MEASURING THE IMPACT OF TRANSFER PRICING ON THE CONFIGURATION AND PROFIT OF AN INTERNATIONAL SUPPLY CHAIN: PERSPECTIVES FROM TWO REAL CASES

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Abstract

Global corporations have to determine transfer prices for products that are traded between wholly owned subsidiaries located in different countries. The transfer prices are often based on a common fixed markup factor multiplied by the product value at that point in the supply chain, which can be taken as the absorption cost, including direct labor and raw materials, indirect variable and fixed manufacturing costs, and overhead. We describe a model and a primal heuristic for the strategic supply chain design configuration problem that determines the optimal location of a new manufacturing facility or capacity expansion for a given transfer price markup rate by maximizing the total net income after tax. The heuristic procedure alternates between solving the MIP model and computing the transfer prices based on a common markup rate, until the change in successive transfer prices is negligible. Several numerical experiments and sensitivity analyses based on two industrial case studies are also presented.

Keywords: Applied optimization. Global supply chain optimization. Transfer pricing.

1. Introduction

Global supply chains include many complicating international factors that are not present in the design and management of domestic, single-country supply chains. Much of the research ignores these significant international factors such as the variety of possible INCOTERMS, duties and tariffs, the nonlinear effects of international taxation, the additional variability introduced by currency exchange rates, and the presence of local content laws. Additionally, many global supply chain models assume that transfer prices are fixed and given. A review of global factors and their presence in supply chain design models is given in Vidal and Goetschalckx (1997).

According to Abdallah (1989), "A transfer price 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 firm." Transfer Pricing (TP) is the determination of the transfer prices and is one of the most important and controversial topics for multinational companies (MNCs) because it is a complex task that affects other major functions of the firm such as marketing, production, location, transportation, and finance, even affecting the ability of the company to accomplish its fundamental objectives. [O'Connor (1997), Abdallah (1989, 2004), Rosenthal (2008)]. There exist numerous publications, workshops, courses, and other services and activities by the major international accounting firms to assist MNCs in determining transfer prices in compliance with the rules and regulations of taxing authorities.

Most researchers have considered TP a typical accounting problem rather than a fundamental decision opportunity that significantly affects the design and management of a global supply chain [Goetschalckx and Vidal (2001)]. In general, when a logistics analyst attempts to determine the optimal flows of products among facilities, the price of a product is almost always considered a given parameter. However, in actual global logistics systems, the transfer prices can be set with some degree of flexibility within a range of values, usually defined by the Organization for the Economic Cooperation and Development (OECD) [Stitt (1995)]. It is in this range where the application of mathematical models can make the difference.

On the other hand, TP policies have major effects on performance evaluation and motivation of subsidiary managers. The impact of TP policies on taxable income, duties, and management performance is significant. On the other hand, the arbitrary manipulation of transfer prices, as presented by Cohen et al. (1989), is currently under severe scrutiny by tax authorities and is strictly penalized. Despite these limitations and observing current regulations, in most cases companies have the flexibility to set their transfer prices within a range of values. Moreover, tradeoffs between the low transfer price desired by the buying division and the high transfer price desired by the selling division will always remain.

One of the widely used methods to set transfer prices is based on the product value at a manufacturing plant, represented by the direct costs (raw materials and labor), indirect production costs (variable and fixed), and overhead. According to Goetschalckx and Vidal (2001), the two main justifications for setting the transfer prices with a fixed markup factor are the simplicity of implementation and the perceived equity to the different divisions of the global company. The determination of the product value and the setting of the common markup factor are typically tactical supply chain management tasks. However, the significant negotiations required between the different subsidiaries and the possible scrutiny of the tax authorities increase the significant corporate aversion for changing the markup factor frequently or at all.

2. Review of Transfer Pricing and Transfer Price Modeling

Some body of literature has addressed the TP problem as an integral component to determine the optimal configuration of a global supply chain. In a seminal work, Nieckels (1976) states that small changes in transfer prices may lead to significant differences in the after-tax profit of a company, and presents a nonlinear mathematical model to determine optimal transfer prices and resource allocation in a multinational textile firm. The model includes transfer prices as decision variables and a linear objective function for maximizing the global net income after taxes.

