

Exchange Cost, regular shipping lines and maritime trade

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Abstract

Through this study, we try to contribute to the improvement of the transport and international maritime trade by suggesting a number of trends to change the costs, the prices, the logistical structures, the supply chains and the comparative advantages in addition to the countries' trade competitiveness and their integration into the global transport and exchange networks. The used methodology analyzes the importance of the continuous decline of the shipping costs. Therefore, the question that should be asked is: Can this analysis contribute to the development of maritime trade in Tunisia. Actually, the main concern of Tunisia is to find ways to better integrate its economy into this new international environment characterized by a rising change in the field of maritime transport. The empirical results also aim at analyzing the different costs associated with international trade in the maritime sector and identifying the different solutions to minimize these costs. Therefore, our approach is to conduct an econometric time series analysis to estimate a multi-product cost function of translog type in the services of regular shipping lines of the Tunisian Navigation Company (TNC). The objective is to implement a policy to reduce these costs.

.Keywords: maritime trade, maritime transport, exchange cost, shipping, regular shipping lines

I. INTRODUCTION

Since 1950, international trade has been growing faster than production. During the 2000/2007 period, growth was twice as high as the Gross Domestic Product (GDP) (except in 2001 where there was the bursting of the financial bubble). The exchanges gave rise to currency inflows. Actually, trade expansion leads to increasingly open economies. Therefore, the weight of various countries is clear, whereas the African continent's presence in the international trade is somewhat timid. In fact, the level of openness measures the intensity of foreign trade in relation to the production of the involved country/countries. Imports and exports are recorded in the balance of payments. Indeed, the opening of economies has led to a substantial growth of international trade since the Second World War, although all the countries and business sectors were not open to international trade on the same level. Various indicators help measure these commercial transactions and monitor their development.

II. THE EXCHANGE COSTS: CONCEPT AND TYPOLOGY

The most obvious cost, and undoubtedly the most important of product trade, is the transportation cost, that is the price that a trader must pay, by any method whatsoever, for the transport of his goods from one place to another. This cost obviously varies according to the traveled distance, the goods weight and

size and perhaps to the care taken along the way to prevent loss or damage. There is also the loading and unloading cost of goods at both ends of the journey and possibly the cost of their transportation to the departure terminal and from the arrival terminal. All of these costs can be non-linear, including the fixed costs which do not depend on the distance and / or shipment dimensions as well as the cost per unit of distance or weight such as economies of scale or discontinuities due to the size of the containers or the geographical factors that also vary [1]. Besides the transportation cost, trade costs have other components to which it is reasonable to assign some importance, even though they seem to have similar implications to those of the transportation cost and therefore could might not need to be analyzed separately. Beside these components, there is the insurance cost which, like the transportation cost, probably depends on the dimensions of shipment and distance. Unlike the transportation costs of most goods, the insurance cost also increases with the value of the transported goods, regardless of their weight or dimensions. Insurance costs have nevertheless determinants and effects similar to those of the cost of transport because they are both often combined [2]. Trade costs, like another component of the their financing cost, are costs that affect even purely national transactions if there is a time lag between the moment at which the production costs take shape and the time when final sale is received. Since it makes time longer, trade adds the cost of financing in varying proportions depending on the time and the period. However, international trade must also overcome financial barriers that internal trade does not have.

Transactions can thus, insofar as the international integration of financial markets leaves to be desired, force them to work with several banks and therefore pay the respective commissions. Moreover, what is perhaps even more important is that international trade often requires the conversion of one currency into another that generates exchange fees and uncertainties. These financial costs would normally depend almost exclusively on the goods value rather than on their weight or dimensions and the distance they travel.

A. Exchange cost and new international trade theory

The concept of the transportation cost is very broad as it may involve both the cost paid by the user and all the costs borne by the community. The chosen concept depends directly on the purpose of analysis, such as decisions on investments, or for example, the desire to establish fair pricing systems between the transport modes. The transportation cost plays a major role in the exchange. However, it should be closely

tightened, defined, and placed in the economic scheme, that is, what it covers [3].

