ISSN 0709-9231

CAHIER 8504

Forecasting Containerized Traffic for the Port of Montreal (1981-1995)*

by

Marcel G. Dagenais and Fernand Martin

January 1985

*This report is based on the results of a research project financed by Transport Canada. Paul Hamelin and Dominique Paskievici collaborated very actively in the realization of the project. Opinions expressed in this text are the sole responsability of the authors and should in no way be considered as reflecting the views of Transport Canada.

Ce cahier est publié conjointement par le département de Science économique et par le centre de Recherche en développement économique de l'Université de Montréal.

Cette étude a été publiée grâce à une subvention du fonds F.C.A.C. pour l'aide et le soutien à la recherche.

FORECASTING CONTAINERIZED TRAFFIC FOR THE PORT OF MONTREAL (1981-1995)

by

Marcel G. Dagenais and Fernand Martin

Université de Montréal

ABSTRACT

The purpose of this paper is to present the approach taken by the authors to make long term forecasts of the overseas container traffic of the port of Montreal. This approach implied, first, the estimation of overseas container traffic by commodity, by origin and by destination for the recent past. The projections of containerized traffic flows for 1995 were then obtained by taking into account the anticipated general trends in Canadian international trade as well as the commodity composition of this trade. Projections of containerization rates were also made, taking into account the specific commodities and also the trading partners involved. The possible evolution of the boundaries of the hinterland of the port of Montreal was also considered. The importance of the traffic generated by the U.S. Midwest has increased considerably over the past ten years, due to a number of institutional factors. The forecasts of container traffic flows passing through the port of Montreal depend therefore in great part on whether the U.S. Midwest will remain within the zone of influence of the port of Montreal. Two forecasting scenarios are finally presented. One of the scenarios implies that the present competitive position of the port of Montreal remains essentially unchanged, while the second scenario implies the possible disappearance of an important Montreal-based carrier.

RESUME

Le but de ce rapport est de présenter l'approche utilisée par les auteurs pour effectuer des prévisions à long terme du trafic de conteneurs outre-mer, pour le port de Montréal. Cette approche suppose d'abord l'estimation du trafic de conteneurs par catégories de marchandise, par origine et destination, au cours des années récentes. Ensuite, nous avons obtenu des prévisions du trafic de conteneurs pour 1995, en nous basant sur des anticipations relatives aux tendances générales du commerce extérieur canadien et à la composition de ces échanges, par groupes de marchandises. Nous avons également dû effectuer des projections sur l'évolution probable des taux de conteneurisation, en tenant compte des diverses marchandises et également des partenaires commerciaux impliqués. Nous avons aussi considéré l'évolution possible des frontières de la zone d'influence ("hinterland") du port de Montréal. L'importance du trafic généré par le Midwest des Etats-Unis a augmenté considérablement au cours de la dernière décennie, à cause d'un certain nombre de facteurs institutionnels. Nos prévisions du trafic de conteneurs, pour le port de Montréal, dépendent donc, en grande partie, de l'éventualité que le Midwest des Etats-Unis demeure dans la zone d'influence du port de Montréal. Finalement, nous présentons deux scénarios de prévisions. Le premier de ces scénarios suppose que la position concurrentielle actuelle du port de Montréal demeure virtuellement inchangée. Le second scénario suppose la disparition d'une importante entreprise de transport de conteneurs, située à Montréal.

I. INTRODUCTION

The purpose of this paper is to present the approach taken by the authors to make long term forecasts of the overseas container traffic of the port of Montreal. In fact, our study concerned all the main Canadian ports handling overseas container traffic [St.John's (Newfoundland), Halifax (Nova Scotia), St.John (New Brunswick), Montreal (Quebec) and Vancouver (British Columbia)], but only the forecasts pertaining to the port of Montreal will be discussed in this paper, since these involve unusual features which, we believe, are of special interest.

