\beta)^2}$.

Based on the above result, we get the following comparative static conditions:

Corollary 4.1. *The level of government subsidy φ positively affects demand, profits, and consumer welfare.*

The above corollary follows from the fact that $\frac{\partial q^{IV*}}{\partial \varphi} > 0$,$\frac{\partial \pi_M^{IV*}}{\partial \varphi} > 0$,$\frac{\partial \pi_S^{IV*}}{\partial \varphi} > 0$, and $\frac{\partial CS^{IV*}}{\partial \varphi} > 0$. Therefore, government subsidy from the supplier's government can effectively improve both firms' incomes and the consumer welfare. Hence, it is sensible and considerate for government to adopt some measures to promote CSR behaviors from domestic suppliers. The processing trade accounts for a significant proportion in the GDP of emerging economies. Exporting low-end intermediate products tends to sacrifice the natural resources, environment, and the human right and the safety of domestic citizens in emerging economies (Jean, 2022; Krishnan et al., 2022; Van Tran, 2020). In the context of economic globalization, emerging economies are also very important export markets for large MNEs (Paul, 2020). Currently, the purpose of emerging government's subsidy is not to reduce the CSR burden of MNEs, but to improve the sustainability of former's social development. This embodies that the emerging government makes concentrated efforts on the welfare of its own citizens and consumers. Especially the due diligence obligations of MNEs in many developed countries have been extended to overseas upstream enterprises, so emerging economies should pay more attention to domestic suppliers' CSR behavior for promoting the trade and economy. Hence, it is reasonable for emerging government to take measures to subsidize some suppliers (Guo et al., 2022; Huang et al., 2019)

We will discuss in Section 5 how different subsidy schemes may generate different equilibrium outcomes, and how the government could make subsidy decisions.

5. Comparative Analysis and Numerical Simulation (Optimal Revenue Sharing and

Government Subsidy)

Based on the analyses of four models from Section 4, this section conducts comparative analyses and numerical simulations. In particular, Section 5.1 compares the equilibriums from all models and examines the link among them. In Section 5.2, we conduct numerical simulations to comprehensively observe the impact of exogenously given parameters on equilibrium outcomes and social welfare.

5.1 Comparative Analyses

Table 2 summarizes the equilibrium outcomes from the four models:

Table 2. Equilibrium Outcomes from Four Models

	π_M^*	π_S^*	CS^*	SW_B^*
I	$\frac{(2-\alpha)(a-b(1+s)(c+\delta))^2}{b(1+s)(4-\alpha)^2}$	$\frac{(a-b(1+s)(c+\delta))^2}{b(1+s)(4-\alpha)^2}$	$\frac{(a-b(1+s)(c+\delta))^2}{2b(1+s)(4-\alpha)^2}$	$\frac{3(a-b(1+s)(c+\delta))^2}{2b(1+s)(4-\alpha)^2}$
II	$\frac{(2-\alpha-\beta)(a-b(1+s)(c+\delta))^2}{b(1+s)(4-\alpha-2\beta)^2}$	$\frac{(1-\beta)(a-b(1+s)(c+\delta))^2}{b(1+s)(4-\alpha-2\beta)^2}$	$\frac{(a-b(1+s)(c+\delta))^2}{2b(1+s)(4-\alpha-2\beta)^2}$	$\frac{(3-2\beta)(a-b(1+s)(c+\delta))^2}{2b(1+s)(4-\alpha-2\beta)^2}$
III	$\frac{(3-\alpha-\beta-\tau)(a-b(1+s)(c+\delta))^2}{b(1+s)(6-\alpha-2(\beta+\tau))^2}$	$\frac{(2-\beta-\tau)\left(a-b(1+s)(c+\delta)\right)^2}{b(1+s)(6-\alpha-2(\beta+\tau))^2}$	$\frac{(a-b(1+s)(c+\delta))^2}{2b(1+s)(6-\alpha-2(\beta+\tau))^2}$	$\frac{(5-2\beta-2\tau)\left(a-b(1+s)(c+\delta)\right)^2}{2b(1+s)(\alpha+2(-3+\beta+\tau))^2}$
IV	$\frac{(2-\alpha-\beta)(a-b(1+s)(c-\varphi c+\delta))^2}{b(1+s)(4-\alpha-2\beta)^2}$	$\frac{(1-\beta)(a-b(1+s)(c-\varphi c+\delta))^2}{b(1+s)(4-\alpha-2\beta)^2}$	$\frac{(a-b(1+s)(c-\varphi c+\delta))^2}{2b(1+s)(4-\alpha-2\beta)^2}$	$\frac{(3-2\beta)(a-b(1+s)(c-\varphi c+\delta))^2}{2b(1+s)(4-\alpha-2\beta)^2}$

Comparing the equilibrium results and using numerical simulation, we obtain the following proposition.

Proposition 1. *From the perspective of profit maximization, there exists conditions such that the supplier voluntarily undertakes CSR activities. When the supplier engages in an insufficient amount of CSR, the manufacturer and the supplier country's governments have incentives to stimulate the supplier to improve CSR activities through revenue-sharing or subsidy.*

First, comparing the results from model I and II, we have $\pi_M^{II*} > \pi_M^{I*}$ when $(\alpha,\beta) \in (0 < \alpha \leq \frac{2}{3}(3-\sqrt{3}) \wedge 0 < \beta < 1) \vee (\frac{2}{3}(3-\sqrt{3}) < \alpha < 1 \wedge 0 < \beta < \frac{-16+16\alpha-3\alpha^2}{-8+4\alpha})$, and $\pi_S^{II*} > \pi_S^{I*}$ when $(\alpha,\beta) \in (0 < \alpha < 1) \wedge (0 < \beta < \frac{1}{4}(4\alpha-\alpha^2))$. Figure 4 plots the profit differences from model I and model II for the manufacture (region C) and the supplier (region B) in the (α,β)-coordinate planes.