III. THE DETERMINANTS OF INTERNATIONAL EVENTS IN THE DIFFERENT THEORIES.

The international trade theories have two facets: a large diversity resulting from the irreconcilable opposition between the various schools of thought and therefore to the specific status of economics. [4]

A. Theories based on international technological differences

The disproportionate and most often incorrect use of the term "technology" instead of "technique" rightly irritates the defenders of the French language. Technology is actually the study of the technique. Its use is not completely moved here: the phenomenon accounted for is the impact of spending on research and development as well as the employment of a significant number of engineers in the production process on the characteristics of the produced and traded goods. When searching for the identifiers of international trade, the focus is on research & development and its consequences, as well as on technical progress and innovations. This theory, which appeared in the early sixties, finds one of its most popular forms in the "product life cycle" presented by Raymond Vernon in 1966.

B. The international trade theory

In all, the international trade theory combines five generations of theories each of which is based on a different exchange ground. The current approach essentially considers them as complementary patterns.

TABLE I: FIVE GENERATIONS OF THE INTERNATIONAL TRADE THEORY
 FONT SIZES FOR PAPERS

Theory	Description		
	Author	Explanatory principle	The variable reflecting the principle
Comparative advantage	David.Ricardo	Countries specialize in the production in which they have a comparative advantage	Labour productivity
Factor endowment	E.Heckscher, B.Ohlin, P.A. Samuelson	Countries export goods produced with the technique using the most abundant factor, relatively, in their territory.	Capital intensity: capital/labour ratio.
Intra-sector trade	B.Balassa, H.Grubel, P.Lloyd, B.Lassudie-Duchêne et J.L.Mucchieli	Prioritization of comparative advantages, monopolistic competition, the position difference in the product lines	Different variables depending on the explanation
Neo-technological approach	R.Vernon	Exports appear during the product	Intensity in research and development, product age.

		growth phase and imports during maturity.	
Neo-marxist approach	J.Mistral	Nation prioritization, domination, uneven dissemination of the regime of accumulation.	Fixed capital gross formation rate, internal market control of investment property

The intra-sector trade, or swaps, is a priori a phenomenon totally incompatible with the Ricardian and HOS theories. One should understand that all the trading countries have a comparative advantage in the same production. However, as soon as becomes a part of a more general perspective, the likely to preserve the principle of comparative advantage appears again. More generally, analyses of the intra-sector trade tend to incorporate phenomena that are difficult to reconcile with the HOS theory and which fall under the oligopoly and monopolistic competition situations (the product differentiation already mentioned, entry barriers, increasing returns ...). The focus is therefore on the micro-economic dimension of the international trade explanation on the basis of the firms' characteristics and strategies, which made us reason about the benefits specific to the firms rather than to the nations. The classical Marxist authors, beginning with Karl Marx, are not genuinely interested in the explanation of international trade and in the composition of the goods flows, but rather in the impact of trade on the nations. Following the studies on imperialism, the previous writers focused on the relationship between the developed capitalist countries and the third world. It is only in the modern period that an explanation called "neo-Marxist" came up and studied international specialization. [5]

C. Econometric analysis of trade costs in maritime regular lines in Tunisia: case of the Tunisian Navigation Company (TNC).

Econometrics is a set of statistical and mathematical methods aimed at quantifying the economic phenomena. It is considered by its users as a valuable analysis and a decision-aid tool. In terms of empirical analysis in the strict sense, the study aims to measure the productive performance of the Tunisian economy by estimating the parameters associated with a system that integrates the average total cost function and its market shares. The main purpose of this work is to obtain estimates of the productivity and performance of the Tunisian maritime sector. It should be noted that the parameters of the variable cost function for regular shipping lines of the CTN will be estimated using annual data over the 1980/2014 period. The estimate provides estimated coefficients that help increase the efficiency and strength of the used tests. Development in the duality theory helped researchers estimate the production capacity using cost functional forms. Generally, a "stacked equation system" and

an "Iterative Seemingly Unrelated Regression model (ITSURE) are applied"

1) Econometric model presentation: It therefore worth estimating a variable cost function that can be written in the general form: $CV = f (y1, y2, y3, wL, wE, wM, F, t)$, where CV is the sum of the variable costs = energy costs+ expenditure of the cabin crew+ maritime expenses.