Other authors fix transfer prices in advance or calculate them independently of the model. See, for example, Canel and Khumawala (1997), Fandel and Stammen (2004), Lakhal (2006), Vila et al. (2006), Ulstein et al. (2006), and Meijboom and Obel (2007).

A dynamic, nonlinear, mixed-integer programming model is presented by Cohen et al. (1989) to maximize the after tax profit of a company. They define the product transfer price as a markup applied on a product cost that includes production, shipping and duties, and apply a primal heuristic to obtain local solutions by iterating between determining optimal flows and supplier contracts and finding the optimal markups. No computational experience is presented in this paper, but some authors implemented variations of the original model [Cohen and Lee, 1989].

Vidal and Goetschalckx (2001) present a model for the optimization of a global supply chain that maximizes the after tax profits of a multinational corporation and that includes transfer prices and the allocation of transportation costs as explicit decision variables. The resulting mathematical formulation is a non-convex optimization problem with a linear objective function, a set of linear constraints, and a set of bilinear constraints. They develop a heuristic solution algorithm that applies successive linear programming and calculates an upper bound based on the reformulation and the relaxation of the original problem. Computational experiments investigate the impact of using different starting points on the convergence of the algorithm. The algorithm produces feasible solutions with very small gaps between the solutions and their upper bound.

Wilhelm et al. (2005) formulate a model to maximize global after-tax profit of a company. They consider transfer prices as decision variables, but allowing them to be different for the same product when it is sent from a location to different destinations. This approach leads to a model that can be linearized and thus it is easier to solve without using heuristics or global optimization procedures. Villegas and Ouenniche (2008) present a non-linear unconstrained optimization model to understand TP, trade quantity decisions, and transportation cost allocations. This model is not empirically tested and no solution approach is presented, according to the authors, because such a procedure would require more information about cost and revenue functions used in the model. The authors explain that this was deliberately done to keep the model more general. Miller and de Matta (2008) present a nonlinear programming model to maximize global supply chain profits. They transform the model into an approximate linear formulation by stating some assumptions about the system under study. Hammami et al. (2009) present a dynamic mathematical model for the design of supply chains for the delocalization problem, which consists in the transfer of manufacturing capacity from developed countries to developing countries in order to benefit from lower labor costs. They consider lower and upper bounds on each transfer price based on the arm's length principle and do not consider inventory variables. In their model, a transfer price may be different from each origin to each destination by time period, which may not be allowed by tax authorities in some American countries. Therefore, the model can be linearized by defining the flow of money transferred from each site to the others and calculating the optimal transfer prices by dividing the money flow by the product flow. The MIP model is solved by applying a commercial branch-and-cut algorithm and using Lagrangian relaxation for larger instances.

More recently, Perron et al. (2010) reformulate the model proposed in Vidal (1998) and Vidal and Goetschalckx (2001). Their model is basically the same one presented in the two last references, but Perron et al. apply new solution procedures such as a metaheuristic called Variable Neighborhood Search (VNS) and an exact branch-and-cut algorithm. According to the authors, their procedures outperform the original methods proposed in Vidal and Goetschalckx (2001) by finding some optimal solutions and smaller optimality gaps in reasonable computational times. Finally, Longinidis and Georgiadis (2011) integrate financial aspects in a mixed-integer linear programming model that seeks to maximize the Economic Value Added (EVA) of a company. However, no explicit consideration of transfer prices is included in the model.

In this paper we assume that the transfer price cannot be different from each origin to all destinations and thus the model cannot be linearized. For this reason, our model is a non-linear mixed-integer program that should be solved using heuristic procedures. We implement the model in two real cases and present several sensitivity analyses that may provide practitioners and MNCs with insights to analyze the fundamental factors to determine transfer prices and optimize global supply chains.