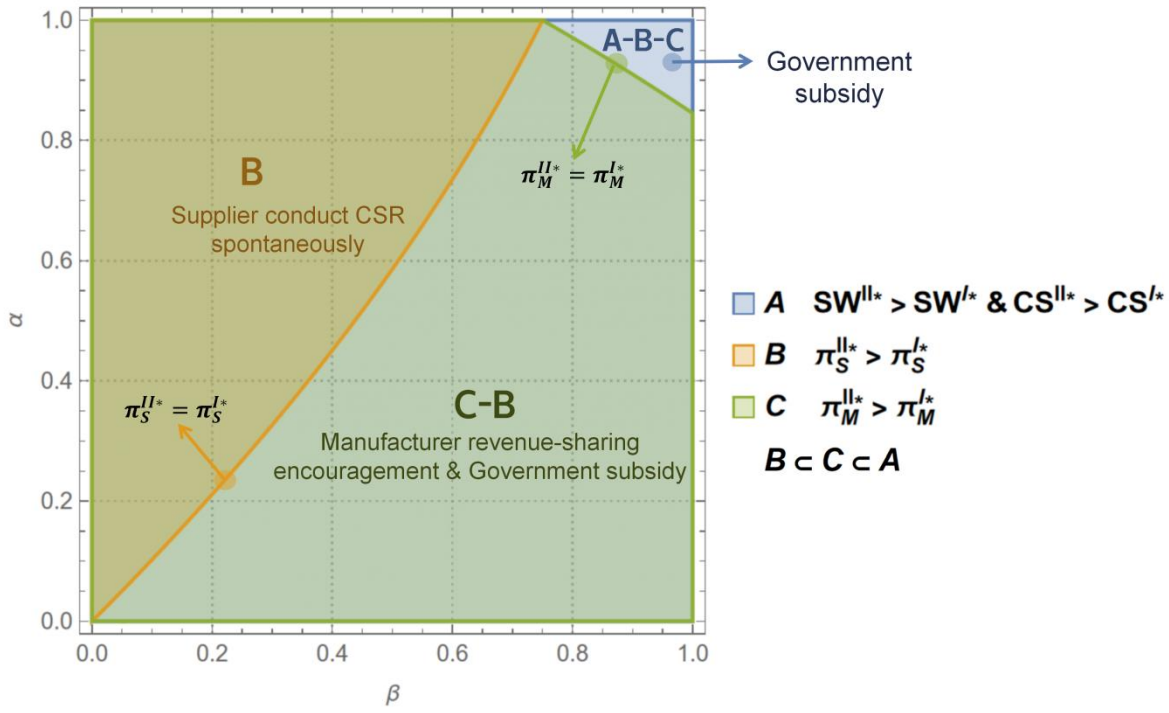

Figure 4. Decision Area

From Figure 4, region A encompasses the entire plane, indicating an improvement in both social welfare and consumer welfare in model II. Region B is the pentagonal region (the entire plane minus the blue area in the upper right corner), while region C is the triangle to the left. Hence, for most (α, β) combination, the manufacturer's profit increases when the supplier shares some of the CSR responsibilities ($\pi_M^{II*} - \pi_M^{I*} > 0$). At the same time, the supplier also benefits from taking on CSR activities ($\pi_S^{II*} - \pi_S^{I*} > 0$). The intersection of these two cases is depicted as regions B ($0 < \alpha < 1 \wedge 0 < \beta < \frac{1}{4}(4\alpha - \alpha^2)$) and C $\left(0 < \alpha \leq \frac{2}{3}\left(3 - \sqrt{3}\right) \wedge 0 < \beta < 1\right) \vee \left(\frac{2}{3}\left(3 - \sqrt{3}\right) < \alpha < 1 \wedge 0 < \beta < \frac{-16+16\alpha-3\alpha^2}{-8+4\alpha}\right)$ in Figure 4. In terms of country B's social welfare, it increases as long as the supplier chooses to engage in CSR. In other words, for any α and β between 0 and 1, we have $CS^{II*} > CS^{I*}, SW_B^{II*} > SW_B^{I*}$. This result is shown as region A ($0 < \alpha < 1, 0 < \beta < 1$) in Figure 4.

Thus, in region A, country B's socially concerned government has the incentive to provide subsidies to the supplier so that the latter would be willing to engage more in CSR. In this way, country B's CSR disaster can be decreased, and the consumer surplus and social welfare can be increased. In region B, it is profitable for the supplier to voluntarily engage in CSR while in region C, the manufacturer would benefit from more CSR activities taken on by the supplier ($B \subseteq C \subseteq A$). Therefore, in region C-B ($\pi_M^{II*} - \pi_M^{I*} > 0$ and $\pi_S^{II*} - \pi_S^{I*} < 0$, the green quadrangle), the manufacturer would have an incentive to devise the revenue-sharing mechanism to improve the supplier's willingness to engage in CSR (as studied in model III). Finally, in region A-B-C (the blue triangle), it is optimal for the government of country B to subsidize its supplier to participate in CSR sharing (model IV) to

improve overall social welfare.

Proposition 2. *The manufacturer can incentivize the supplier that does not wish to voluntarily engage in CSR through revenue sharing. This scheme would be a Pareto improvement for all supply chain participants.*

Comparing the outcomes from model I and 3, we have $\pi_M^{III*} > \pi_M^{I*}$ when (α, β, τ) satisfies $\frac{2-\alpha}{(4-\alpha)^2} < \frac{3-\alpha-\beta-\tau}{(6-\alpha-2(\beta+\tau))^2}$. Under these conditions, the manufacturer would invite the supplier to the revenue-sharing contract, as the supplier's participation in CSR increases the manufacturer's profit. On the other hand, we have $\pi_S^{III*} > \pi_S^{I*}$ when (α, β, τ) satisfies $\frac{2-\beta-\tau}{(6-\alpha-2(\beta+\tau))^2} > \frac{1}{(4-\alpha)^2}$. Under these circumstances, the supplier will have a higher profit if it accepts the revenue-sharing contract.

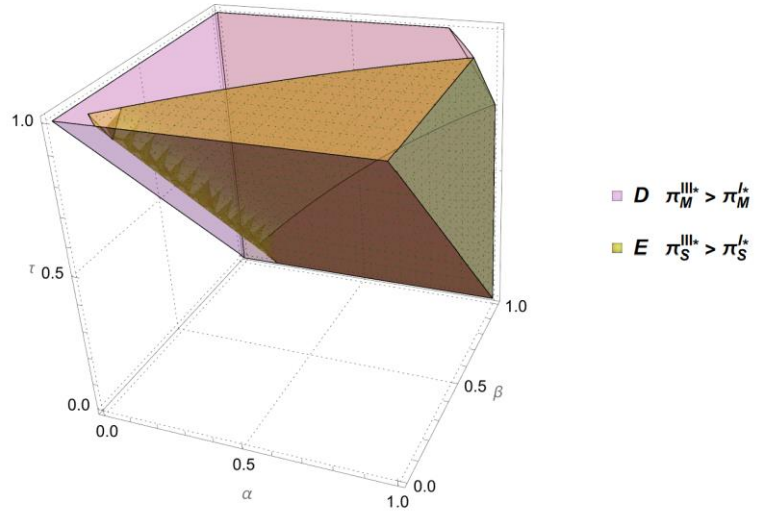

Figure 5. The regions of manufacturer revenue-sharing contract decision

Figure 5 plots the 3D diagram of these cases. Notice that when (α, β, τ) falls into the region D, the manufacturer would devise the revenue-sharing contract, whereas only in region E, the supplier would accept the contract. Therefore, there exist conditions under which all supply chain members' profits are improved through manufacturer's revenue-sharing proposal.

Finally, the government of country B can facilitate higher CSR participation by its supplier through production subsidy. There are three potential schemes that country B's government can deploy.

Proposition 3.1. *There exists φ_S^* such that undertaking more CSR would not change the profit of the supplier.*

If the supplier from country B is reluctant to voluntarily engage in CSR activities due to profit maximization consideration, the government of country B can provide subsidy to the supplier such that the latter enjoys the same profit as when it does not take on CSR. Formally, solving $\pi_S^{IV*} = \pi_S^{I*}$ one can

get:

$$\varphi_S^* = \frac{-c(1+s)(1-\beta)\big(a-b(1+s)(c+\delta)\big)+(4-\alpha-2\beta)^2\sqrt{\frac{c^2(1+s)^2(1-\beta)\big(a-b(1+s)(c+\delta)\big)^2}{(4-\alpha)^2(4-\alpha-2\beta)^2}}}{bc^2(1+s)^2(1-\beta)}.$$

Proposition 3.2. *There exists φ_{CS}^* such that the sum of country B's consumer surplus and government revenue is maximized.*

This optimal subsidy level can be obtained by solving the maximization problem:

$$max_{\varphi}\ CS^{IV*} - \varphi cq^{IV*} + sp^{IV*}q^{IV*}.$$

The optimal subsidy level is:

$$\varphi_{CS}^* = \frac{b(1+s)(3+2s-\alpha-2\beta)(c+\delta)-a(3-\alpha-2\beta-s(2-\alpha-2\beta))}{bc(1+s)(7+2s-2\alpha-4\beta)}.$$

Notice that there exist certain parameter values to ensure $\varphi_{CS}^* \in [0,1]$.