Various port authorities use different methods to forecast their traffic of general cargo. Some of them rely on externally produced international trade forecasts and use shift and share methods†, by broad commodity groups, to infer what part of this trade will go through their ports. Others use trend extrapolations or a mixture of trend analysis and shift and share‡. Some of the larger ports use more elaborate models. For example, the port of Rotterdam uses a freight flow model which includes econometric import and export functions, by commodities*. These functions are based essentially on the Gross National Product of the Netherlands and neighboring countries. Scenarios are then developed about the future evolution of the variables considered in the model, including the containerization rates. The port of New York uses also a somewhat similar approach involving multiple regression analysis accounting for "the sensitivity of foreign trade volumes" to "the economic well-being" of the surrounding states which constitute its hinterland**.

†. Perloff, H.S., E.S. Dunn, E.E. Lampard and R.F. Muth, 1960, Regions, Resources and Economic Growth, Resources for the Future, John Hopkins Press, Baltimore, pp. 70-74.

‡. Studiecentrum Voor de Expansie Van Antwerpen, 1981, Haven van Antwerpen Tendensen in het Maritiem Massagoeden Stukgoedverkeer 1980-1985.

*. Haven van Rotterdam, 1980, How to Invest - And Stay Competitive : the Rotterdam System.

**. Gilbert, J. and A. Ilan, 1976, "New Planning Tool for Cargo Transportation in Foreign Trade", Transportation Research Record 591, Washington, D.C.

Most of the features of the above approaches can be retained in models forecasting overseas container traffic, by incorporating the following elements :

- the anticipated general trends in international trade activity,
- the commodity effect
- the trading partner effect,
- the containerization effect,
- the hinterland effect.

Clearly, the evolution of the volume of containerized traffic in a port depends in a general manner, upon the level of activity in international trade. The volume of containerized traffic depends also upon the commodity mix of the general cargo handled. Indeed, the changes in the commodity composition of the international trade of a country has an impact on the traffic of the desserving ports. Since the commodity composition of the traffic handled by the various ports is often quite different, this impact may differ markedly, between ports. Furthermore, not all commodity groups are equally containerizable. In addition, the volume of general cargo and of containerized goods handled by a port depends also upon the evolution of the economic activity of its trading partners. Depending upon its geographical location and other factors, each port will usually accommodate some of the trading partners of the hinterland better than others. Hence, a reorientation of the country's international trade in terms of trading partners may change the comparative advantages of its different ports.

The changes in the containerization rates is also an important factor in the evolution of the containerized traffic. In turn, if one assumes that the port under consideration has the adequate equipment, the anticipated changes in the containerization rates depend upon the nature of the commodities handled by the port, and also upon the container handling facilities of the trading partners involved.

Finally, the variations in the volume of general cargo and containerized freight passing through a port will also depend upon the changing conditions of its hinterland. The first element to consider is the boundaries of this hinterland. One must investigate whether the boundaries of the hinterland are fixed or whether they are likely to vary over time. The differences in the economic evolution of the different subregions included in the hinterland may also have an effect on the volume of containerized traffic, since the commodity content of the traffic associated with these different subregions may be markedly different.

In the case of the port of Montreal, we will see that the size of its hinterland has varied markedly over the past decade. One of the most difficult task of our forecasting exercice is to anticipate whether the geographical boundaries of this hinterland will remain unchanged over the next decade. This hinterland effect is often neglected when producing maritime traffic forecasts, because it is assumed that the hinterland of most ports is fixed. Not so in the case of the port of Montreal, which has two distinct subregions, in its hinterland, namely the Canadian provinces and the U.S. Midwest. The subregion associated with the Canadian provinces can be considered as relatively fixed†, but the importance of the traffic coming from the U.S. Midwest has increased considerably in the past ten years. Whether the U.S. Midwest will remain within the zone of influence of the port of Montreal over the next ten years is a debatable and problematical question. This point will be further discussed in a subsequent section.

