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A market-driven transfer price for distributed products using mathematical programming ☆

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Abstract

A distributed product has its manufacturing activities distributed among many locations. These locations could belong to one or more firms in a manufacturing network. Often, components needed to manufacture a distributed product move through different nodes in the network and sometimes across international borders. Hence, a *transfer price* is needed for the purpose of estimating duties and drawbacks. Being aware of the fact that transfer price can be used to manipulate taxable profits, many countries have instituted rules concerning transfer price estimation. For example, in the United Sates, the *Internal Revenue Service* (*IRS*) says that the right price is the market value. But for many components it is difficult to find a free market. Similar products may exist in the market but they may have different attributes. In such cases, it is important to be able to estimate the *market-driven transfer price,* given other similar products in the open market.We develop a method using a mathematical programming model and providing companies an opportunity to work proactively with the IRS in a cooperative manner in order to avoid costly audit and litigation. This way, companies avoid penalties and also gain certainty regarding tax liability. An example illustrating the method is presented.

Keywords: Pricing; Market-driven transfer pricing; Distributed product; Least absolute deviation

1. Introduction

In the face of increasing global competition, many firms are involved in the manufacture and logistics of distributed products (Achrol and Kotler, 1999). A distributed product has its manufacturing activities dispersed through many locations. These locations could be either subsidiaries of one firm or several firms collaborating within a manufacturing network. With the distributed product strategy, firms target

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favourable labour climates, proximity to markets, proximity to suppliers and resources, proximity to the parent company's facilities and utilities, lower taxes and lower real estate costs. Despite its popularity, using the distributed product strategy could have some disadvantages: (1) transportation costs could be higher, (2) customer response time could be longer, (3) transferring commodities produced from one unit to another could be difficult to manage, and (4) distributing the profit generated by the firm's network could be complicated. This paper focuses on the third point above and considers the case when products are transferred from one country to another. The *transfer price* should be declared and accepted by an authority, an example of which is the Internal Revenue Service (IRS) in the US (IRS, 1996).

The term "*Transfer price*" refers in general to the price at which an enterprise transfers goods or intangible property or provides services to a subsidiary (Wrappes et al., 1999). This definition could be extended to include the transfer between collaborating companies within the same manufacturing network. In such cases, the transfer price is the value of the product when crossing international boundaries. Each company draws up its balance sheet based on the transfer price.

In most developed countries, the national revenue service agency is concerned that firms could use transfer prices to show reduced profits and thereby pay less taxes, especially when activities are distributed in different tax legislation areas with different tax rates. Transfer pricing is used as a strategy to manipulate profit distribution across firms (Bolander and Gooding, 1999). In practice, many countries have tax regulations to limit the ability of firms to use transfer pricing as a means of tax mitigation. For instance in the United States (Zhao, 2000), section 482 of the Internal Revenue Code requires that transfer prices be set at an arm's length. Furthermore, since the late 1980s, the US began imposing penalties varying between 20% and 40% of the tax underpayment resulting from transfer pricing manipulations (Wrappes et al., 1999). Levey et al. (1998) and Ruchelman and Voght (1998) compared and discussed the global development of some of the international mechanisms that have been put in place by many countries to remedy tax reduction through transfer price manipulation. According to their study, the penalty is 10, 25 or 50% in Australia, 10% in Canada, 10 to 200% in Belgium, 40% in France, 40% in Denmark and 100,000 DM in Germany.

As Tang (1997) and Lewis (1998) pointed out, transfer pricing takes place in 40% of US foreign trade and 20% of world trade. For this reason, the IRS in the US and income taxing authorities in many other countries insist that companies should use a transfer price based on average market value, in other words, a fair price (Arnau and Gómez, 2000; Borkowski, 2000). However, it is difficult to determine the market value for components (semi-finished products) and for products where there are only a few competitive products to be compared with. The Advanced Pricing Agreement (APA) created by the IRS provides companies with an opportunity to negotiate transfer prices as long as it is based on facts, a methodology for calculation, and within an acceptable range of prices.

Two approaches have been suggested to derive transfer pricing in complex organizations (Pfeiffer, 1999): the economic approach and the mathematical programming approach.

- Economic approach: This approach, which is used for problems with no capacity constraints, uses methods of marginal analysis to derive transfer prices (Garrett, 1992; Madan, 2000),
- Mathematical programming approach: which has been developed to overcome the limitation of the economic approach by considering capacity constraints is based on the dual decomposition principle (Yong, 1998; Marcos and Joshua, 1999).

Both approaches are based on the inputs, resources, and labour costs. Neither considers market factors in transfer price determination. Furthermore, these two approaches focus on decentralized multinational firms (Elliot and Clive, 2000; Madan, 2000).

The mathematical programming approach has also been applied for the case where market price is brought into the estimation. Many estimation models have been developed based on linear programming; they have shown great stability and good predictive ability (Kettani et al., 1998). Examples can be found in