Proposition 3.3. *There exists φ_{SW}^* such that country B's overall social welfare, defined as the sum of consumer welfare and supplier profit, is maximized.*

Solving the optimization problem:

$$max_{\varphi}\ SW_B^{IV*} - \varphi cq^{IV*} + sp^{IV*}q^{IV*},$$

where $SW_B^{IV*} = \pi_S^{IV*} + CS_B^{IV*}$. We have:

$$\varphi_{SW}^* = \frac{b(1+s)(1+2s-\alpha)(c+\delta)-a(1-\alpha-s(2-\alpha-2\beta))}{bc(1+s)(5+2s-2\alpha-2\beta)}.$$

Notice that there exist certain parameter values to ensure $\varphi_{SW}^* \in [0,1]$.

The size of the subsidy reflects the intensity and cost of the subsidy policy. The government should choose the appropriate subsidy strategy based on the purpose and the cost input, depending on the market demand, additional costs of the supply chain global operation, and the CSR attention degree from the supply chain members. This argument is evident from Figure 6 that depicts the relative size of φ_S^*, φ_{CS}^*, and φ_{SW}^*.

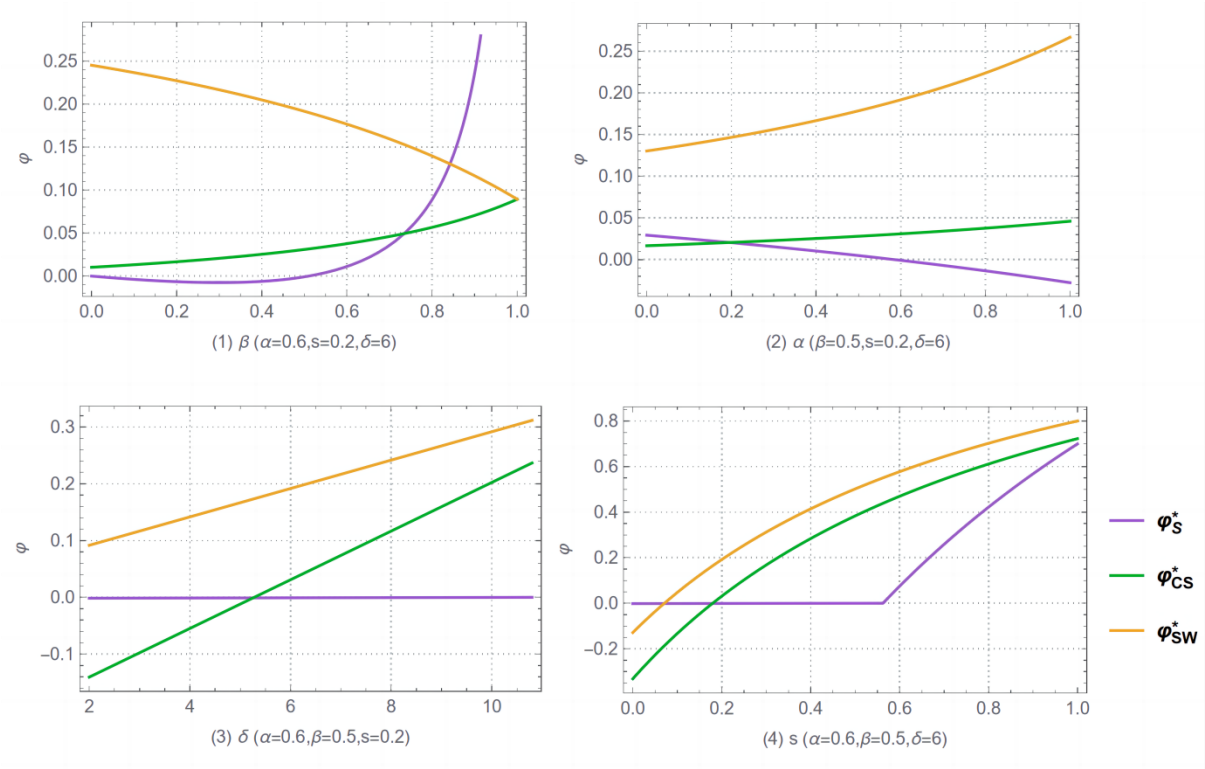

Figure 6. Subsidy sizes under different subsidy goals (a=300, b=12, c=10)

Notice that the relative size of three subsidy parameters is not fixed when either the CSR attention (α, β)changes (panel 1 and 2 in the upper half of Figure 6) or the transnational cost (s, δ)-changes (panel 3 and 4 in the lower half of Figure 6). Specifically, if the government considers supplier's profit when devising the subsidy policy, the cost of the policy is typically higher than if only increasing consumer welfare is the goal (i.e., $\varphi_{SW}^* > \varphi_{CS}^*$). This does not mean that φ_{SW}^* is always the highest cost policy. In fact, if β is sufficiently high (panel 1), it is possible to have $\varphi_S^* > \varphi_{SW}^*$, whereas if α is sufficiently low (panel 2), it is possible to have $\varphi_S^* > \varphi_{CS}^*$. However, when α and β are fixed (panel 3 and 4), we rarely observe situations that φ_S^* is too high. Moreover, it is unrealistic for φ to converge to 1 (meaning that the government bears all the supplier's cost).

When fixing α and β but varying s and δ (i.e., panel 3 and 4), it is possible for φ_{SW}^* and φ_{CS}^* to become negative. Under this condition (when s and δ is sufficiently low), it is optimal from the social welfare perspective to not provide subsidies to the supplier.

We also calculate subsidy levels under different parameter choices through numerical simulation. Table 3 tabulates the results. Notice that when demand is positive (i.e., $a > b(1+s)(c+\delta)$) and s and δ are fixed, $\varphi_S^* > \varphi_{SW}^*$ only occurs when the β is sufficiently large. However, it is common to observe $\varphi_S^* > \varphi_{CS}^*$. On the other hand, when α and β are fixed, $\varphi_{SW}^* < 0$ would only occur if s is sufficiently small. In this paper, we set the minimum tariff rate at 0.12. Under the condition of $\alpha = 0.5, \beta = 0.5, s \geq 0.12$, there only exists the situation that $\varphi_{CS}^* < 0$. When this happens, the

government can choose to subsidize the supplier through maximizing social welfare or maintaining supplier profit to enhance β.

Table 3. Numerical simulation of the subsidy parameters

Panel A: Simulation results of the subsidy parameters under different CSR sharing parameters

（s=0.2,δ=6, a=300, b=12, c=10）

β(α=0.4)	φ_{SW}^*	φ_{CS}^*	φ_S^*	β(α=0.5)	φ_{SW}^*	φ_{CS}^*	φ_S^*
0.5	0.1667	0.0254	0.0103	0.5	0.1784	0.0280	0.0049
0.6	0.1520	0.0310	0.0261	0.6	0.1635	0.0342	0.0189
0.7	0.1354	0.0377	0.0559	0.7	0.1467	0.0417	0.0461
0.8	0.1167	0.0461	0.1171	0.8	0.1274	0.0510	0.1034
0.9	0.0952	0.0567	0.0567	0.9	0.1051	0.0631	0.2590
β(α=0.6)	φ_{SW}^*	φ_{CS}^*	φ_S^*	β(α=0.7)	φ_{SW}^*	φ_{CS}^*	φ_S^*
0.5	0.1917	0.0310	-0.0008	0.5	0.2067	0.0342	-0.0069
0.6	0.1767	0.0377	0.0112	0.6	0.1917	0.0417	0.0030
0.7	0.1595	0.0461	0.0358	0.7	0.1744	0.0510	0.0247
0.8	0.1397	0.0567	0.0888	0.8	0.1542	0.0631	0.0734
0.9	0.1167	0.0705	0.2359	0.9	0.1303	0.0792	0.2114

Panel B: Simulation results of the subsidy parameters under different transnational operating costs

