

Modeling of Supply Chains Delocalization Problems Taking into Account the New Financial Policies: Case of Multinational Firms Established in OECD Member Countries

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Abstract—For many enterprises, the delocalization of a part or the totality of their supply chain to low cost countries is the best way to reduce costs and remain competitive against the growing globalized market. This new tendency is driven by logistics advantages, as well as, financial and tax discount offered by the host countries. The objective of this article is to examine the new financial challenges introduced by the project of base erosion and profits shifting (BEPS), published in 2015, and also their impact on the decision of delocalization. In fact, the strategy adopted by multinational firms for determining the transfer price (TP) of goods and services, as well as the shared amount of revenues and expenses have a major impact upon group profit and may contribute to divergent results. In order to get more profit, a coherent decision of delocalization should be based on an evaluation of all the operational and financial characteristics associated with such movement. Therefore, it is interesting to model these new constraints and integrate them in a more global decision model. The established model will enable to measure how much these financial constraints impact the decision of delocalization and will give new helpful directives for enterprise managers.

Keywords—Delocalization, intragroup transaction, multinational firms, optimization model, supply chain management, transfer pricing.

I. INTRODUCTION

IN order to remain competitive in the global market, companies are compelled to delocalize many of their activities to developing countries that offer low production costs. However, the success of delocalization is based on an overall assessment of all operational and financial criteria that impact the supply chain, as well as the geographic choice and fiscal incentives offered by potential host countries. The price of transferred goods and services among delocalized affiliates of the same group is one of the new criteria that are seldom discussed in the literature related to the relocation of firms. In fact, the transfer price has a major impact on firm's revenues and may contribute to divergent results according to the method of its evaluation. Hence, we emphasize the examination of TP strategies that govern transactions between

affiliates. We also give prominence to the impact of the new financial challenges that have been raised by the BEPS project in 2015. We seek to determine the optimal decision that provides more profit for the global company, by integrating these new challenges in a more global decisional model.

The management of supply chains by facility location, as confirmed by Melo et al. [1] is taking increasingly more importance. This new tendency is manifested by the transfer of a part of the supply chain to other less developed sites that produce intermediate goods, whereas the finished product is assembled in a site close to the final customer. Therefrom the concept of delocalization has been raised in order to identify the operations in which the production is ensured inside the group but abroad by its own subsidiaries [2]. Once relocated, the group will be composed of a parent company and other subsidiaries located abroad and exchanging both goods and services. The values of these traded goods are valued in terms of TP.

It is important to show the tremendous growth of multinational corporations. Despite the last worldwide financial crisis in 2008, multinational firms have recorded in 2014, 26.039 billion dollars on their domestic stock of direct investment abroad against 13.894 billion dollars in 2007. Also, they have employed 75 million people in 2014 while only 53 million were employed in 2007 [3]. Therefore, the management of the supply chain (SCM, i.e. Supply Chain Management) has emerged as a mandatory science in order to create value and ensure the competitiveness of enterprises. In this paper, we show particular interest in the concept of delocalization and new financial challenges impacting this activity.

The remainder of this article is organized as follows: In Section II, we present the characteristics of decisional models of delocalization that are considered in the literature, and we show the importance of the financial criteria. Section III is dedicated to the description of existing classic methods for TP evaluation. The illustration of the transactional net margin method and its relation to profit shifting is given in Section IV. We then project new financial challenges introduced by the BEPS project, in Section V. Finally, we present the objective function of the model and give concluding remarks and future research directions.

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II. LITERATURE REVIEW: DIMENSIONS OF THE DELOCALIZATION DECISION MODEL AND ITS DIFFERENT VARIABLES

The review of contemporary business literature, confirms to us the existence of relationship between fiscal factors and decisions of supply chain design. Indeed, Oliveira [4] demonstrates the influence of transfer pricing and tax rates upon the investment decision. Also Shunko et al. [5] show how companies can use the transfer pricing as a decisive element for shifting incomes to countries that have low tax rates in order to maximize the overall profit after taxation. A simple illustrative example is quoted in Fig. 1. In this example, we can see how the multinational firms can manipulate TP for determining the geographic location of their profit.

