

# DISSERTATION DEFENSE

## Global Supply Chain Planning: Impact of International Taxation and Transfer Pricing

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Global supply chains make their strategic design decisions with tax considerations in mind (Ernst & Young, 2007). However, taxation issues, such as varying tax rates across the supply chain or the use of transfer pricing strategies to optimize after-tax profitability, are typically omitted in the supply chain management literature. One of the strategies of incorporating tax benefits into supply chain operations is income shifting to favorable tax jurisdictions; hence, global companies design their supply chains in a way that facilitates such income shifting possibilities. One of the tools widely used in practice for income-shifting purposes is transfer pricing. For example, the U.S. Treasury estimates that in the year 2008, global companies incorporated in the U.S. saved \$60 billion in taxes by using transfer pricing strategies (Drucker, 2010). There exists empirical evidence that many multinational corporations use the same transfer price for tax and for managerial reporting purposes (Czechowicz et al., 1982). Hence, transfer prices have a dual role in global supply chain management: They are used to (i) determine taxable income in different parts of the supply chain; and (ii) determine divisional income used for managerial compensation, and consequently affect the decisions made by the managers. Transfer pricing for income-shifting purposes has been addressed in economics and accounting research multiple times (Horst, 1972; Hirshleifer, 1956); Dawson and Miller (2000) recognized the dual role of transfer prices and modeled the decentralized global supply chain in which transfer prices have dual role. All these studies, however, have been done in deterministic settings. In my thesis I study the effect of the dual role of transfer prices on the optimal strategies of global firms operating under uncertainty and use a combination of comparative statics analysis and computational experiments to find global strategies of such firms and to understand the impact of various supply chain parameters on these strategies.

My first essay, "Role of Transfer Prices in Global Supply Chains with Random Demands", is a joint work with Srinagesh Gavirneni and has been published in the Journal of Industrial and Management Optimization in February, 2007. In this essay, we analyze the impact of optimizing transfer prices on the global supply chain performance of a price-setting firm facing random demand. It is well-established in the economics and accounting literature that optimization of transfer prices is beneficial for firms operating in a deterministic environment. In this work we find that the benefit of optimizing transfer pricing is even greater for supply chains facing random demands. The basic dynamics of the result are as following. The supply chain sets the transfer price above the manufacturing cost in order to shift income to the low tax jurisdiction. As a result, the selling price set by the retailer who views transfer price as his cost is set higher than in the absence of transfer price. The presence of randomness in demand, however, counter-balances this effect by reducing the selling price and bringing it closer to the globally optimal selling price. As a result, the supply chain facing random demand gets more benefit from transfer pricing than its deterministic counterpart. Using a detailed computational study, we show that this effect is the greatest when the customer base is small, price elasticity is high, and the ratio of underage cost to overage cost is high.

The second essay, "Transfer Pricing and Offshoring in Global Supply Chains with Cost Uncertainty", is a joint work with Laurens Debo and Srinagesh Gavirneni and has received the 1st prize in the POMS Best Student Paper competition in 2009. In this essay, we focus on the cost uncertainty as a source of randomness in the supply chain while keeping the demand deterministic. We also make the sourcing decision endogenous as opposed to the first essay. We study how global firms can design coordinated transfer pricing and sourcing strategies to leverage tax and cost differences. We derive a trade-off curve between tax and cost differences that determines the optimal sourcing strategy. Such curve can be used by companies in order to find the optimal strategy and also by policy makers in order to find the tax rate that should be offered to multinationals to attract their business. Global firms, however, also face the following incentive problem. The headquarters is more concerned about the consolidated after tax profits than the local divisions. Local divisions, on the other hand, have a better view on the product cost structure and hence, have a better view on the appropriate sourcing strategies. Hence, many global supply chains operate in a decentralized manner and we need to understand how different transfer price strategies and different decentralization strategies can help global supply chains exploit tax and cost benefits. We find that when the tax differential is large, a fully centralized strategy works best. In other settings, a decentralized sourcing strategy (enabling the global firm to take advantage of the local cost information) should be considered. In comparing decentralized structures, we find that the optimal sourcing strategy has an "all-or-nothing" structure only if pricing decision is kept at the headquarters level. However, when the pricing decision is decentralized, partial offshoring solution is optimal because of the transfer pricing regulations imposed by the Internal Revenue Code. Finally, we show that when the cost of outsourcing increases, a decentralized company has more flexibility in setting transfer prices and hence can achieve higher profits.

My third essay, "Optimal Sourcing and Transfer Pricing Strategies for Global Supply Chains facing Cost and Exchange Rate Uncertainty" is a joint work with Laurens Debo and Srinagesh Gavirneni. In this essay, we add a second source of uncertainty to the supply chain,

namely exchange rate uncertainty. However, we now consider a price-taking firm rather than a price-setting firm as in previous two essays. We again derive a trade-off curve between tax and cost differences that can be useful for both global firms and for policy makers. Similarly to the previous essay, we study how decentralization of the sourcing decision can be used by firms to take advantage of better cost information that the local divisions have. We find that the incentive conflict in the supply chain forces the headquarters to set transfer prices below the level that would be optimal for tax purposes. We demonstrate that supply chain flexibility, namely postponement of the sourcing decision, can be used to loosen this conflict and to set the transfer prices closer to the globally optimal level. Hence, we show that supply chain flexibility has a dual impact on the after-tax profitability of a tax optimized supply chain: (i) it helps the firm cope with uncertainty and (ii) it allows the firm to get higher tax benefits.

### **References**

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