（α=0.5, β=0.5, a=300, b=12, c=10）

δ	φ_{SW}^*	φ_{CS}^*	φ_S^*	δ	φ_{SW}^*	φ_{CS}^*	φ_S^*
	(s=0.12, δ<12.3214)				(s=0.15, δ<11.7391)		
4	0.0166	-0.1836	0.0084	4	0.0594	-0.1344	0.0079
5	0.0395	-0.1425	0.0074	5	0.0837	-0.0925	0.0068
6	0.0623	-0.1015	0.0064	6	0.1079	-0.0507	0.0058
7	0.0851	-0.0604	0.0054	7	0.1321	-0.0088	0.0048
8	0.1080	-0.0194	0.0044	8	0.1564	0.0331	0.0038
9	0.1308	0.0216	0.0034	9	0.1806	0.0749	0.0028
δ	φ_{SW}^*	φ_{CS}^*	φ_S^*	δ	φ_{SW}^*	φ_{CS}^*	φ_S^*
	(s=0.20, δ<10.8333)				(s=0.30, δ<9.23077)		
4	0.1255	-0.0583	0.0069	4	0.2408	0.0747	0.0053
5	0.1520	-0.0152	0.0059	5	0.2714	0.1204	0.0043
6	0.1784	0.0280	0.0049	6	0.3019	0.1661	0.0033
7	0.2049	0.0712	0.0039	7	0.3325	0.2117	0.0023
8	0.2314	0.1144	0.0029	8	0.3630	0.2574	0.0012
9	0.2578	0.1576	0.0019	9	0.3936	0.3030	0.0002

5.2 Numerical Analyses

In this section, we use numerical analysis to demonstrate how changes in different parameters affect equilibrium outcomes in different models. Combining with Panda (2014) and Peng et al.(2023), throughout the analysis we set a=300, b=12, and c=10. As a baseline, we use α=0.6, β=0.3, s=0.12, δ=5, τ=0.90, and φ=0.02. This paper assumes that core multinational companies will pay more attention to CSR, and according to the conclusion of this paper, the optimal CSR attention of upstream enterprises is half that of downstream enterprises, and tariffs refer to the real data.[5] The results are tabulated in Table 4.

Table 4. Numerical analysis of the game results

The computational results in model I									The computational results in model II							
		p^{I*}	w^{I*}	q^{I*}	π_M^{I*}	π_s^{I*}	CS^{I*}	SW_B^{I*}			p^{II*}	w^{II*}	q^{II*}	π_M^{II*}	π_s^{II*}	CS^{II*}	SW_B^{II*}
baseline		**20.168**	**12.153**	**28.941**	**87.249**	**62.321**	**31.160**	**93.481**	**baseline**		**19.707**	**11.830**	**35.143**	**101.081**	**64.324**	**45.946**	**110.270**
α	0.5	20.230	12.092	28.114	88.216	58.811	29.405	88.216	α	0.5	19.797	11.767	33.931	102.796	59.964	42.832	102.796
	0.7	20.103	12.219	29.818	86.002	66.155	33.078	99.233		0.7	19.610	11.898	36.444	98.824	69.177	49.412	118.589
	0.8	20.034	12.288	30.750	84.425	70.354	35.177	105.532		0.8	19.506	11.971	37.846	95.915	74.601	53.286	127.887
s	0.10	20.455	12.273	30.000	95.455	68.182	34.091	102.273	β	0.4	19.506	11.690	37.846	106.572	63.943	53.286	117.230
	0.20	19.118	11.716	24.706	59.343	42.388	21.194	63.581		0.5	19.271	11.525	41.000	112.567	62.537	62.537	125.074
	0.25	18.529	11.471	22.059	45.415	32.439	16.220	48.659		0.6	18.994	11.331	44.727	119.079	59.540	74.424	133.964
δ	4	19.874	12.448	32.894	112.711	80.508	40.254	120.762	s	0.10	19.968	11.932	36.429	110.587	70.373	50.267	120.640
	6	20.462	11.859	24.988	65.043	46.459	23.230	69.689		0.20	18.750	11.458	30.000	68.750	43.750	31.250	75.000
	7	20.756	11.565	21.035	46.092	32.923	16.461	49.384		0.25	18.214	11.250	26.786	52.615	33.482	23.916	57.398
									δ	4	19.350	12.080	39.943	130.578	83.095	59.354	142.449
										6	20.064	11.580	30.343	75.354	47.953	34.252	82.204
										7	20.421	11.330	25.543	53.399	33.981	24.272	58.253

The computational results in model III									The computational results in model IV							
		p^{III*}	w^{III*}	q^{III*}	π_M^{III*}	π_s^{III*}	CS^{III*}	SW_B^{III*}			p^{IV*}	w^{IV*}	q^{IV*}	π_M^{IV*}	π_s^{IV*}	CS^{IV*}	SW_B^{IV*}
baseline		**19.881**	**9.964**	**32.800**	**96.057**	**64.038**	**40.024**	**104.062**	**baseline**		**19.635**	**11.680**	**36.103**	**106.678**	**67.886**	**48.490**	**116.377**
α	0.5	19.960	9.893	31.742	97.457	59.973	37.483	97.457	α	0.5	19.728	11.616	34.858	108.489	63.285	45.204	108.489
	0.7	19.797	10.040	33.931	94.230	68.531	42.832	111.362		0.7	19.536	11.750	37.440	104.297	73.008	52.149	125.157
	0.8	19.707	10.121	35.143	91.891	73.513	45.946	119.459		0.8	19.429	11.825	38.880	101.227	78.732	56.237	134.969
β	0.4	19.707	9.860	35.143	101.081	64.324	45.946	110.270	β	0.4	19.429	11.536	38.880	112.474	67.485	56.237	123.722
	0.5	19.506	9.739	37.846	106.572	63.943	53.286	117.230		0.5	19.188	11.367	42.120	118.801	66.001	66.001	132.001

[5] According to China's import tariff regulations, the majority of goods are subject to import duties ranging from 10% to 20%, with a presumed baseline rate of 12% in this paper.

The details can be found in https://www.gov.cn/zhengce/zhengceku/2019-10/14/content_5439470.htm

	0.6	19.271	9.598	41.000	112.567	62.537	62.537	125.074		0.6	18.903	11.168	45.949	125.674	62.837	78.546	141.383
s	0.10	20.152	10.046	34.000	105.091	70.061	43.788	113.849	s	0.10	19.896	11.782	37.371	116.385	74.063	52.902	126.966
	0.20	18.889	9.667	28.000	65.333	43.556	27.222	70.778		0.20	18.679	11.308	31.029	73.545	46.801	33.430	80.231
	0.25	18.333	9.500	25.000	50.000	33.333	20.833	54.167		0.25	18.143	11.100	27.857	56.908	36.214	25.867	142.449
δ	4	19.548	10.264	37.280	124.089	82.726	51.704	134.430	δ	4	19.278	11.930	40.903	136.931	87.138	62.241	149.379
	6	20.214	9.664	28.320	71.609	47.739	29.837	77.577		6	19.992	11.430	31.303	80.198	51.035	36.454	87.488
	7	20.548	9.364	23.840	50.745	33.830	21.144	54.974		7	20.350	11.180	26.503	57.488	36.583	26.131	62.714
τ	0.85	19.960	9.014	31.742	93.708	63.722	37.483	101.205	φ	0.03	19.635	11.680	36.103	106.678	67.886	48.490	116.377
	0.80	20.034	8.052	30.750	91.461	63.319	35.177	98.496		0.05	19.528	11.455	37.543	115.358	73.410	52.436	125.845
	0.75	20.103	7.082	29.818	89.309	62.847	33.078	95.925		0.10	19.350	11.080	39.943	130.578	83.095	59.354	142.449
	0.70	20.168	6.103	28.941	87.249	62.321	31.160	93.481		0.20	18.992	10.330	44.743	163.848	104.267	74.476	178.743

Baseline parameters: α=0.6, β=0.3, s=0.12, δ=5, τ=0.90, φ=0.02 (a=300, b=12, c=10)

First, as shown in Table 4, the manufacturer's increasing social responsibility attention will reduce its profit, and the cost of CSR investment and profit loss will increase as α rises. The left panel of Figure 7 visualizes this result for selected parameters (we set $\beta = 0.3$ for model II and plot the equilibrium profits against those from model I, in which there is no β). However, the manufacturer is still willing to bear some CSR cost as it boosts its profit. Comparing baseline results from model I and model II tabulated in Table 4, when the supplier voluntarily takes on some CSR duty (i.e., β increases from 0 to 0.3), the supplier's profit increases (π_S^{II*} rises from 62.321 to 64.324). When fixing $\alpha = 0.6$ and varying β, we see that the manufacturer's profit rises constantly, whereas the supplier's profit is a hump-shaped curve (see the right panel of Figure 7), suggesting there is an optimal level CSR engagement for the supplier.