The decision-making model of supply chain design in the context of delocalization was interpreted by many works. The primary step is to recognize the different characteristics and

constraints impacting the model. In fact, these characteristics were summarized by Hammami et al. [6] and were classified under four axes as mentioned in Fig. 2.

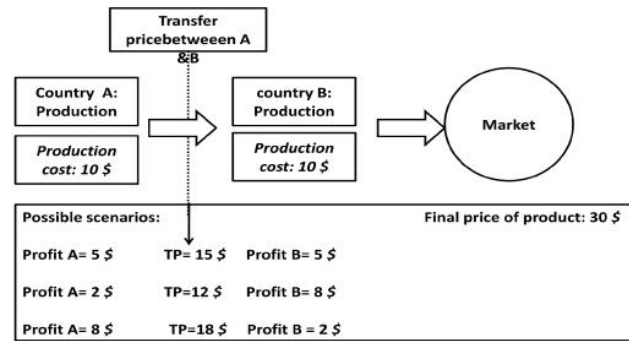


Fig. 1 An illustrative example of the relation between the TP manipulation and geographic profit shifting

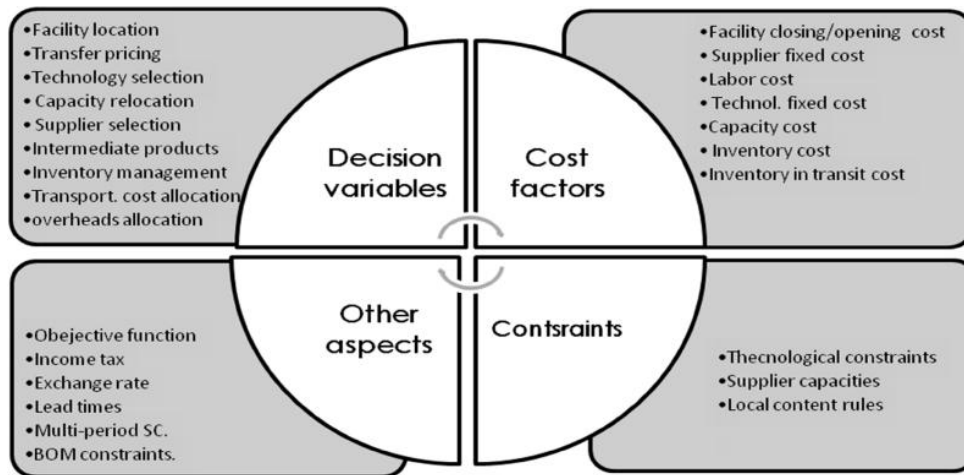


Fig. 2 Classification of the 25 characteristics of the existing models of supply chain design

The purpose of this paper is to mark out the impact of the fiscal conditions on the decisional model and on the conception of the conception of supply chain in the context of delocalization.

The literature is teaching us that many works have insisted of the fiscal and tax conditions of host territories in the context of delocalization (Table I). However, only seven works have considered the TP in their model as given in Fig. 3. In the next paragraph, we give interest to the study of the limits of these works in order to justify the contribution of our paper.

In Table I, all the analyzed works are built on an objective function of profit maximization or else cost minimization. In this context, we focused on some financial and tax factors that compose the net profit of a firm. Therefore, we evaluate in Table I, the completeness of the profit structure by comparing the integration of below criteria in the literature:

- Taxes (T): Income tax in the host country.
- Exchange rate (ER): Exchange rate factor for converting costs and prices from local currency to the standard

currency.

- Transfer pricing (TP): We assess the consideration of TP in existing models in the literature.
- Financing and taxation incentives (FI) are offered by host governments to attract facility investments in their regions.
- Delocalization context (D): We assess the compatibility of existing models with context of delocalization.