3. The Optimization Model

We assume that a single, positive corporate income tax rate is charged on net income before taxes (*nibt*) at each country whenever *nibt* > 0, and define these variables as *nibtprof*. When *nibt* ≤ 0, no tax is charged on the subsidiary, and define these variables as *nibtloss*. Tax credit carryovers from other years that are caused by losses in those previous years are not considered in the model.

Overall Formulation

Maximize: **Total Corporate Net Income After Tax**

Subject To: **Expressions for Net Income Before Tax by Country:**

Net Income before Tax of the Country = *nibtpro* – *nibtloss* =
Local sales of finished products
\+ Intermediate product exports
\+ Finished product exports
\- Intermediate product imports
\- Finished product imports
\- Cost of local raw materials
\- Cost of imported raw materials
\- Variable production costs of intermediate products at first-stage production machines
\- Fixed costs of first-stage production machines
\- Variable (incremental) costs of finished products at second-stage production machines
\- Fixed production costs of second-stage production machines
\- Transportation costs of intermediate products from local first-stage production machines to local second-stage production machines
\- Transportation costs of finished products from local second-stage production machines to local distribution centers
\- Pipeline inventory costs of imported intermediate products
\- Pipeline inventory costs of imported finished products
\- Total promotion, marketing, advertisement, sales, general, and administrative costs for the country

Suppliers Capacity (corporate and external)
Production Capacity (multiple stages)
Customer Demand (corporate and external)
Conservation of Flow at each Production Stage
General Configuration Constraints
Decision Variables Bounds

Vidal and Goetschalckx (2001) showed that the after-tax profit of a corporation depends jointly on the product of the flow of products and the transfer price between the two countries. This implies that the corresponding model is no longer mixed-integer linear since it has bilinear terms in the constraints that define the net income before tax in each country.

The full formulation is very large but analogue to the standard domestic or single-country design models for strategic supply chain design. We focus on the features of the model that are different from the standard models. Due to space limit, the complete model is available upon request. First, the objective function is illustrated in equation (1), which defines a separate variable for the net income before taxes profit (*nibtprof*) and loss (*nibtloss*) in each country. The profit is then taxed with the country specific tax rate (TAX_c) to yield the after tax profit. It is easy to prove that no basic or optimal solution can yield both *nibtprof* and *nibtloss* > 0.

$$\sum_{c \in \mathbf{Country}} \left[\left(1 - TAX_c\right) nibtprof_c - nibtloss_c \right] \tag{1}$$

Part of the expression for the net revenue in a particular country is given next. It illustrates that the profit is determined by the product of the product flows and the transfer prices. In other words, the profit is determined by the monetary flows across the borders.

$$\begin{aligned} nibtprof_c - nibtloss_c = \\ & + \sum_{i \in \mathbf{FACILITY_c}} \sum_{j \in \mathbf{EXPORT_c}} \sum_{p \in \mathbf{PRODUCT}} tp_{ip} \cdot flow_{ijp} \\ & - \sum_{i \in \mathbf{IMPORT_c}} \sum_{j \in \mathbf{FACILITY_c}} \sum_{p \in \mathbf{PRODUCT}} \left(tp_{ip} + trc_{ijp}\right)\left(1 + duty_{ijp}\right) \cdot flow_{ijp} \\ & - \sum_{i \in \mathbf{FACILITY_c}} \sum_{j \in \mathbf{EXPORT_c}} \sum_{p \in \mathbf{PRODUCT}} h \cdot tt_{ij} \cdot value_{ip} \cdot flow_{ijp} \\ & - fixed_c \end{aligned} \tag{2}$$

using the following notation:

$duty_{ijp}$	Duty on flow of product *p* from facility *i* to facility *j* (zero if facilities are in the same country)
$fixed_c$	Total fixed cost for country *c* (overhead)
$flow_{ijp}$	Flow of product *p* from facility *i* to facility *j*
h	Holding cost rate per monetary unit per time unit [$/($.year)]
$nibtprof_c$, $nibtloss_c$	Net income (positive profit or negative loss) before taxes in country *c*
tp_{ip}	Transfer price for product *p* when leaving facility *i* (does not depend on the destination facility)
tax_c	Constant marginal tax rate in country *c*
tmf	Transfer price markup factor (i.e. 10 % markup would yield 0.10; in some cases, this parameter may be negative)
trc_{ijp}	Unit transportation cost of product *p* from facility *i* to facility *j*
tt_{ij}	Transportation time from facility *i* to facility *j* (in compatible time units)
$value_{ip}$	Value of product *p* when leaving facility *i*.