II. THE FORECASTING APPROACH

As we just mentioned, the hinterland of the port of Montreal contains two main regions : the Canadian provinces and the United States. The hinterland associated with the Canadian provinces can be considered as fixed, while the U.S. hinterland of the port of Montreal has evolved over the recent past. For this reason, two different formulas were developed to forecast the containerized traffic passing through the port of Montreal. One formula was used for the traffic associated with the Canadian provinces, while a different formula was used for the traffic associated with the U.S. transit traffic.

A) *The Canadian traffic*

The general formula that was applied in this case was itself broken down into two variants, one being appropriate for exports and the other being applied to imports. The formula used for exports is given first and is explained in detail. The case of imports will be considered afterwards.

†. In fact, the Canadian Eastern ports of Halifax, St.John and Montreal share the same Canadian hinterland. Montreal attracts mostly traffic connected with the North Atlantic region. Its main competitor within its Canadian hinterland is Halifax. The competitive position of the port of Montreal vis-à-vis Halifax, with respect to the Canadian market of containerized cargo, has not altered significantly since 1979.

A.1 *Exports*

The forecast of Canadian overseas container traffic of exports (x) for the year of the forecast (year F), namely 1995, by commodity (m), province of origin (k), region of destination (j) and by port (i), namely the port of Montreal in the present case, is obtained as follows :

$$(1)\quad x_{im}^{kj}(F) = \underbrace{\left[\underbrace{\frac{x_{im}^{kj}(B)\ (1+w_{*m}^{k*})}{\sum\limits_{ijk} x_{im}^{kj}(B)\ (1+w_{*m}^{k*})}}_{\text{[term 1.A]}} \quad \underbrace{\sum_{ijk} x_{im}^{kj}(B)}_{\text{[term 1.B]}} \right]}_{\text{[term 1]}} \quad \underbrace{[1+w_{*m}^{x*}]}_{\text{[term 2]}} \cdot \underbrace{[1+w_{im}^{xj}]}_{\text{[term 3]}}$$

where

$x_{im}^{kj}(B)$ is the Canadian container traffic observed in the base year B, namely 1981;

w_{*m}^{k*} is the anticipated relative change in the share of province k for the production of commodity m, between the years B and F;

w_{*m}^{x*} is the anticipated relative change in the Canadian exports of commodity m, between the years B and F;

w_{im}^{xj} is the anticipated relative increase in the containerization rate of the exports of commodity m destined to the world region j and passing through port i, between the years B and F.

The commodity categories considered were the 78 categories used by the Canadian National Harbour Board, since our basic data was obtained with such categories†. There were seven world regions considered, namely, North Atlantic, Mediterranean, Middle East, Far East, Oceania, Africa, Central and South America.

† These categories are given in Appendix A.

These regions were chosen so as to coincide as much as possible with the shipping rate system of the maritime conferences.

The rationale for using the forecasting formula shown in equation (1) is easier to explain by considering its different terms. The term identified under equation (1) as [term 1.A] calculates what share of the flow of exports of containerized commodity m will originate from province k, in year (F). It is assumed that the share of exports of commodity m originating from province k will grow as the share of this province in the production of the commodity†. Forecasts of the changes in the provincial contributions to Canadian production, for different commodity groups, can be obtained from specialized government or private institutions. Since the shares represented by [term 1.A] are then multiplied by the total actual export flows of commodity m through all Canadian ports in *the basic year,* as represented by [term 1.B], the overall [term 1] therefore represents the *hypothetical* flows that would have originated from the different provinces to go through port i to the different world regions, if the *overall activity* would have been that observed in year B but the *distribution* of this activity among the provinces were that anticipated for year F.

Note that the procedure used to estimate these hypothetical flows changes also *indirectly*, for each commodity, the shares of the exports to the different world regions as well as the shares of the traffic handled by the different ports. These indirect effects appear reasonable since the anticipated differences in the rates of growth of provincial production, for a given

†. Note that our procedure does not require prior allocation of provincial traffic among competing ports. Our implicit assumption, however, is clearly that the competitive position of the port of Montreal in the Canadian market of containerized cargo, will remain rather stable over the forecasting horizon.

commodity, could very well be associated in part to changes in their shares of exports. Clearly, depending upon the nature of the commodities and upon the geographical locations of the provinces, the normal trading partners of the different provinces differ; consequently, the ports through which they ship their exports also differ. In practice, however, since for most containerizable commodities, the production shares of the different provinces are not anticipated to change drastically between now and 1995, the *indirect* effects induced by using [term 1] are not of major importance†.