y1=Mediterranean line; y2=Northern European line; y3=CAO & MO line (West African Coast) + (Middle East); wL=labor price; wE=energy prices; wM=price of maritime expenses; F: quasi-fixed capital assessed at the fleet capacity of the CTN and measured in DWT (deadweight tonnes); t: the time. The flexible multi-product translog cost function with a quasi-fixed factor can be written as follows:

$$\ln\left(\frac{CT}{w_L}\right) = \alpha_0 + \alpha_E \cdot \ln\left(\frac{w_E}{w_L}\right) + \alpha_M \cdot \ln\left(\frac{w_M}{w_L}\right) + \sum \beta_j \cdot \ln y_j + \frac{1}{2} \sum \beta_{jj}^2 \cdot \ln y_j^2 + \frac{1}{2} \alpha_{EE} \cdot \left(\ln\left(\frac{w_E}{w_L}\right)\right)^2 + \frac{1}{2} \alpha_{MM} \cdot \left(\ln\left(\frac{w_M}{w_L}\right)\right)^2 + \alpha_{EM} \cdot \ln\left(\frac{w_E}{w_L}\right) \cdot \ln\left(\frac{w_M}{w_L}\right) + \sum \rho_{yjm} \cdot \ln y_j \cdot \ln\left(\frac{w_M}{w_L}\right) + \sum \rho_{yje} \cdot \ln y_j \cdot \ln\left(\frac{w_E}{w_L}\right) + \alpha_{FE} \cdot \ln F + \frac{1}{2} \alpha_{FF} \cdot (\ln F)^2 + \sum_{E \in M} \alpha_{FE} \cdot \ln F \cdot \ln\left(\frac{w_E}{w_L}\right) + \sum_{M \in E} \alpha_{ME} \cdot \ln F \cdot \ln\left(\frac{w_M}{w_L}\right) + \sum \rho_{tj} \cdot t \cdot \ln y_j + \rho_{tE} \cdot t \cdot \ln\left(\frac{w_E}{w_L}\right) + \rho_{tM} \cdot t \cdot \ln\left(\frac{w_M}{w_L}\right) + \alpha_{tE} \cdot t + \frac{1}{2} \cdot \alpha_{tt} \cdot t^2 + \alpha_{ct} \cdot t \cdot \ln F$$

Taking into account the equations of relative shares of the factor cost, which result from the application of Lemma Shephard (1953), helps us raise the number of observations without changing the that of the coefficients and consider the producer's supposed rationality, that is to say, assuming that the cost function actually means the sum of the business minimum expenses.

$$S_E = \alpha_E + \alpha_{EE} \cdot \ln\left(\frac{w_E}{w_L}\right) + \alpha_{EM} \cdot \ln\left(\frac{w_M}{w_L}\right) + \sum \rho_{jE} \cdot \ln y_j + \alpha_{FE} \cdot \ln F + \rho_{tE} \cdot t$$

$$S_M = \alpha_M + \alpha_{MM} \cdot \ln\left(\frac{w_M}{w_L}\right) + \alpha_{ME} \cdot \ln\left(\frac{w_E}{w_L}\right) + \sum \rho_{jM} \cdot \ln y_j + \alpha_{FM} \cdot \ln F + \rho_{tM} \cdot t$$

Therefore, to avoid the correlation problem between the market share equations and get unbiased estimates, the first market share equation related to the cabin crew expenditure us chosen.

2)-Data presentation: The data collection is an essential step in any process or economic study. In fact, to the assess this model, a database in time series covering the 1980/2014 period is used. This database was taken from the annual activity of the Tunisian Navigation Company's reports (TNC) the main Tunisian shipping line. Then, these data were processed so that they are adequate statistics and economic characteristics of our model to be estimated. The dataset contains the variable expense data of the CTN 88 observations. The number of period (T = 35) exceeds the number of the factors of production (N = 4), which allows us to use the

SURE model to estimate the average variable cost functions and shares equations.

3)- Output and input measurement: the regular online transport is a multi-product activity where each line served by the CTN is a specific output produced from the combination of some production factors to minimize the costs. Nevertheless, in the network activities and especially in shipping, there is often some ambiguity in the output measurement due to the line diversity. In fact, each line has its own characteristics in terms of path length, the amount of traffic, the original destination zone, the nature of the transported goods, the choice of the type of vessel, and other specificities linked to supply and demand.

