Computers & Industrial Engineering 76 (2014) 243–252

Contents lists available at ScienceDirect

Computers & Industrial Engineering

journal homepage: www.elsevier.com/locate/caie

Integration of the profit-split transfer pricing method in the design of global supply chains with a focus on offshoring context ☆

R. Hammami [a,*], Y. Frein [b]

[a] ESC Rennes School of Business, Rennes, France
[b] Laboratoire G-SCOP, Grenoble INP, UJF, CNRS, Grenoble, France

ARTICLE INFO

Article history:
Received 17 May 2013
Received in revised form 18 July 2014
Accepted 22 July 2014
Available online 31 July 2014

Keywords:
Global supply chain design
Transfer pricing
Profit split
Intangible activities
Mixed-integer programming

ABSTRACT

This paper presents an optimization model for the design of global supply chains where the emphasis is made on transfer pricing for both tangible and intangible elements. We adopt the profit split transfer pricing method which is dictated by OECD guidelines and may be accepted by fiscal authorities. The proposed model is particularly suited for the offshoring context. In addition to transfer pricing, the model integrates several relevant decisions such as the location of tangible and intangible activities. Intangible activities refer to R&D and supplier management. Experimental analyses are conducted in order to prove the feasibility and the solvability of the model and to show the impacts of transfer pricing on supply chain decisions and profits.

1. Introduction

Due to the considerable growth in offshoring, many practitioners and academic researchers have been motivated to incorporate international considerations into supply chain management (Perron, Hansen, Le Digabel, & Mladenovic, 2010). Among these international factors, transfer pricing is one of the most relevant and complex issues facing multinational companies (MNC) today. In the literature, the term "transfer pricing" designates the strategy of determining the transfer price (TP) which is the price that a selling department, division, or subsidiary of a company charges for a product or service supplied to a buying department, division, or subsidiary of the same company (Abdallah, 1989).

In this paper, we develop a mathematical optimization model for the design of global supply chains while focusing on the integration of TP decisions. This is motivated by the high correlation that exists between transfer pricing and SC design decisions as highlighted by many authors (e.g., Altshuler, Grubert, & Newlon, 1998;Meixell & Gargeya, 2005; Perron et al., 2010). According to Abdallah (1989), making TP decisions for MNC is a relevant and a complicated task because it affects other major functions of the firm such as production, location and transportation. Unlike most existing SC design models that incorporate TP, we adopt the profit split transfer pricing method which is dictated by OECD guidelines and may be accepted by fiscal authorities. The choice of this method will be discussed in the next section.

In addition to the TP of tangible items, our SC design model deals with the TP of relevant intangible components which is one of the main contributions of this work. Indeed, given that subsidiaries in MNC (especially, in the offshoring context) are highly dependent on the parent company, the transactions among the different sites involve various valuable intangible activities such as the research and development (R&D) associated with the manufacturing processes and the activities of supplier management (SM). Intangible activities of a given entity generate services (intangible products) that can be used by any other entity of the company. This raises the issue of TP of intangible products. Srivastava, Fahey, and Kurt (2001) stressed that intangible components must be taken into account within SC. Abdallah (2004) highlighted that the TP of both tangible and intangible resources is becoming an important issue in international SC, as decisions on policies to guide pricing decisions become increasingly complicated. According to Clements and Price (2007), the main challenge in transfer pricing, is how the SC partners can capture tangible and intangible value added within the divisions of the SC.

The proposed SC design model is particularly relevant for offshoring context. Indeed, we take into account most relevant decisions of the offshoring problem described in Hammami, Frein, and Hadj-Alouane (2008) such as the location of tangible and intangible activities, the transfer pricing, the capacity relocation, the supplier selection, and the technology selection.

☆ This manuscript was processed by Area Editor Alexandre Dolgui.
* Corresponding author.

http://dx.doi.org/10.1016/j.cie.2014.07.021
0360-8352/

This research makes contributions by: (1) integrating relevant logistics decisions with transfer pricing for both tangible and intangible products in a SC design optimization model, (2) adopting a transfer pricing method that is dictated by OECD guidelines and may be accepted by fiscal authorities, and (3) taking into account many characteristics of the offshoring context that may make the model adapted to offshore companies. Although the main focus of this works is on the mathematical modeling aspect, we use the proposed model to derive some insights regarding the impacts of transfer pricing on SC decisions.

Many authors (e.g., Goetschalckx, Vidal, & Dogan, 2002; Clements & Price, 2007; Perron et al., 2010; Shunko, Debo, & Gavirneni, 2013) pointed out that relatively few researchers have addressed the TP decisions in the optimization of SC. In fact, when it is considered, the TP is always introduced as an input parameter (e.g., in Vila, Martel, & Beauregard, 2006). The SC management research papers that consider TP decisions can be classified into two categories. The first category includes works that focus basically on transfer pricing by studying its impacts on some managerial decisions or by comparing different TP policies while the second category regroups papers that optimize large scale SC where multiple products are considered and where transfer pricing is coupled with multiple logistics decisions. Our work falls into the second stream of research.