The model is a large bilinear, mixed-integer programming formulation. The bilinear character is caused by the monetary flows, which are the product of the product flows and the transfer prices. The integer character is caused by binary status variable indicating if a facility and manufacturing lines are used (installed) or not. Finally, the demand of the customers and the capacity limitations of the manufacturing and distribution create a large capacitated multi-commodity network flow formulation. The transfer price is computed as the product of the value of the product at that stage multiplied by a constant markup factor. In other words,

$$tp_{ip} = value_{ip} * (1 + tmf) \tag{3}$$

4. Fixed Markup Transfer Pricing Heuristic

Given the high quality of the primal heuristic for the tactical global supply chain design problem presented in Vidal and Goetschalckx (2001), a heuristic solution algorithm for the strategic configuration of a global supply chain using a single corporate-wide fixed transfer pricing markup rate was developed and tested in two real global supply design problems. The main characteristics of the heuristic are presented below and the computational results are given in the next section.

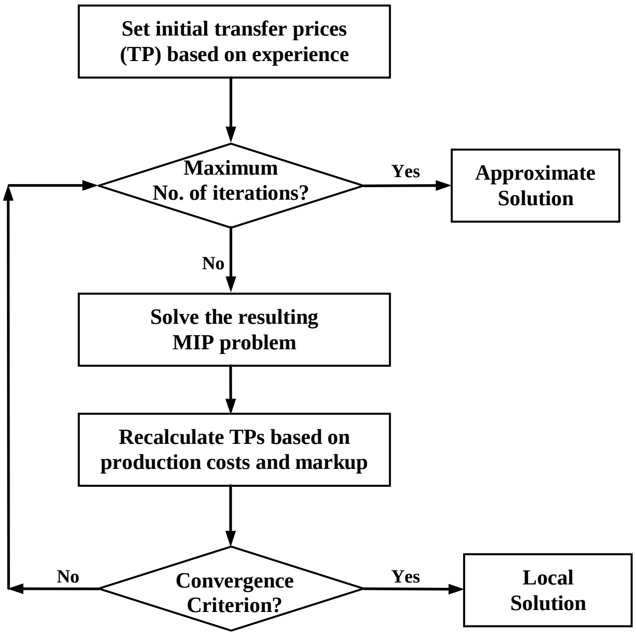

Figure 1. Primal heuristic algorithm to solve the TP problem based on fixed markups

Figure 1 illustrates the structure of the primal heuristic, which iterates between two steps assuming a given common markup rate. The first step solves the mixed-integer formulation to determine the logistics systems configuration and product flows for given transfer prices. The second step determines the new values of the total product value at the various points in the supply chain and the corresponding transfer prices. The transfer prices are calculated based on a fixed markup charged on the total production costs, which include variable production costs and fixed production costs allocated to the actual production quantities. Initial values of the transfer prices are required to start this iterative solution algorithm. This iterative process continues until the differences between successive values of the transfer prices are negligible for all the transfer prices involved. In the numerical experiments, the iterative process continues until the maximum relative difference between successive transfer prices is less than or equal to 1%.

The value of a product in a location is computed as the sum of the value the product has when entering the location plus any value added at that location plus its allocation of the fixed overhead costs (if any). For example, in the supply chains in the numerical experiment there are two manufacturing stages. The value of the finished product is calculated summing the value of the intermediate product at the first-stage manufacturing plant supplying the intermediate product, plus the transportation cost, plus other related costs such as duties, plus the added value at the second-stage manufacturing plant. According to the policies of the organization, fixed costs may or may not be added to this calculation. In essence, since the transfer price calculations are made externally to the MIP model, any method for the calculation of TP may be implemented in this heuristic procedure. As a consequence, the nonlinear expressions for the value calculations are isolated from the model itself. Finally, the above algorithm is repeated for different values of the markup rate within the limit values imposed by the corporation to determine the relation of the total net income after tax and the markup rate used to calculate the transfer prices.