The first pioneer paper that has introduced local content in the decision model was in 1989 by Cohen et al. [7] and it covers 40% of the characteristics. But this model presents some limits to its application in the current industrial context due to the fact that it is built according a productive approach. Nevertheless, in the meantime, a process approach presents more flexibility to define activities and more pertinent for the conception of Supply chain. This was followed by Vidal and Goetschalckx's works in 2001 [12], where they have proposed a model for global profit maximization after taxation. But it is too far to be a global model as it is taking into consideration

only 4 decision variables: Facility location, intermediate products, TP and transport cost allocation. Besides, the third work was of Fandel and Stammen, 2004 [19]. The authors ignored the transfer of capacities and introduced the TP as a parameter in the model and not as decisive variable. It is also the case of works by Vila et al., 2006 [24], where they have used TP as parameter and they have covered only 52% of the characteristics. Based on a very specific wood industry, this last model will be difficult to be generalized for other sectors.

TABLE I
CHRONOLOGICAL CLASSIFICATION OF EXISTING SC DESIGN MODELS IN THE LITERATURE ACCORDING TO THE SELECTED FINANCIAL FACTORS

| Reference | T | ER | FI | TP | D | Year |
|-----------|---|----|----|----|---|------|
| [7] | x | x | x | x | x | 1989 |
| [8] | x | x | | | | 1989 |
| [9] | x | x | | | | 1995 |
| [10] | x | x | | | | 1996 |
| [11] | x | | x | x | | 1997 |
| [12] | x | x | | x | x | 2001 |
| [13] | | | | | x | 2001 |
| [14] | x | | x | x | | 2001 |
| [15] | | | | | x | 2002 |
| [16] | x | | | x | | 2002 |
| [17] | x | | x | x | | 2002 |
| [18] | | | | | x | 2003 |
| [19] | x | x | | x | x | 2004 |
| [20] | | | | | x | 2005 |
| [21] | x | | | x | | 2005 |
| [22] | x | | | x | | 2005 |
| [23] | x | | | x | | 2005 |
| [24] | x | x | | x | x | 2006 |
| [25] | x | | | x | | 2007 |
| [26] | x | | | x | | 2007 |
| [27] | x | | | | | 2008 |
| [28] | x | x | x | x | x | 2009 |
| [29] | x | | | x | | 2010 |
| [30] | x | x | | x | x | 2011 |
| [4] | x | | | x | | 2011 |
| [5] | | | | x | | 2014 |
| [31] | x | x | | x | x | 2014 |

It is only on 2009, when Hammami et al. [28] have established a more global model for supply chain design where the objective function is the profit maximization. In this new model, the TP is a decisive variable. However, the authors have omitted the inventory costs related to buffer stock and transit stock. These costs can be significant and may affect the general decision of delocalization.

By covering 60% of the characteristics, the model of Georgiadis et al. [30] is more global and it aims to optimize the supply chain during general strategic operations without taking into consideration the particular aspects and objectives of the supply chain delocalization.

The last work in the context of delocalization belongs to Hammami and Frein, 2014 [31], where they have used the same model but under two different methodologies for transfer pricing. Their objective was to measure the impact of adopted TP methodology on the decision of delocalization. It is a very

interesting work in the measure that it is highlighting the interaction between geographical allocation of subsidiaries and transfer pricing; yet the TP methodologies are subject to many factors that have been recently introduced by the BEPS project in 2015 [34], [35]. This justifies our paper in order to emphasize the necessity to add new constraints and revise the global model by integrating other elements. Thus, we are giving in Fig. 3, a summary of all works that integrate TP in their decision model. We also show the efforts of authors towards a more global model that covers a maximum of characteristics (as mentioned in Fig. 2).