Our model includes three output variables related to Mediterranean lines (y1), Northern Europe lines (y2) online and Western African coast and the Middle East (y3). On each zone, the output is measured in transported tonne-kilometres (TTK), in other words, by multiplying the total quantity of the transported goods (measured in tonnes) by the distance (in kilometers) on each line respectively. We will now describe how the input prices were calculated. In this work, there are three variable inputs, labor, energy and maritime fees and a fixed input, namely the capacity of the fleet.

The labor cost

The labor costs represent approximately 13% of the total expenditure of the CTN. The labor price measurement will be inspired by previous studies in the transport field. If the data had been available, we could have measured the costs of the price factor in a much more refined manner, taking into account that this factor is actually heterogeneous (cabin crew, administrative staff, agents, etc.)

$$W_L = \frac{\text{Sum of personnel expenses}}{\text{the total staff employed}}$$

The energy cost

The fuel costs account for about 9% of the total company's expenses. The energy cost will be calculated as follows: These expenditures are derived from the company's operating accounts.

$$W_E = \frac{\text{Annual expenditure on fuel}}{\text{quantity consumed}}$$

The value of the marine fees

This heading includes: the loading and unloading costs, stevedoring and handling costs, the port transit costs, etc. The corresponding price will be calculated as follows :

$$W_M = \frac{\text{Annual spending on maritime fees}}{\text{total quantity transported ton}}$$

We should not neglect the fact that this topic is a major proportion in the company's overheads.

The fleet capacity

There is nothing else that can be done now other than calculate the stock of the fixed factor, namely, the fleet capacity measured in dead weight tons (dwt). It is a measure

of the size of the fleet put into operation by the company on all its regular lines or in all the three treated zones.

D- The resulting estimates

The applied microeconomic methodology, (the approach by a cost function), uses the results of the duality theory. The estimated econometric model is derived from the so-called flexible functional forms (the Translog cost function). The econometric implementation is based on annual data over the 1980/2014 period. Econometrically, the focus is on the estimation methods for seemingly unrelated equations (the SURE or Zellner method).

First, there has been an additional restriction on the trending method where it is assumed that technical progress is neutral according to Hicks (because the sample size (T=35) is smaller than the number of parameters of the cost equation. For this reason, 6 parameters have been eliminated.

TABLE 2: THE ESTIMATED R2 AND CHI-SQUARE COEFFICIENTS

Equation	Observation	Parameter	The R2	chisquare (χ^2)
$Ln\left(\frac{CT}{W_r}\right)$	35	28	0.9666	1.12*10 ¹⁰
SE	35	6	0.3859	35.56
SM	35	6	0.3964	32.96

Table 2 shows that the explanatory power of the model is satisfactory in its overall equation for the total cost. R2 is found to tend to 1 for the model equation. Given that the share equations are not significant, R2 is found to be lower than 0.5. It should be recalled that in our model, the symmetry and linear homogeneity constraints compared to the factor prices are already checked in the assessment since they were imposed by the model. However, we did not attempt to check other regularity conditions of the cost function (according to the work of Christensen, LR and Greene, WH (1976) Deborgler B. (1984) Thiry, and B. Lawaree, J. (1987)).

After correcting the serial problems, the Translog cost function estimates of non constant returns to scale showed economic evidence. In fact, the convexity relative to the fixed factor F and the concavity relative to input prices pi are checked.

The significant effect of low investment in capital factor is justified by the small effect on the total cost. The great chi-square values statistics clearly show the effectiveness and the proper significance of the iterative SURE model under Zellner's constraint (1962) despite the low values of R2 for the part equations, mainly, from production which previously showed contradictory effects compared to other equations.

The energy factor has no significant effect on the capital or on its investment. Economically, the results are not surprising, due to the nature and construction of the variables that are typically aggregations.

On the basis of the test specification results, a composed error model can be adjusted to the various variables, however, since the constant number of lines is smaller than that of the coefficients to be estimated, a random effect model cannot be used. Therefore, the equation system will be estimated by the SURE iterative technique (see Table 3).