5. Numerical Experiments and Results

The model and the heuristic solution algorithm were tested based on two major real strategic supply chain design case studies, developed in a global company that manufactures consumer paper products. The production process involves two stages and includes raw materials, intermediate products, and finished products. The customers considered in the case studies were distribution centers (DCs), typically one center per country, although some countries had more than one distribution center.

One case study included five countries in South America (Case No. 1) and the other case study covered six countries in Central America (Case No. 2). A single transportation mode that was determined beforehand as the cheapest available mode between those facilities was modeled between the various facilities. Furthermore, all transportation modes were considered to be uncapacitated. All cases were run on a DELL Studio XPS with 9 GB of RAM using AMPL/CPLEX (It is also possible to run the model on the NEOS Server). Computation time is not restrictive in these real cases, since major sensitivity analyses run in less than five minutes. Table 1 shows the main characteristics of the two cases and corresponding models.

Table 1. Main characteristics of the industrial cases solved

CHARACTERISTIC	CASE 1	CASE 2
Total number of raw material suppliers	6	10
Number of first stage manufacturing plants	10[a]	18[a]
Number of second stage manufacturing plants	36[a]	54[a]
Number of distribution centers	17[b]	8[b]
Number of aggregated intermediate products	8	19
Number of aggregated finished products	8	19
Number of raw materials	13	15
Number of decision variables	7,507[c]	6,119[c]
Number of binary configuration variables	57[c]	72[c]
Number of constraints	7,760[c]	5,245[c]

[a] The number of first and second stage manufacturing plants include the potential sites for locating new plants.

[b] For this model, the distribution centers in each country are the final stage of the supply chain, and are considered the consumer zones.

[c] The number of decision variables and constraints shown correspond to each problem after preprocessing.

For each case, there are two different sets of transfer prices. One set for the intermediate products sent from first-stage manufacturing plants to second-stage plants, and the other set for finished products sent from second-stage manufacturing plants to DCs. Before the first iteration, these transfer prices are set to initial values based on the experience of the company. After the first iteration, these transfer prices are recalculated using either the variable production costs or the absorption costs multiplied by a markup factor that generally is greater than or equal to one, except for the cases where a destination subsidiary is subsidized. Convergence was attained in 100% of the cases within the specified successive TP difference, as explained above.

The differences among the cases consist of different strategies for selecting new first and second stage machines. For example, one strategy may be based on locating one single mega-machine and selecting the best location; another strategy may be locating two machines with half the capacity, most likely in different countries; and a third strategy may be locating several machines in different countries. These strategies progressively reduce the concentration of manufacturing capacity and the associated risks.

Also, for each of these strategies, extensive sensitivity analyses were performed. The demand projections, transportation costs, machine learning curves, and corporate tax rates were varied. In addition, different markup factors for transfer prices were considered. Next, we report on typical sensitivity results for Case 1. The results for the other cases are similar indicating the robustness of the model developed and its solution.