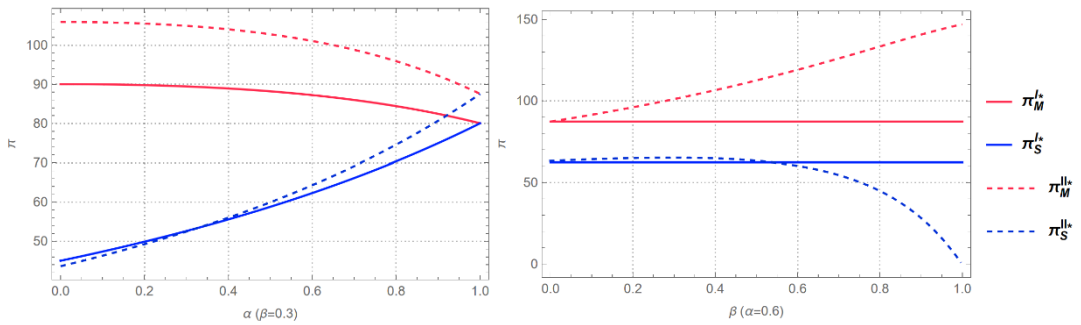

Figure 7. Members' profit under different levels of α and β

Second, compared to their sensitivities to changes in α and β, profits of the manufacturer and the supplier are more sensitive to changes in δ and s. Formally, we have $\left|\frac{\Delta\pi_S^*}{\Delta s}\frac{s}{\pi_S^*}\right| > \left|\frac{\Delta\pi_S^*}{\Delta\alpha}\frac{\alpha}{\pi_S^*}\right|$, $\left|\frac{\Delta\pi_M^*}{\Delta s}\frac{s}{\pi_M^*}\right| > \left|\frac{\Delta\pi_M^*}{\Delta\beta}\frac{\beta}{\pi_S^*}\right|$, and $\left|\frac{\Delta CS^*}{\Delta s}\frac{s}{CS^*}\right| > \left|\frac{\Delta CS^*}{\Delta\beta}\frac{\beta}{\Delta CS^*}\right|$ hold true across all models. For instance, as

demonstrated in Table 4, an increase in the subsidy parameter φ from 0.03 to 0.20 will cause a 53.77% increase in manufacturer's profit and 53.59% increase supplier's profit. Moreover, we have $\left|\frac{\Delta CS^*}{\Delta \varphi}\frac{\varphi}{CS^*}\right| > \left|\frac{\Delta CS^*}{\Delta \tau}\frac{\tau}{CS^*}\right|$, suggesting that government subsidy to the supplier has a more significant impact on the social welfare than that of the revenue-sharing contract between the manufacturer and the supplier. As shown in Figure 8, a change in φ (orange) results in a much larger change in consumer surplus than a same range change in τ (green) does. Therefore, our findings suggest that it is necessary for emerging economies to subsidize their suppliers if they want to significantly improve social welfare.

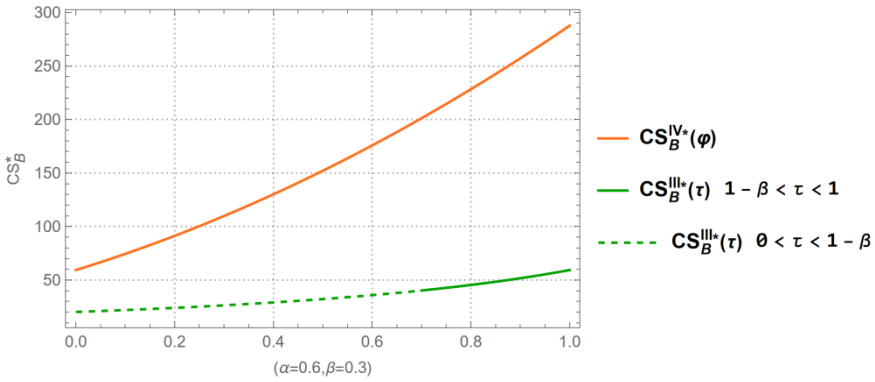

Figure 8. Changes in consumer welfare under changes in τ and φ

Notice that different types of companies have different economic benefits from CSR investment (Hong & Kacperczyk, 2009; Lys et al., 2015). Hence, the gap in initial CSR behaviors from different MNEs is relatively large, and this heterogeneity also exists in the government subsidy behavior. The subsidy policy is not necessary to target all the suppliers in their countries because some MNEs' attentions are sufficient. Emerging government should focus on the firms that do more damage to social sustainability, such as the suppliers from industries with high pollution, labor demand, and the brands with high purchase willingness of domestic consumers. MNEs from these industries also pay less attention to CSR behavior because of the lower return on socially responsible investment (Hong, 2009), and the heavier burden from multinational operation (Corollary 1.3). However, the details of emerging government's heterogeneous behavior are not within our discussion.

In addition, comparing different equilibrium outcomes under the same model, we find that when altering exogenous parameters (costs of transnational operation and CSR behavior), supply chain members' optimal choices (p and w) only varies in a small range, whereas demand and consumer welfare react more significantly. Thus, we conclude that the impacts of exogenous parameters on consumer welfare mainly operate through their influences over market demand.

6. Conclusion and Discussion

In this increasingly competitive international market, conducting socially responsible behaviors has become one of the most widely adopted strategies by MNEs to win over investors and consumers. However, the CSR problem happens frequently in the upstream of the multinational supply chain

(Golgeci et al., 2021; Ha et al., 2022; Villena & Gioia, 2020) . Moreover, whether CSR will always have a positive impact on the performance of MNEs remains controversial (Beji et al., 2021; Hong & Kacperczyk, 2009; Liao et al., 2018; Lys et al., 2015) To shed more lights on these issues, we build a transnational supply chain model to investigate the CSR sharing schemes along the supply chain under the international operational costs. Then, we reveal the importance of suppliers' CSR engagements to all supply chain participants' profits and overall social welfare by comparing different schemes. Finally, we explore internal (revenue sharing) and external (subsidy) mechanisms to incentivize emerging market suppliers to engage in CSR activities and reduce the sustainable burdens of MNEs and emerging countries' governments. We consider four scenarios with different CSR-sharing mechanisms in this paper. In addition to filling the existing theoretical gaps, we draw the following conclusions and managerial implications.

