Competition of domestic manufacturer and foreign supplier under sustainable development objectives of government

Ashkan Hafezalkotob*

Department of Industrial Engineering, Islamic Azad University, South Tehran Branch, Kafaee Amani St. Gerami St. Enghelab Ave., Tehran 1151863411, Iran

A B S T R A C T

Currently, governments that maintain sustainable objectives often adopt financial incentives and deterrents to orchestrate the outsourcing decisions of manufacturers. This work investigates the effect of government financial intervention on the competition and cooperation of two manufacturers. One manufacturer pursues an in-house production strategy, and the other outsources production to a foreign supplier. Regarding the financial, environmental and social objectives of the government and the leadership role of the government in the market, this problem is formulated as a multi-level, multi-objective decision making model. We found that specific boundaries for tariffs set by the government lead to a stable competitive or monopolistic market. A comprehensive analysis of the government policies reveals the possible outcomes of the policies regarding the sustainable objectives.

1. Introduction and literature review

Outsourcing has gradually become commonplace in most industries, often transforming into a key business trend. Various explanations are proposed for this trend in manufacturing companies. For instance, several manufacturing companies in the United States (US) have increasing incentives to outsource their core competencies to reduce their costs [19]. Because wages in countries like China and Mexico are significantly lower than in the US [2], these countries are attractive locations for companies to outsource their production. Whereas an increasing number of manufacturers outsource their operations, serious discussions about social (such as employment [3]), environmental and financial issues (e.g., low quality of foreign products, environmental standards, and losing competitive advantage to foreign manufacturers [1,18,20]) have initiated. These considerations underscore the necessity for governmental interventions to achieve holistic and sustainable development objectives.

Legislation often establishes limits and incentives for producers, which are defined by technical or ecological standards and taxes or subsidies. For example, specific targets for a central government department and its agencies are set by the "greening government commitment" in the United Kingdom (UK) to decrease waste, water usage and carbon emissions by 2015 along with maintaining stable procurement ("https://www.gov.uk/government/policies/making-sustainable-development-a-part-of-all-government-policy-and-operations"). With the aid of financial interventions and ecological and technical standards established by the central government, some producers can obtain a competitive advantage by fulfilling these standards as a marketing strategy. For instance, in the chemical industry, companies regularly require a large capital investment to construct filter systems that fulfill established standards [9]. However, several European

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* Corresponding author.
E-mail address: a_hafez@azad.ac.ir, hafezalkotob@alumni.iust.ac.ir

countries, such as England and Germany, impose a tax on automobiles according to their emission standards for annual exhaust fumes. By enjoying a governmental intervention, sustainability-driven companies may outperform rivals that could not develop their technology fast enough.

Governments often adopt incentive and deterrent policies to impose external positive and negative effects on companies, respectively [26,27]. For instance, regarding the pressure of the environment and resource, some governments and environmental organizations persuade companies to involve in remanufacturing [28]. Literature has recently emerged that analyzes government interventions by using game theory approaches. Several of these studies have concentrated on reverse logistics, recycling and closed loop supply chains (SCs). A game-theoretic model between a manufacturer and a remanufacturer was proposed by Mitra and Webster [21] in which the government is responsible for collecting and disposing products. Chen and Sheu [10] suggested a differential game model to design environmental-regulation-pricing strategies of firms in a competitive market. They showed that manufacturers' responsibility for product recyclability will be higher when regulation standards are improved. Sheu [26] constructed a Nash bargaining model to investigate the negotiation power of producers and reverse-logistics suppliers experiencing financial interventions by the government. Afterwards, Sheu and Chen [27] investigated green taxation and subsidization on Nash equilibrium solutions in a green SC. Their analyses revealed that the integration of forward and reverse SCs would be enriched when the government acts as a facilitating mediator.

Moreover, several studies apply game theory models to analyze government intervention in the promotion of green SCs and the reduction of emissions. ZHU and DOU [32] established an evolutionary game model to analyze the interaction between the government and core enterprises in green SCs. They noted that appropriate subsides and penalties can result in a win-win strategy between governments and core enterprises over the long term. Using legislation imposed by the government, Du et al. [12] constructed a game-theory analytical model based on the newsvendor problem to analyze the effects of the emission 'cap-and-trade' mechanism in a SC. Zhao et al. [31] suggested a game theory model for green SCs to reduce the life-cycle environmental risk of materials and carbon emissions by incorporating penalties or incentives. Additionally, coordination mechanisms, such as Nash bargaining and revenue sharing, were proposed by Zhang and Liu [30] to analyze government intervention in the bargaining power of members of a three-echelon green SC.

However, other studies have recently concentrated on outsourcing games in the supply chain management (SCM). When a firm outsources, it hires an outside firm to perform a certain operation instead of executing the operation itself [11]. Kogan and Tapiero [17] showed that the interactions between two firms can be properly evaluated by game theory models. They extended a single-period classical newsvendor problem with a setup cost into an outsourcing game. The interaction between a manufacturer and a supplier were evaluated when the manufacturer was able to produce in-house or outsource production. Cachon and Harker [8] presented a competition game model between two firms that were able to outsource their production process to a single supplier. They showed that the scale of economies generates intense price competition. Similarly, Ni et al. [24] developed game models to investigate the multi-client outsourcing phenomenon between two firms. They demonstrated how multi-client outsourcing phenomenon can cause exploiting scope economies and lead to lower market prices than in-house production. Bühler and Haucap [7] computed the asymmetric and symmetric equilibria for a sequential game between two firms deciding on outsourcing production. They concluded that to better understand the economics of outsourcing decisions, the prices of outsourcing at both the downstream and upstream levels of an industry must be understood. Benjaafar et al. [5], Jin and Ryan [16] and Elahi [13] concentrated on the outsourcing problem of suppliers modeled as make-to-stock queues. Benjaafar et al. [5] investigated the service competition among suppliers under supplier-selection and supplier-allocation approaches, whereas Jin and Ryan [16] studied price and service competition in a SC. In a somewhat different study, Elahi [13] evaluated a combination of service level and inventory parameters and their effects on the competition of suppliers.

Foreign and domestic products often have different environmental, social and financial effects. Thus, government intervention is essential to orchestrate market equilibrium between products. To the best of the authors' knowledge, no study has been conducted to consider the effects of different government's policies on the outsourcing decisions of manufacturers. In a broader sense, this work provides a bridge between two main streams of supply chain game literature; this study combines government intervention models with outsourcing models. Therefore, three primary contributions are provided in this study. First, this paper involves the government as a decision maker (leader player) in the outsourcing problem of SCs (follower players). Second, sustainable development objectives are proposed for the decision making by the government concerning the tariffs on products. Third, this paper investigates the comparison between the responses of manufacturers in monopolized and competitive markets. Specifically, this work attempts to address the following research questions:

1. With respect to the decision-making structure of the government and manufacturers, how can the interaction between them be formulated?
2. What are the differences between monopolized and competitive markets with respect to the response to tariffs?
3. Should specific boundaries for tariffs be considered by the government?

The reminder of the paper is organized as follows. Section 2 describes the prerequisites and assumptions. Section 3 provides the formulations of manufacturers, supplier, and government problems. Section 4 discusses a numerical example along with a sensitivity analysis. Section 5 presents the conclusions and several directions for future research.