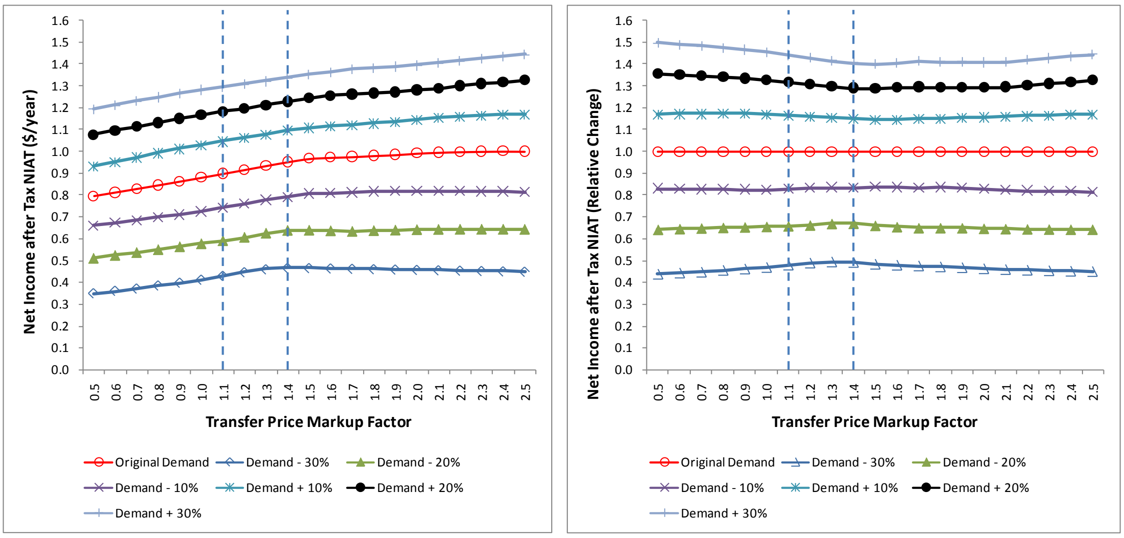

Figure 2. Sensitivity analysis for demand fluctuation
(Dotted vertical lines represent the likely markup factor legal limits)

Figure 2 shows the sensitivity results for demand fluctuation (keeping other parameters constant). The dotted lines represent the likely range for which the markup factor should be accepted to tax authorities in the specific countries of the case. In the left part of the Figure, the actual Net Income After Tax (NIAT) values have been modified due to confidentiality issues and have been expressed in relative amounts based on the best objective function value obtained with the original demand data. It is clear that the optimization of transfer prices (markup factors) is significant here and that changes of demand of ±10% may lead to changes close to respectively ±18% in the NIAT.

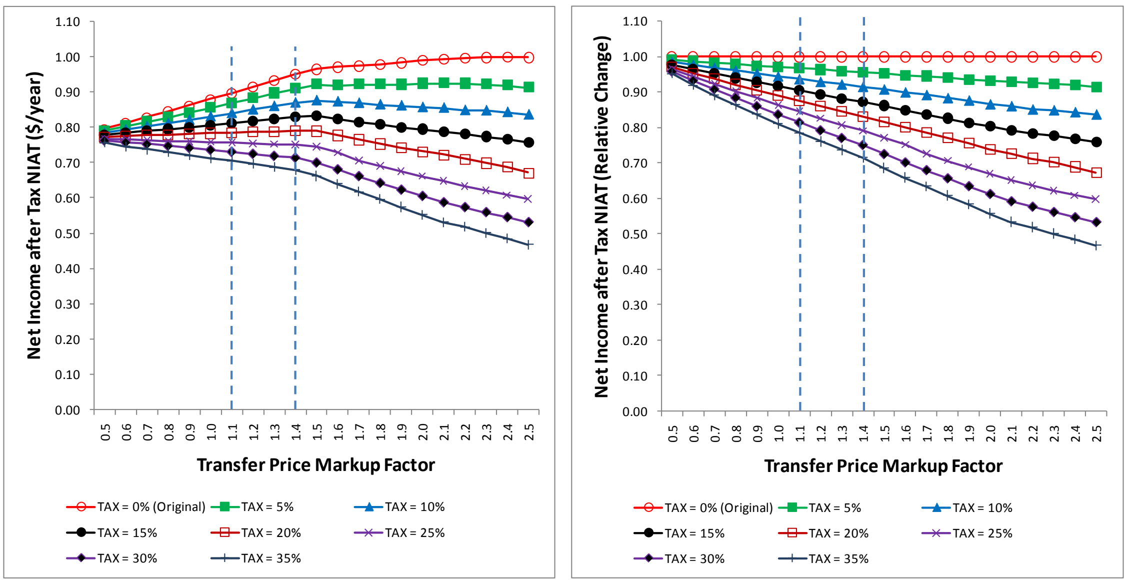

Figure 3. Sensitivity analysis for corporate tax rate

(Dotted vertical lines represent the likely markup factor legal limits)

We observed that when the markup factor increases, there are some subsidiaries that may shift from positive to negative NIAT, leading to the question of finding the maximum markup factor so that all subsidiaries may obtain their expected NIAT. An important issue here is the centralization of the company regarding transfer pricing decisions. Often constraints forcing a minimum positive value for the net income before tax in each country can be added to the model, and in such a case the loss variables can be eliminated. Additionally, we found that changing the transfer prices from iteration to iteration does not change significantly the configuration of the system. In other words, the main location binary variables remain the same for most cases while changing transfer prices, showing the robustness of the model.