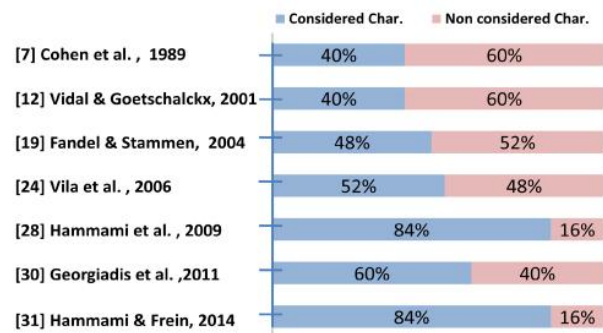


Fig. 3 Summary of works that integrate the TP in their decisional model in the context of delocalization

The contribution of our work is to cover the gaps seen in the current established models and propose a driving decisional model more global that will be both prospective and applicable in the delocalization context. We also introduce, in the same model, the new constraints added by the BEPS project. In order to formulate these constraints, it will be necessary to have first a look on existing classic methods for TP evaluation. These methods are described by the Organization for Economic Cooperation and development (OECD).

III. CLASSIC METHODS TO EVALUATE THE TP

In almost all countries, the rules arising from national legislations are fixing the methods of TP calculation in order to establish a fully competitive price. The methods are defined internationally by large organizations such as the OECD that essentially plays a role of a consultative assembly whose members are the 35 most developed countries (USA, Canada, Australia, South Korea, European Union members, etc.).

Since the approval of OECD transfer pricing guide in 1995, five methodologies for TP assessment were introduced [32]:

A. Price CUP Method: Comparable Uncontrolled

For this method, the TP is fixed to the market price of a comparable good for the exchanged good between two subsidiaries. These comparisons can be internal or external to the group. Thus, the minor differences found between the goods traded upon intragroup and the goods traded on the external market will require a correction. Its advantage is that

it is based on a bilateral analysis, except that it is difficult to find always comparable for intragroup transactions. This method is generally used during financial or commodity transactions.

B. Cost Plus Method

The TP is set by using the full cost of production of a good plus a margin which corresponds to what a comparable independent company would have realized on this transaction. It is used to analyze the TP when it comes to tangible goods and services. It seems advantageous since it is based on the internal price. However, it is difficult to find benchmark profit rates. Also, this method depends only on the supplier of good or service and can cause losses for other parties. This method is mostly used during transactions related to manufacturing activities.

C. Resale Minus Method

The TP is determined using the final sales price to the customer from which we subtract the complete distribution costs, plus a margin corresponding to that a comparable company would have achieved. It is a more realistic method because it is based on the free market price. It is more suitable for use when there is no relationship between the cost incurred and the selling price. Criticizes about this method are related to the unilateral aspect, as well as the difficulty of finding benchmark profit rates. It is mainly used by distributors, which do not have additional costs to the product.

D. Transactional Net Margin Method (TNMM)

This method is not designed to calculate directly the TP, but to set a level of profit for the subsidiary. The profit is calculated by comparison of the net profit achieved by comparable companies. The advantage of this method lies in the ease of finding a comparable transaction. In fact, product comparability is less critical, and only functional comparability matters. However, the MTMN method may include some non-tariff factors that have an effect on the net margin and the profit of subsidiaries, but less significant effect on the transfer price. In addition, it is difficult to determine sales revenues, operating expenses and assets of a transaction, especially when the business involves multiple parties and activities. The MTMN method is commonly used for transactions involving high value intangible assets.

E. Profit Split Method

The total profit generated by the group business is shared between the different subsidiaries concerned in proportion to the value of their respective contributions. This method is useful when comparables are not available. It is the only method that uses the synergy between intangible assets or profits from economies of scale. Its complexity in implementation is due to the lack of clear guidelines in the OECD principles. Indeed, this method is little described by the tax administrations that using it puts a very strong legal risk for the company. The profit sharing method is used when both parts of the controlled transaction have significant intangible properties.

The five methods, listed above, for TP assessment represent the international consensus on how to apply the arm's length principle. However, it is possible to use another different method, since it complies with the arm's length principle. In such cases, the rejection of the above described methods and the selection of another method should be justified [33].

F. Illustration of TNMM

Due to the profits provided by the use of TNMM method compared to other methods of TP method, the TNMM is the most commonly used. Moreover, it is a relevant tool to verify other traditional methods. We give in Fig. 4 TP computing illustration with the method TNMM.