A. V- References

[1] Elisworth P.T (1950), << The International Economy, its structure and Operation >>. The MacMillan C°, New York, ce schéma est repris par Marcy G. (1953), << la structure de l'économie internationale >> dans *Traité d'économie politique* publié sous la direction de Louis Baudin, Dalloz, Paris, p.316 sp.

[2] S.Enke et V.Salera (1947), << International Economics >>, Dennis Dobson Ltd, Londres, p.260-262.

[3] DOUET M. (1986). << Les consortiums maritimes de lignes régulières >> les cahiers scientifiques du transport n°13-14.Economica, 52.

[4] HUCHET PHILIPPE (1997). << Transport maritime : la gestion des lignes régulières >> *Revue Transports* n° 386 novdec

[5] BLASSUDRIE-DUCHENE et J.L. MUCCHIELLI, << les échanges intra-branche et la hiérarchisation des avantages compares dans le commerce international >>, *Revue économique*, mai 1979.

[6] Berndt, R. Ernst & Fuss Melvyn A., (1986), << Productivity measurement with adjustment for variations in capacity utilization and other forms of temporary equilibrium >>. *Journal of Econometrics*, vol.33, pp. 7-29.

[7] VITON .P.A, (1981). << A translog cost function for urban bus transit >> *Journal of industrial Economics*, mars, n°3,pp 287-304.

[8] Caves, D.W. & Christensen L.R., (1980), << Global Properties of Flexible Functional Forms >>. *American Economic Review*, vol.70, pp.422-432.

[9] Wen, Yi, (1998), << Capacity Utilization under Increasing Returns to Scale >>. *Journal of Economic Theory*, volume 81, issue1, pp. 7-36, July.

[10] Zellner, A., & Ryn H., (1998), << Alternative Functional Forms for Production, Cost and Returns to Scale Functions >>. *Journal of Applied Econometrics*, vol. 13, pp.101-127.

IV. CONCLUSION

This objective of this paper is to clearly develop a coherent strategy compatible with the real possibilities of the country to remedy the situation and deal with the challenges facing the sector. However, the problem is then how we can achieve these goals. Is it only through the total disengagement of the State and the privatization of the maritime transport or through the support given to the carriers and the simultaneous encouragement of private carriers?

The first solution is a topical issue since the country's economic policy expected to shift towards the market liberalization. The solution requires that the State withdraw from a domain so far operated by public companies supported directly by the State so that private companies, which are assumed to be more enterprising, can take over as they are better defenders against international competition of freight. Indeed, Tunisian private companies will however further penetrate the Tunisian market and consequently increase the participation of the national flag in volume and revenues.

The results achieved along this econometric analysis are consistent with the new data and changes that have characterized our maritime transport market. Actually, the TNC became aware of the market contestable nature and, consequently, of the credible threat from the actual and potential competitors. Therefore, it can no longer protect itself by its status as a "natural monopoly". In this context, the unique solution for the TNC is to improve the quality of its services and the management of its network.

To avoid these risks, it is necessary to develop a regulatory framework so as to make the State no longer the only maritime operator, but an arbitrator between the various operators, and thereby create an incentive framework for investment in maritime transport by public and private enterprises. Therefore, this new solution gives our future fleet some flexibility and a better competitiveness as a result of a voluntary complementarity of the public and private carriers to face more confidently and heavily the European challenge.

However, the development of our fleet plan must be backed by a dynamic through a modern and motivating training for both the crews and management staff. Finally, being aware of the importance of the operational costs, of the weakness of the maritime transport service profitability and of the competition magnitude that characterizes this sector, ship-owners adopted new strategies to manage their traffic flows and restructure their businesses. This process consists in building alliances or 'mega-carriers' or even multinational transport companies (MTC). These MTC emerged due to the containerization and the concern to ensure the continuity of the transport chain. The objective set for these companies is to perform an end-to-end transport by reducing transshipments, the shipment forwarding time, and the operational costs. In this context, Tunisia has to pursue these new business strategies of maritime transport by restructuring its legislation for a greater flexibility and decision autonomy given to the exploratory maritime national transportation companies.