Figure 3 shows the sensitivity analysis for selected corporate tax rates (keeping demand and other parameters constant). Specifically, since in one of the real cases there existed a special economic zone within a country with tax incentives (corporate tax rate = 0% for a given period of time), it was important to show the impact of possible future changes in the tax rate. As it can be seen in the left part of Figure 3, depending on the country tax rate, the optimal markup factor may shift from the lower bound to the upper bound within the legal range. Moreover, there exists a tax rate for which the change is negligible (approximately 20% in the Figure). Knowing in what region of the figure a company is working is a fundamental question for global supply chain design.

A very important finding in Case 1 was that the best international supply chain configuration that we found did not change significantly by varying the corporate tax rate at the new subsidiary to be created in the special economic zone. Furthermore, this optimal location remains the same even without the tax incentives, which shows the robustness of the solution and the excellent location of the involved country.

The model with its solution algorithm and sensitivity analysis proved to be a very powerful decision support tool for very significant strategic decisions that were about to be made. We do not have information about savings, since the configurations were all new. However, the results of the model when running sensitivity analyses were invaluable in comparing different configurations of the supply chain and justifying the recommended new sites. In addition, the information given by the model regarding raw material and intermediate and finished product costs was essential information to analyze the economic feasibility of the project.

6. Conclusions and Further Research

The model we develop here extends the work by Vidal and Goetschalckx (2001) by including the location decisions of facilities and manufacturing lines and by restricting all transfer prices to have a common calculation formula. The resulting model is a nonlinear MIP. The developed heuristic solution algorithm converged to a local optimum for all cases run during the sensitivity analyses of two industrial test cases. The common transfer price markup rate enables the explanation of the profits in the various countries to the tax authorities and the local organizations in those countries. This was especially important since some of the local organizations were joint ventures. Sensitivity analyses for the two test cases showed that the total after tax profit could be improved by increasing the transfer price markup rate from its current value and the significant impact on NIAT of variable corporate tax rates.

While the corporation was satisfied with the quality and accuracy of the solutions generated by the heuristic, further research could focus on developing and applying global optimization algorithms for the bilinear MIP formulation. The impact of the common transfer price markup rate in the current algorithm is examined by complete enumeration of all values within the acceptable limits for the rate. A solution algorithm that determines different optimal markup rates for different countries concurrently with the optimal location of facilities and manufacturing capacity may be of interest to global corporations. Although our results show the robustness of the solutions, a second valuable extension involves the incorporation of the inherent uncertainty of the parameter values in model and the use of stochastic optimization and risk analysis to identify the best facility and manufacturing capacity location for the risk preferences of the corporation. In any case, our results show the importance of implementing optimization models in the design and configuration of real global supply chains as a fundamental part of Applied Operations Research.

References

Abdallah, W.M. (2004), *Critical Concerns in Transfer Pricing and Practice*, Praeger Publishers, Greenwood Publisher Group, Inc., Westport.

Abdallah, W.M. (1989), *International transfer pricing policies: Decision making guidelines for multinational companies*, Quorum Books, New York.

Ben-Tal, A.,Eiger, G. and Gershovitz, V. (1994), Global Minimization by Reducing the Duality Gap, *Mathematical Programming*, 63, 193-212.

Canel, C. and Khumawala, B. M. (1997), Multi-period international facilities location: an algorithm and application, *International Journal of Production Research*, 35, n. 7, 1891-1910.

Cohen, M. A. and Lee, H. L. (1989), Resource deployment analysis of global manufacturing and distribution networks, *Journal of Manufacturing Operations Management*, 2, 81-104.