First, supply chain members' socially responsible behaviors will expand the demand for the supply chain's final product, meaning that CSR strategy can help MNEs win market shares. The reason is that consumers can benefit directly from socially responsible behaviors and thus are more willing to buy products from responsible MNEs. As a result, MNEs can also improve their overall utility through CSR activities . Therefore, due to the surge of investors' attention to sustainability and ethical behaviors, and the ambitions of global expansion, the MNEs should bring CSR planning to a strategic level. And MNEs should expand their CSR focus beyond environmental issues to include social issues such as human rights and employee benefits. At present, some MNEs are also conducting global CSR management activities. For example, Unilever's business goal is to make sustainable life normal and strive to reduce carbon emissions in reproduction and operations, while Apple has clearly stated that it will support everyone and the community in the supply chain.[6]

Second, high additional costs stemming from international operations will amplify the CSR costs borne by the MNEs. Even though MNEs will pass on some of the costs to other parties along the supply chain, the additional costs harm MNEs more than their suppliers. Thus, with more countries involved in the supply chain, these additional operational costs would further hamper MNEs' CSR commitments. This result is consistent with the findings that MNEs with more complicated international backgrounds perform worse on the CSR front (Beji et al., 2021; Liao et al., 2018). Hence, for MNEs to achieve long-run development, their managers must balance the additional cost of international operations and CSR inputs. Certain CSR actions ought to be taken in accordance with the circumstances of various nations. This is already being done by a few sizable international corporations. For instance, since opening in China, Wal-Mart has donated about 160 million yuan of funds and goods nationwide, and its Chinese staff members have put in over 240,000 hours on social welfare projects.employees

[6] Some evidence can be found on the company's official website: https://www.unilever.com/sustainability/, https://www.apple.com.cn/supply-chain/

have invested more than 240,000 hours in social welfare undertakings. Likewise, Xiaomi has multinational CSR policies for factories in other countries, such as developing a "Diversity-Equality-Inclusion" strategy to improve the employment situation of local women.[7]

Third, compared to the CSR activities of MNEs, suppliers' CSR activities have more profound impacts on MNEs' profitability and social development. The reason is that demand and consumer welfare are more sensitive to the change of β than to the change of α. In addition, suppliers' CSR engagements can reduce the cost of MNEs' CSR activities. However, even though, under certain conditions, suppliers will voluntarily engage in CSR activities, the level of engagement is insufficient. Therefore, MNEs have the incentive to share revenue with suppliers to improve the CSR activities of the latter. This sharing mechanism brings along a Pareto improvement to society. Besides, because of the significance of suppliers' CSR behavior, the CSR activities of suppliers from emerging markets would help them to stand out from the competition with other suppliers in the global supply chain operation. Hence, to stimulate domestic sustainability development, emerging economies' governments can provide subsidies to suppliers from their countries for higher CSR activities. Compared to the MNE revenue-sharing mechanism, government subsidy has a more profound positive impact on supply chain participants' profits and social welfare. Therefore, governments of emerging market should consider appropriate levels of CSR subsidy and tariff reduction to induce their suppliers to engage in sufficient levels of CSR. Especially if certain rich nations have implemented supply chain CSR legislation, developing countries' subsidies will be more valuable in integrating their domestic firms into the global value chain division of labor.

Besides, there are also certain limitations in our work. First, our model provides a simplified framework for the international supply chain. In future research, we can allow richer features that provide a closer representation of reality. Second, we only consider a two-tier supply chain in our analyses. In future studies, one can add more layers to the supply chain, allowing more complicated subsidy and revenue-sharing mechanisms. Third, our model simplifies the international operating cost to the tariff. However, other uncertainties in international operations (e.g., exchange rate and geopolitical risk) can be explored in future studies.

[7] Data can be found incompany's official website: https://www.walmart.cn/sustainability/,

https://www.mi.com/csr#/

References

Amaeshi, K. M., Osuji, O. K., & Nnodim, P. (2008). Corporate social responsibility in supply chains of global brands: A boundaryless responsibility? Clarifications, exceptions and implications. *Journal of Business Ethics*, *81*(1), 223–234. https://doi.org/10.1007/S10551-007-9490-5/METRICS

Amir, A. Z., & Serafeim, G. (2018). Why and how investors use ESG information: Evidence from a global survey. *Financial Analysts Journal*, *74*(3), 87–103. https://doi.org/10.2469/FAJ.V74.N3.2

Bai, Q., Chen, M., Nikolaidis, Y., & Xu, J. (2021). Improving sustainability and social responsibility of a two-tier supply chain investing in emission reduction technology. *Applied Mathematical Modelling*, 95, 688-714.

Barin Cruz, L., Boehe, D. M., & Ogasavara, M. H. (2015). CSR-based Differentiation Strategy of Export Firms From Developing Countries: An Exploratory Study of the Strategy Tripod. *Business and Society*, *54*(6), 723–762. https://doi.org/10.1177/0007650312473728/ASSET/IMAGES/LARGE/10.1177_0007650312473728-FIG2.JPEG

Beji, R., Yousfi, O., Loukil, N., & Omri, A. (2021). Board Diversity and Corporate Social Responsibility: Empirical Evidence from France. *Journal of Business Ethics*, *173*(1), 133–155. https://doi.org/10.1007/S10551-020-04522-4/TABLES/13

Bian, J., Liao, Y., Wang, Y. Y., & Tao, F. (2021). Analysis of firm CSR strategies. *European Journal of Operational Research*, *290*(3), 914–926. https://doi.org/10.1016/J.EJOR.2020.03.046

Boehe, D. M., & Cruz, L. B. (2010). Corporate social responsibility, product differentiation strategy and export performance. *Journal of Business Ethics*, *91*(SUPPL 2), 325–346. https://doi.org/10.1007/S10551-010-0613-Z/METRICS

Brander, J. A., & Spencer, B. J. (1985). Export subsidies and international market share rivalry. *Journal of international Economics*, 18(1-2), 83-100.

Buell, R. W., & Kalkanci, B. (2020). How Transparency into Internal and External Responsibility Initiatives Influences Consumer Choice. *Management Science*, *67*(2), 932–950. https://doi.org/10.1287/MNSC.2020.3588

Cachon, G. P., & Lariviere, M. A. (2005). Supply Chain Coordination with Revenue-Sharing Contracts: Strengths and Limitations. *Management Science*, *51*(1), 30–44. https://doi.org/10.1287/MNSC.1040.0215

Chen, J., Hu, Q., & Song, J. S. (2017). Supply Chain Models with Mutual Commitments and Implications for Social Responsibility. *Production and Operations Management*, *26*(7), 1268–1283. https://doi.org/10.1111/POMS.12674

Chen, J. Y., Dimitrov, S., & Pun, H. (2019). The impact of government subsidy on supply Chains' sustainability innovation. *Omega*, *86*, 42–58. https://doi.org/10.1016/J.OMEGA.2018.06.012

Chen, L., & Lee, H. L. (2017). Sourcing Under Supplier Responsibility Risk: The Effects of Certification, Audit, and Contingency Payment. *Management Science*, *63*(9), 2795–2812. https://doi.org/10.1287/MNSC.2016.2466

Chen, X., Wang, X., & Chan, H. K. (2017). Manufacturer and retailer coordination for environmental and economic competitiveness: A power perspective. *Transportation Research Part E: Logistics and Transportation Review*, *97*, 268–281. https://doi.org/10.1016/J.TRE.2016.11.007

Chkir, I., El Haj Hassan, B., Rjiba, H., & Saadi, S. (2021). Does corporate social responsibility influence corporate

innovation? International evidence. *Emerging Markets Review*, *46*, 100746. https://doi.org/10.1016/J.EMEMAR.2020.100746

Clarke, T., & Boersma, M. (2017). The Governance of Global Value Chains: Unresolved Human Rights, Environmental and Ethical Dilemmas in the Apple Supply Chain. *Journal of Business Ethics*, *143*(1), 111–131. https://doi.org/10.1007/S10551-015-2781-3/METRICS