Now these hypothetical flows represented by [term 1] are then multiplied by [term 2] which represents the anticipated growth in the exports of the commodity concerned to countries other than the U.S.‡. Again, export forecasts can be obtained from specialized institutions. The result of the product of [term 1] and [term 2] yields the forecasted flows of containerized exports by commodity, province of origin, region of destination and by port, under the assumption that containerization rates do not change. Clearly, these forecasts could be improved if one could use forecasts of Canadian exports by commodities and destination *broken down* into a greater number of world regions that only the U.S. and the rest of the world. Such more detailed forecasts were unfortunately not available to us when this task was performed.

†. Given that these indirect effects are not important, one could possibly have ignored the provincial origin of the Canadian traffic in producing our forecasts, thus reducing the complexity of equation (1). However, the forecasts described in the present paper were also used, within the framework of a broader forecasting exercice, to evaluate the Canadian COFC (container on flat cars) traffic. The provincial origin of containerized exports were essential for this other purpose.

‡ Our forecast of *overseas* container traffic does not include the Canadian exports destined to the United States.

Finally, [term 3] makes the necessary corrections in the forecast produced by the first two terms, to take account of anticipated increases in containerization rates. These anticipated increases were obtained by using the following formula :

$$t_{im}^{xj}(F) = \min \{t_m^{xMAX}(1981), [t_{im}^{xj}(B) \times (1.06504)^{F-B}]\}$$

where t_{im}^{xj} is the containerization rate anticipated for year F, for the exports of commodity m to world region j through port i. The term $t_{im}^{xi}(B) \times (1.06504)^{F-B}$ supposes that the containerization rate will increase by 6.504% per year and the exponential (F-B) measures the number of years between year F and year B. The value 1.06504 implies that the containerization rate would double in 11 years. A detailed examination of the evolution of containerization rates since the early seventies have led us to infer that this was a reasonable hypothesis. Clearly containerization rates cannot continue to grow indefinitely. Their upper bound cannot exceed one. It is even likely to lie below 1 for most commodity groups, since not all individual goods, within a given commodity group, are containerizable in practice. For each containerization rate, the upper bound was therefore assumed to be equal to $t_m^{xMAX}(1981)$ which corresponds to the maximum of the containerization rates observed in 1981 for a given commodity, in the different ports, for the exports destined to the different world regions. Since some of the Canadian ports, such as the port of Montreal, and some of the world regions of destination such as North Atlantic are fully equipped to handle container traffic, it was assumed that, for each commodity, the maximum containerization rate observed during the most recent year for which such data are available, would constitute a reasonable upper limit.

A.2 *Imports*

For exports, we have assumed that the share of exports originating from the different provinces will vary like the provincial shares in the production of the commodity. The corresponding assumption for imports would have been that the shares of imports destined to each province would vary like the provincial share in the appropriate weighed sum of the productions of the *industries that use these imports*. Although the necessary information to calculate such shares could have been obtained by using the provincial input-output tables, the scope of our research project did not allow us to resort to this procedure, which would have required a sizable amount of additional calculations. We assumed, instead, more crudely, that the shares of imports between the different provinces would vary uniformly, for all commodities, in proportion to the relative growth in the provincial gross domestic products.

Hence the formula used for forecasting imports was similar to that used for exports, except that the term w_{*m}^{k*} was replaced by w_{**}^{k*} where w_{**}^{k*} corresponds to the relative change of the share of province k in the Canadian gross domestic product.