Cohen, M. A., Fisher, M. and Jaikumar, R. (1989), International manufacturing and distribution networks: A normative model framework, in Ferdows, K. (Ed.), *Managing international manufacturing*, North-Holland, Amsterdam, 67-93.

Fandel, G. and Stammen, M. (2004), A general model for extended strategic supply chain management with emphasis on product life cycles including development and recycling, *International Journal of Production Economics*, 89, n. 3, 293-308.

Goetschalckx, M. and Vidal, C. J. (2001), Production Allocation in a Global Supply Chain based on Fixed Markup Transfer Prices, *Proceedings of the Flexible Automation and Manufacturing Conference FAIM 2001*, Dublin, Ireland, 484-492.

Hammami, R., Frein, Y. and Hadj-Alouane, A. B. (2009), A strategic-tactical model for the supply chain design in the delocalization context: Mathematical formulation and a case study, *Int. J. of Production Economics*, 122, n. 1, 351-365.

Lakhal, S.Y. (2006), An operational profit sharing and transfer pricing model for network-manufacturing companies, *European Journal of Operational Research*, 175, n. 1, 543-565.

Longidinis, P. and Georgiadis, M. C. (2011), Integration of financial statement analysis in the optimal design of supply chain networks under demand uncertainty, *Int. J. Production Economics*, 129, n. 2, 262-276.

Meijboom, B. and Obel, B. (2007), Tactical coordination in a multi-location and multi-stage operations structure: A model and a pharmaceutical company case, *Omega*, 35, n. 3, 258-273.

Miller, T. and de Matta, R. (2008), A Global Supply Chain Profit Maximization and Transfer Pricing Model, *Journal of Business Logistics*, 29, n. 1, 175-199.

Nieckels, L. (1976), *Transfer pricing in multinational firms: A heuristic programming approach and a case study*, John Wiley & Sons, New York.

O'Connor, W. (1997), International transfer pricing, in Choi, F. D. S. (Ed.), *International accounting and finance handbook*, second edition, John Wiley & Sons, Inc., New York.

Perron, S., Hansen, P., Le Dibagel, S. and Mladenovic, N. (2010), Exact and heuristic solutions of the global supply chain problem with transfer pricing, *European Journal of Operational Research*, 202, n. 3, 864-879.

Rosenthal, E.C. (2008), A game-theoretic approach to transfer pricing in a vertically integrated supply chain, *International Journal of Production Economics*, 115, n. 2, 542-552.

Stitt, I. (1995), Transfer pricing for the next century, *Accountancy*, 116, 92-94.

Ulstein, N.L., Christiansen, M., Gronhaug, R., Magnussen, N. and Solomon, M. M. (2006), Elkem Uses Optimization in Redesigning its Supply Chain, *Interfaces*, 36, n. 4, 314-325.

Vidal C. J. and Goetschalckx, M. (2001), A Global Supply Chain Model with Transfer Pricing and Transportation Cost Allocation, *European Journal of Operational Research*, 129, n. 1, 134-158.

Vidal C. J. (1998), *A Global Supply Chain Model with Transfer Pricing and Transportation Cost Allocation*, Doctoral Thesis, School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta.

Vidal, C. J. and Goetschalckx, M. (1997), Strategic production-distribution models: A critical review with emphasis on global supply chain models, *European Journal of Operational Research*, 98, 1-18.

Vila, D., Martel, A. and Beauregard, R. (2006), Designing logistics networks in divergent process industries: A methodology and its application to the lumber industry, *International Journal of Production Economics*, 102, n. 2, 358-378.

Villegas, F. and Ouenniche, J. (2008), A general unconstrained model for transfer pricing in multinational supply chains, *European Journal of Operational Research*, 187, n. 3, 829-856.

Wilhelm, W., Liang, D., Rao, B., Warrier, D., Zhu, X. and Bulusu, S. (2005), Design of international assembly systems and their supply chains under NAFTA, *Transportation Research Part E*, 41, n. 6, 467-493.