Cohen, M. C., Lobel, R., & Perakis, G. (2015). The Impact of Demand Uncertainty on Consumer Subsidies for Green Technology Adoption. *Management Science*, *62*(5), 1235–1258. https://doi.org/10.1287/MNSC.2015.2173

Dai, X., Lin, Y. T., Shi, R., & Xu, D. (2020). A manufacturer's responsible sourcing strategy: going organic or participating in fair trade? *Annals of Operations Research*, *291*(1–2), 195–218. https://doi.org/10.1007/S10479-018-3090-X/FIGURES/2

Donaldson, T., & Preston, L. E. (1995). The Stakeholder Theory of the Corporation: Concepts, Evidence, and Implications. *Academy of Management Review*, *20*(1), 65–91. https://doi.org/10.5465/amr.1995.9503271992

Felbermayr, G., Jung, B., & Larch, M. (2015). The welfare consequences of import tariffs: A quantitative perspective. *Journal of International Economics*, *97*(2), 295–309. https://doi.org/10.1016/J.JINTECO.2015.05.002

Fourati, Y. M., & Dammak, M. (2021). Corporate social responsibility and financial performance: International evidence of the mediating role of reputation. *Corporate Social Responsibility and Environmental Management*, *28*(6), 1749–1759. https://doi.org/10.1002/CSR.2143

Galagedera, D. U. A. (2019). Modelling social responsibility in mutual fund performance appraisal: A two-stage data envelopment analysis model with non-discretionary first stage output. *European Journal of Operational Research*, *273*(1), 376–389. https://doi.org/10.1016/J.EJOR.2018.08.011

Gereffi, G. (2019). Economic upgrading in global value chains. In S. Ponte, G. Gereffi, & G. Raj-Reichert (Eds.), *Handbook on Global Value Chains* (pp. 240–254). Edward Elgar Publishing Ltd. https://doi.org/10.4337/9781788113779.00022

Gillan, S. L., Koch, A., & Starks, L. T. (2021). Firms and social responsibility: A review of ESG and CSR research in corporate finance. *Journal of Corporate Finance*, *66*, 101889. https://doi.org/10.1016/J.JCORPFIN.2021.101889

Golgeci, I., Makhmadshoev, D., & Demirbag, M. (2021). Global value chains and the environmental sustainability of emerging market firms: A systematic review of literature and research agenda. *International Business Review*, *30*(5), 101857. https://doi.org/10.1016/J.IBUSREV.2021.101857

Guo, R., Lee, H. L., & Swinney, R. (2016). Responsible Sourcing in Supply Chains. *Management Science*, *62*(9), 2722–2744. https://doi.org/10.1287/MNSC.2015.2256

Guo, X., Cheng, L., & Yu, Y. (2022). Government subsidy policy for green and efficient raw materials considering farmer heterogeneity. *Production and Operations Management*, *31*(11), 4095–4112. https://doi.org/10.1111/POMS.13806

Ha, A. Y., Shang, W., & Wang, Y. (2022). Supplier Audit Information Sharing and Responsible Sourcing. *Management Science*, *69*(1), 308–324. https://doi.org/10.1287/MNSC.2022.4358

Heydari, J., & Rafiei, P. (2020). Integration of environmental and social responsibilities in managing supply chains: A mathematical modeling approach. *Computers & Industrial Engineering*, 145, 106495.

Hong, H., & Kacperczyk, M. (2009). The price of sin: The effects of social norms on markets. *Journal of Financial*

Economics, *93*(1), 15–36. https://doi.org/10.1016/J.JFINECO.2008.09.001

Huang, L., Song, J.-S., & Swinney, R. (2022). Managing Social Responsibility in Multitier Supply Chains. *Manufacturing & Service Operations Management*, *24*(6), 2843–2862. https://doi.org/10.1287/MSOM.2021.1063

Huang, Z., Liao, G., & Li, Z. (2019). Loaning scale and government subsidy for promoting green innovation. *Technological Forecasting and Social Change*, *144*, 148–156. https://doi.org/10.1016/J.TECHFORE.2019.04.023

Jamali, D. (2008). A stakeholder approach to corporate social responsibility: A fresh perspective into theory and practice. *Journal of Business Ethics*, *82*(1), 213–231. https://doi.org/10.1007/s10551-007-9572-4

Jean, C. (2022). A Study of India's Role and Importance in Future Global Supply Chains. *Supply Chain and Sustainability Research: SCSR*, *1*(1).

Kim, K. H., Kim, M. C., & Qian, C. (2018). Effects of Corporate Social Responsibility on Corporate Financial Performance: A Competitive-Action Perspective. *Journal of Management*, *44*(3), 1097–1118. https://doi.org/10.1177/0149206315602530

Kim, S., Wagner, S. M., & Colicchia, C. (2019). The Impact of Supplier Sustainability Risk on Shareholder Value. *Journal of Supply Chain Management*, *55*(1), 71–87. https://doi.org/10.1111/JSCM.12188

Kouvelis, P., & Rosenblatt, M. J. (2002). A Mathematical Programming Model for Global Supply Chain Management: Conceptual Approach and Managerial Insights. In J. Geunes, P. M. Pardalos, & H. E. Romeijn (Eds.), *Supply Chain Management: Models, Applications, and Research Directions* (Vol. 62, pp. 245–277). Springer, Boston, MA. https://doi.org/10.1007/0-306-48172-3_10

Krajewski, M., Tonstad, K., & Wohltmann, F. (2021). Mandatory Human Rights Due Diligence in Germany and Norway: Stepping, or Striding, in the Same Direction? *Business and Human Rights Journal*, *6*(3), 550–558. https://doi.org/10.1017/BHJ.2021.43

Krishnan, LRK., Krishnan, D., & Meenakshi. (2022). Employment Practices at Apple; Social and Legal Issues Disrupting India's Industrial Relations Landscape. *Journal of the International Academy for Case Studies*, *28*(4).

Kumar, A., Ayedee, N., & Gupta, N. (2020). Xiaomi's Journey in India: A Roller Coaster Ride. *International Journal of Management (IJM)*, *11*(3). https://doi.org/10.1108/02756660610640173

Lee, K., & Jung, M. (2015). Overseas factories, domestic employment, and technological hollowing out: a case study of Samsung's mobile phone business. *Review of World Economics*, *151*(3), 461–475. https://doi.org/10.1007/S10290-015-0219-8/METRICS

Li, Y., Tong, Y., Ye, F., & Song, J. (2020). The choice of the government green subsidy scheme: innovation subsidy vs. product subsidy. *International Journal of Production Research*, *58*(16), 4932–4946. https://doi.org/10.1080/00207543.2020.1730466

Liao, L., Lin, T. P., & Zhang, Y. (2018). Corporate Board and Corporate Social Responsibility Assurance: Evidence from China. *Journal of Business Ethics*, *150*(1), 211–225. https://doi.org/10.1007/S10551-016-3176-9/TABLES/7

Lys, T., Naughton, J. P., & Wang, C. (2015). Signaling through corporate accountability reporting. *Journal of Accounting and Economics*, *60*(1), 56–72. https://doi.org/10.1016/J.JACCECO.2015.03.001

Ma, P., Shang, J., & Wang, H. (2017). Enhancing corporate social responsibility: Contract design under information asymmetry. *Omega*, *67*, 19–30. https://doi.org/10.1016/J.OMEGA.2016.03.004

Melo, M. T., Nickel, S., & Saldanha-da-Gama, F. (2009). Facility location and supply chain management – A review. *European Journal of Operational Research*, *196*(2), 401–412. https://doi.org/10.1016/J.EJOR.2008.05.007

Mitra, S., & Webster, S. (2008). Competition in remanufacturing and the effects of government subsidies. *International Journal of Production Economics*, *111*(2), 287–298. https://doi.org/10.1016/J.IJPE.2007.02.042

Modak, N. M., Kazemi, N., & Cárdenas-Barrón, L. E. (2019). Investigating structure of a two-echelon closed-loop supply chain using social work donation as a Corporate Social Responsibility practice. International Journal of Production Economics, 207, 19-33.