We consider two sites: site A, belonging to country A, which ensures the production of intermediate product. And site B, a subsidiary belonging to country B, which provides production of the final product.

First, a benchmark analysis will determine the profit to be allocated to the site B. This profit is calculated by comparing the net profit achieved by comparable companies. We take for example, the profit rate equal to 3.33% of the selling price. We also consider that the market price for the final product is 30\$ (standard unit price).

Production costs of the site A and B are both 10 \$. Then profit of site B is expressed by (1). The TP is deducted from (2).

$$\text{Profit B} = 30 \times 3,33\% = 1 \quad (1)$$

$$\text{TP} = 30 - 1 - 10 = 19 \quad (2)$$

Thereafter, the residual profit of A is given by:

$$\text{Profit A} = \text{TP} - \text{production cost} = 9 \quad (3)$$

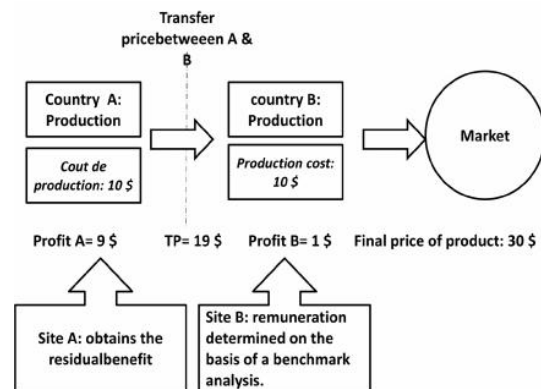


Fig. 4 Illustration of TP calculation with method TNMM

It is widely possible to set arbitrarily the subsidiary A and make it incomparable to other sites of the group, particularly by storing in it a highly valuable intangible asset (like Copyright, trademark...) or by contractually allocating all the risk of the group to this subsidiary. Therefore, we concluded that the application of the method TNMM gives groups, great latitude to locate their profit.

IV. NEW CHALLENGES OF THE PROJECT OF BEPS

On 5 October 2015, the OECD has published its final reports regarding to the project against erosion of the tax BEPS. The goal of the project is to increase the consistency, substance and transparency of the international tax system. Indeed, it has turned the balance of power towards the tax authorities and has upset the world economy by limiting the ability of multinational firms to decide on which site to allocate their profits.

The recommendations of the BEPS project revolve 15 actions [34], [35]. The most important actions concerning the transfer pricing are listed below:

- Action 5 (Advance Pricing Agreement -APA): Improve the fight against harmful tax practices, taking into account transparency and substance. BEPS project recommends to sign up in advance a unilateral and transborder agreement about any decision related to the transfer pricing. The goal is to ensure legal security and fiscal stability for relocated firms.
- Action 6 (Elimination of Double Taxation): Prevent the granting the profits of fiscal conventions when it is inappropriate to assign these profits. This is an agreement between two different countries for prevention of evasion and tax fraud by eliminating double taxation about taxes on incomes and capital.
- Action 8 (intangible): Develop rules that prevent the erosion of the tax base and the transfer of profits through the transfer of intangible assets between members of the same group. Indeed, the profit resulting from the exploitation of intangible assets shall be distributed between the entities that contribute to the creation of the intangible. The legal ownership is no more enough.
- Action 9 (risks): Develop rules that prevent the erosion of the tax base and the transfer of profits through assignment of an excessive capital of risk to some subsidiaries of a group. This implies that it is not possible to decide on the allocation of risk via purely intragroup contracts. The risk assumed by a subsidiary must be assessed according to the level of control it has over its decisions.
- Action 10 (redefinition of transactions): If a transaction between two subsidiaries does not comply with commercial rationality, tax authorities have the ability to substitute intragroup contract with new terms that are more in line with economic rationality.