B) *The U.S. Hinterland*

For the U.S. transit traffic (through Montreal) the forecasting formula used for exports was the following :

$$x_{im}^{US,j}(F) = x_{im}^{US,j}(B)\ [1 + w_{**}^{xUS}]\ [1 + w_{im}^{xj}]$$

where

$x_{im}^{US,j}(F)$ is the U.S. container traffic of commodity m passing through port i and destined to world region j, in year F;

w_{**}^{xUS} is the relative growth of U.S. exports of manufactured goods to countries other than Canada, between year B and year F;

w_{im}^{xj} is the relative growth of containerization rates.

The above formula is rather self explanatory. Clearly, these forecasts could be improved if one could use measures of the relative growth of U.S. exports *by commodity* or even better, *by commodity and world region* of destination. Although such detailed forecasts could be produced by special agencies, they were not available for this project.

The formula used to forecast the incoming U.S. transit traffic was similar to that used for the outgoing traffic.

Finally, it must be pointed out that the above formula assumed that the size of the U.S. hinterland associated with the port of Montreal will remain relatively fixed, over the forecasting period. Since it has not been so in the past, this assumption will be scrutinized in more detail in Section IV below. An alternative scenario will also be proposed.

III. ESTIMATING THE TRAFFIC FLOWS IN THE BASE YEAR

One of the problems raised by the use of the formulas described above is clearly the estimation of the past overseas container traffic flows passing through the Canadian ports, by commodity, by origin and by destination†.

†. This problem arises in the case of the port of Montreal and of the other Canadian ports because, contrary to the situation prevailing in some of the other ports referred to in our introduction, no exhaustive survey giving the complete breakdown of traffic flows by commodity, by origin and by destination was available. For example, for the port of Montreal, the port statistics give container tonnage by province of origin or destination, but no commodity breakdown. The commodity breakdown had to be inferred from a different source, namely the interprovincial trade flow data supplied by the Statistics Canada provincial input-output system. Similarly, the statistics of the port of Montreal give the traffic flows by commodity, but the world regions of origin or destination had to be inferred by using different data sets supplied by

The procedure used to estimate these detailed flows in the base year is best explained by referring to Figure 1. For illustration purposes, this figure relates only to exports passing through the port of Montreal. A similar procedure was used for imports. The same approach was also used for the other Canadian ports, with minor modifications depending upon the data available.

Control totals of the container traffic handled by each port, by commodity, for exports and imports, were supplied by the National Harbour Board (N.H.B.). Each Canadian port also has statistics on its own activities but these statistics are sometimes less detailed and may even differ slightly from the official statistics available at the N.H.B. This was not so, however, for the port of Montreal. Other sources, such as Statistics Canada, produce similar statistics; but comparisons with the data compiled by the individual ports and a number of additional cross-verifications convinced us that the totals supplied by the N.H.B. were more accurate.

From the total export traffic, the U.S. transit traffic $x_{i',m}^{US*}$ (see Figure 1) associated with the U.S. hinterland is first substracted to obtain the Canadian traffic $x_{i',m}^{CAN*}$. The data on the U.S. transit traffic through the port of Montreal was obtained from the port statistics. It is commonly agreed that, except for negligeable tonnage, all this traffic is destined to the North Atlantic region. Therefore, our estimates of the overseas container exports passing through the port of Montreal and originating from the U.S., by commodity and world region ($x_{i',m}^{US,j}$) was simply obtained by allocating all the U.S. transit traffic passing through the port of Montreal to the North Atlantic region.

FIGURE 1

Evaluation of overseas container flows of exports, by commodity, region of origin and region of destination, for the port of Montreal