Muller, A., & Kolk, A. (2009). CSR Performance in Emerging Markets: Evidence from Mexico. *Journal of Business Ethics*, *85*(S2), 325–337. https://doi.org/10.1007/s10551-008-9735-y

Newman, C., Rand, J., Tarp, F., & Trifkovic, N. (2018). The transmission of socially responsible behaviour through international trade. *European Economic Review*, *101*, 250–267. https://doi.org/10.1016/J.EUROECOREV.2017.10.013

Ni, D., & Li, K. W. (2012). A game-theoretic analysis of social responsibility conduct in two-echelon supply chains. *International Journal of Production Economics*, *138*(2), 303–313. https://doi.org/10.1016/J.IJPE.2012.04.002

Orsdemir, A., Hu, B., & Deshpande, V. (2019). Ensuring Corporate Social and Environmental Responsibility Through Vertical Integration and Horizontal Sourcing. *Manufacturing & Service Operations Management*, *21*(2), 417–434. https://doi.org/10.1287/MSOM.2018.0744

Panda, S. (2014). Coordination of a socially responsible supply chain using revenue sharing contract. *Transportation Research Part E: Logistics and Transportation Review*, *67*, 92–104. https://doi.org/10.1016/J.TRE.2014.04.002

Panda, S., & Modak, N. M. (2016). Exploring the effects of social responsibility on coordination and profit division in a supply chain. *Journal of Cleaner Production*, *139*, 25–40. https://doi.org/10.1016/J.JCLEPRO.2016.07.118

Panda, S., Modak, N. M., Basu, M., & Goyal, S. K. (2015). Channel coordination and profit distribution in a social responsible three-layer supply chain. *International Journal of Production Economics*, *168*, 224–233. https://doi.org/10.1016/J.IJPE.2015.07.001

Panda, S., Modak, N. M., & Cárdenas-Barrón, L. E. (2017). Coordinating a socially responsible closed-loop supply chain with product recycling. *International Journal of Production Economics*, *188*, 11–21. https://doi.org/10.1016/J.IJPE.2017.03.010

Patz, C. (2022). The EU's Draft Corporate Sustainability Due Diligence Directive: A First Assessment. *Business and Human Rights Journal*, *7*(2), 291–297. https://doi.org/10.1017/BHJ.2022.19

Paul, J. (2020). Marketing in emerging markets: a review, theoretical synthesis and extension. *International Journal of Emerging Markets*, *15*(3), 446–468. https://doi.org/10.1108/IJOEM-04-2017-0130/FULL/XML

Peng, Q., Wang, C., & Goh, M. (2023). Green innovation decision and coordination of supply chain under corporate social responsibility and risk preferences. *Computers & Industrial Engineering*, 185, 109703-. https://doi.org/10.1016/j.cie.2023.109703

Prior, D., Surroca, J., & Tribó, J. A. (2008). Are Socially Responsible Managers Really Ethical? Exploring the Relationship Between Earnings Management and Corporate Social Responsibility. *Corporate Governance: An International Review*, *16*(3), 160–177. https://doi.org/10.1111/J.1467-8683.2008.00678.X

Puggioni, D., & Stefanou, S. E. (2019). The value of being socially responsible: A primal-dual approach. *European Journal of Operational Research*, *276*(3), 1090–1103. https://doi.org/10.1016/J.EJOR.2019.01.065

Raj, A., Modak, N. M., Kelle, P., & Singh, B. (2021). Analysis of a dyadic sustainable supply chain under asymmetric information. *European Journal of Operational Research*, *289*(2), 582–594. https://doi.org/10.1016/J.EJOR.2020.07.042

Saeidi, S. P., Sofian, S., Saeidi, P., Saeidi, S. P., & Saaeidi, S. A. (2015). How does corporate social responsibility contribute to firm financial performance? The mediating role of competitive advantage, reputation, and customer satisfaction. *Journal of Business Research*, *68*(2), 341–350. https://doi.org/10.1016/J.JBUSRES.2014.06.024

Schwartz, M. S., & Carroll, A. B. (2003). Corporate social responsibility: A three-domain approach. *Business Ethics Quarterly*, *13*(4), 503–530. https://doi.org/10.5840/BEQ200313435

Shao, L., Yang, J., & Zhang, M. (2017). Subsidy scheme or price discount scheme? Mass adoption of electric vehicles under different market structures. *European Journal of Operational Research*, *262*(3), 1181–1195. https://doi.org/10.1016/J.EJOR.2017.04.030

Sinayi, M., & Rasti-Barzoki, M. (2018). A game theoretic approach for pricing, greening, and social welfare policies in a supply chain with government intervention. *Journal of Cleaner Production*, *196*, 1443–1458. https://doi.org/10.1016/J.JCLEPRO.2018.05.212

Sprinkle, G. B., & Maines, L. A. (2010). The benefits and costs of corporate social responsibility. *Business Horizons*, *53*(5), 445–453. https://doi.org/10.1016/J.BUSHOR.2010.05.006

Steurer, R. (2010). The role of governments in corporate social responsibility: Characterising public policies on CSR in Europe. *Policy Sciences*, *43*(1), 49–72. https://doi.org/10.1007/S11077-009-9084-4/METRICS

Su, R. H., Weng, M. W., & Yang, C. Te. (2021). Effects of corporate social responsibility activities in a two-stage assembly production system with multiple components and imperfect processes. *European Journal of Operational Research*, *293*(2), 469–480. https://doi.org/10.1016/J.EJOR.2020.12.027

Xiaomi India: From Underdog to #1 Smartphone Brand, Xiaomi India: From Underdog to #1 Smartphone Brand ___ (2021). https://doi.org/10.4135/9781529755800

Tien, N. H., & Ngoc, N. M. (2019). Coping With Challenges and Taking Opportunities in International Business Strategies of Foreign Enterprises in Vietnam. *International Journal Of Advanced Research in Engineering& Management*, *5*(7).

Tsao, Y. C., Thanh, V. Van, Chang, Y. Y., & Wei, H. H. (2021). COVID-19: Government subsidy models for sustainable energy supply with disruption risks. *Renewable and Sustainable Energy Reviews*, *150*, 111425. https://doi.org/10.1016/J.RSER.2021.111425

Van Tran, N. (2020). The environmental effects of trade openness in developing countries: conflict or cooperation? *Environmental Science and Pollution Research*, *27*(16), 19783–19797. https://doi.org/10.1007/S11356-020-08352-9/TABLES/4

Villena, V. H., & Gioia, D. A. (2020, March). A More Sustainable Supply Chain. *Harvard Business Review*. https://hbr.org/2020/03/a-more-sustainable-supply-chain

Xu, X., Zeng, S., & Chen, H. (2018). Signaling good by doing good: How does environmental corporate social responsibility affect international expansion? *Business Strategy and the Environment*, *27*(7), 946–959. https://doi.org/10.1002/BSE.2044

Yu, Y., Han, X., & Hu, G. (2016). Optimal production for manufacturers considering consumer environmental

awareness and green subsidies. *International Journal of Production Economics*, *182*, 397–408. https://doi.org/10.1016/J.IJPE.2016.09.014

Zhang, W., Zhang, & Wenjing. (2021). Crisis PR Study on Samsung Galaxy Note 7 Explosion Incident. *International Journal of Business and Management*, *15*(7). https://EconPapers.repec.org/RePEc:ibn:ijbmjn:v:15:y:2021:i:7:p:68