V. MODELISATION

We assume that for an original firm, the supply chain of suppliers, manufacturers and distributors is already established. The model will propose a combination of alternative sites. We denote by:

- EF: the group of suppliers;
- EC: the group of customers;
- SA: combination of alternative sites;
- i: an affiliate firm from SA;
- f: a supplier from EF;
- k: a customer from EC.

The transferred products among the supply chain are either a raw material (m), or a half-finished product (r) or a finished product (s). The decision variables linked to sells are:

- n_{pi} : quantity of product P manufactured at affiliate i;
- n_{rij} : quantity of product r transferred by i to an affiliate j;
- n_{sik} : quantity of products s sold by site i to customer k;
- $pt(r,i,j)$: unit price of transferred product r from site i to j;
- $PV(s, i, k)$: selling price of product s by site i to customer k.

It is important to note that PV is a cost factor and not a decision variable. We can then formulate the total profit of site i, using the standard currency, as:

$$Pr(i) = \sum_k \sum_s n_{sik} .PV(s, i, k) + \sum_r \sum_j [n_{rij} .pt(r, i, j) - nrji .pt(r, j, i)] - Inv(i) - Op(i) \quad (4)$$

where: Pr(i) is the profit gained by site i; Inv (i) is the total cost of investment which includes implementation of new activities, capacities acquisition from other affiliates or external source, integration of new suppliers, sites closure costs and opening cost of new sites due to delocalization. Op (i) is the total operating cost that encompasses the cost of using an activity, labor cost, production costs, purchasing costs of raw materials and transport.

It is judicious to mention that the transport cost of raw materials from external suppliers to site I is included in purchase price. However, the cost of transport between two affiliates of same group i and j is not included in the TP. In fact, the majorities of multinational firms have possibility to distribute transportation costs between its affiliates in order to maximize the global profit.

According to (4), the profit of the site i depends on the TP fixed for all intermediate products and also the amount of transactions between affiliates. The global profit of the group will be the sum of all generated profits by affiliates i. We denote also by:

- PG: the global profit.
- T_i : the imposition rate on profit expressed en percentage.
- D_i : the conversion rate from currency of site i to its value in standard currency.

Then, the global profit expresses as:

$$PG = \sum_i [(1 - T_i) . D_i . Pr(i)] \quad (5)$$

Equation (5) shows well the relation between global profit PG and taxations imposed T_i by host countries as well as the currency conversion for each country D_i . The model can then manipulate these parameters in order to generate the maximum profits by shifting revenues to low tax countries.

We deduce the objective function of the model:

$$Max (PG, IT) \quad (6)$$

where IT is a time interval corresponding to the period of

study.

Our perspectives following this article are to formulate the new constraints introduced by the BEPS project and analyze their impact on the global decision of delocalization. In fact, as previously mentioned, the BEPS project has limited the variance interval of TP $pt(r,i,j)$ and also the geographic allocation of profits by managers. This will affect in a large degree the profit $Profit(i)$ generated by each subsidiary i . Through a case study, we aim to analyze the impact on the overall profit of the company as well as the geographical choice of subsidiaries and the rate of activity to install on it. Finally we can conclude useful new guidelines for government and multinational firms.

VI. CONCLUSION AND PERSPECTIVES

We conducted an overview analysis of the different dimensions and parameters that influence the optimization of supply chain models in the context of firms delocalization. We have shown the importance of transfer pricing as a decision variable in the selection of potential affiliates and geographical relocation of profit. Several conventional methods are available for the evaluation of TPs. However, these methods are not universal and have limitations in their application. BEPS project, on its part, has introduced new challenges in terms of transfer pricing. Therefore, it will be interesting to see how these challenges will impact the relocation decision. It will be useful to adopt an optimization model that takes into account all operational and financial characteristics and new constraints added by BEPS project to analyze the sensitivity of the delocalization decision toward the change of the transfer pricing strategy. By analyzing results of a case study we can measure the impact of the new constraints on the overall profit of the company as well as the geographical choice of a subsidiary. It is interesting that the model will propose the rate of activity to operate on each subsidiary. Finally, we can draw new conclusions useful for government and multinational firms.

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