The first category of papers includes Lakhal, H'Mida, and Venkatadri (2005), Lakhal (2006), Shunko and Gavirneni (2007), Villegas and Ouenniche (2008), Shunko et al. (2013), Huh and Park (2013). For instance, Shunko and Gavirneni (2007) consider a two-stage serial SC with a parent company (retailer) and its controlled foreign corporation (manufacturer) where a single product is exchanged between the two members. The demand of the product is price sensitive. The authors study the impacts of the TP of this product on the profit of each member and on the total profit for two scenarios: deterministic setting and stochastic setting with random demand. It was assumed that there is a significant flexibility in determining TP. The authors found out that SC facing random demands benefit more from engaging in TP practices than SC facing deterministic demand. Shunko et al. (2013) consider a MNC with three entities: the headquarters, a local division that sells a product, and an offshore facility that is capable of manufacturing this product. They study the impacts of transfer pricing on the make-or-buy decision (produce in house at the offshore facility or source from external supplier). The authors restrict the range of legal TP to be between exogenously specified bounds. Huh and Park (2013) consider variants of the price-setting newsvendor framework where there is a firm with two divisions and a unique product is exchanged. The downstream division faces price-sensitive random demand. The authors analyze the effect of two transfer pricing methods (cost plus and resale price) on SC profits.

The second category of papers includes Nieckels (1976), Cohen, Fisher, and Jaikumar (1989), Canel and Khumawala (1997), Vidal and Goetschalckx (2001), Hammami, Frein, and Hadj-Alouane (2009), Perron et al. (2010). Most of these works adopt a TP method that exogenously imposes lower and upper bounds on the TP of each product. Unfortunately, such a method is difficult to use when comparable products cannot be found or when intangible activities are considered. For instance, Perron et al. (2010) consider the problem of a MNC that attempts to maximize its global after tax profits by determining the flow of goods, the TPs, and the transportation cost allocation, between each of its subsidiaries. There are four levels in the global SC considered in the problem: the suppliers, the manufacturing plants, the distribution centers, and the customers. This problem corresponds to the one studied by Vidal and Goetschalckx (2001). To the best of our knowledge, the use of the profit split method for the determination of TP of both tangible and intangible products within a large scale SC design model with multiple products has never been considered in the literature.

The remainder of this paper is organized as follows. In Section 2, we review the transfer pricing methods while justifying the use of the profit split approach. We present, in Section 3, the main features of the studied problem. Section 4 is dedicated to the mathematical formulation. Computational experiments and managerial insights are reported in Section 5. We finally give concluding remarks and future research directions.

2. Selection of transfer pricing method

The transfer pricing issue stems from the fact that MNC can simply manipulate TP (since TP are set in-house) in order to shift profits from countries where income taxes are relatively high into low tax countries, to pay less taxes and thereby to maximize their global after tax profit (see, for example, Lakhal et al., 2005). In order to curtail these opportunities, most governments have adopted transfer pricing regulations based on the OECD (Organization for Economic Cooperation and Development) guidelines (Organisation for Economic Co-operation & Development, 1995). The OECD transfer pricing guidelines have become internationally respected. They maintain the arm's length principle (ALP) of treating related enterprises within a multinational group. According to the ALP, the TP charged between related parties have to be equivalent to those which would have been charged between independent parties (i.e. in uncontrollable transactions) under similar circumstances.

The ALP imposes restrictions on the manipulation of TP by MNC. However, there is still a margin of flexibility that MNC could use to increase their global after tax profit. Samuelson (1982) showed that firms have an incentive to manipulate production and sales to achieve a tax advantage under an arm's length transfer pricing regime. Villegas and Ouenniche (2008) highlighted that MNC must operate in this context of fiscal control while trying to use it in the best possible manner. The OECD guidelines (Organisation for Economic Co-operation & Development, 1995) provide five major transfer pricing methods for operationalizing the ALP. These five methods consist in three "traditional transaction methods": the comparable uncontrolled price method, the resale price method, and the cost plus method; and two "transactional profit methods": the transactional net margin method and the transactional profit split method. These methods are generally accepted by national tax authorities (Li, 2002).

The traditional methods are likely the most used by companies. The comparable uncontrolled price method is generally used when the intermediate product has its own market outside the firm. In such a case, the arm's length price is the market price. Under the cost-plus method, the TP of the product is determined by multiplying the manufacturing cost by a fixed markup. This method is appropriate if reliable information about the markup can be obtained. Under the resale-price method, the TP is calculated based on the price of the product sold to the external market reduced by an appropriate margin (resale price margin). Thus, this method is appropriate if reliable information about the resale price margin can be obtained. We refer the reader to the OECD guidelines (Organisation for Economic Co-operation & Development, 1995) for more details about the transfer pricing methods.

According to the OECD guidelines, the selection of a transfer pricing method always aims at finding the most appropriate method for a particular case. We simply note that traditional methods are more appropriate when there exist strict criteria of comparability between products and services in the external market and those which flow between the different entities of the company. Profit based methods are likely the most suitable when operations of two or more parties are highly integrated, intangibles are present, and/or no quality comparable data are available to apply the