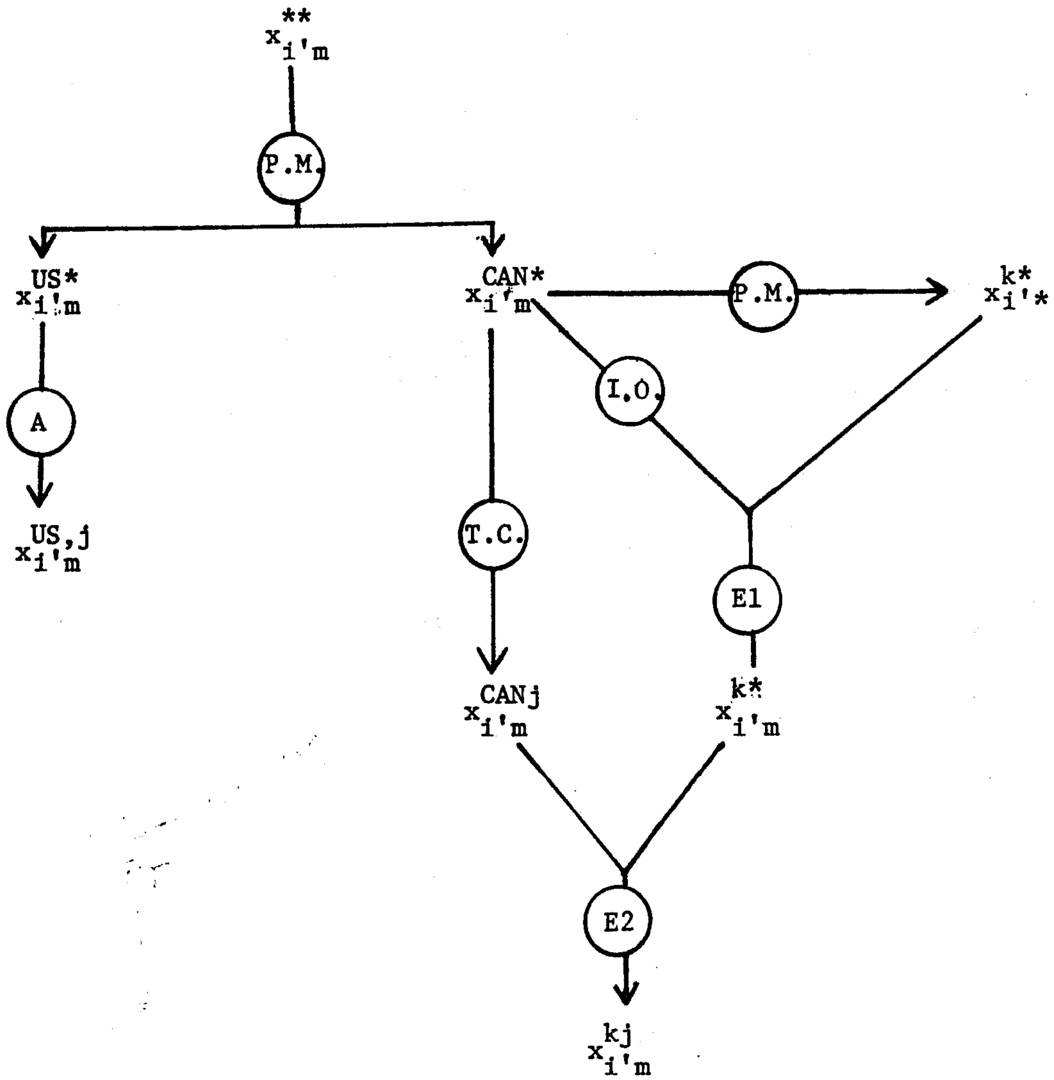

FIGURE 1 (suite)

Explanation of Symbols

$x^{**}_{i'm}$ = total overseas container exports, by commodity (m), passing through the port of Montreal (i');

(P.M) = breakdown performed, using statistical data from the port of Montreal;

$x^{US*}_{i'm}$ = overseas container exports originating from the U.S. (US), by commodity (m), for the port of Montreal (i');

$x^{CAN*}_{i'm}$ = overseas container exports originating from Canada (CAN) by commodity (m), through the port of Montreal (i');

$x^{US,j}_{i'm}$ = overseas container exports originating from the U.S. (US), by commodity (m) and region of destination (j);

x^{k*}_{i*} = overseas container exports, by province of origin (k), through the port of Montreal (i');

(T.C.) = breakdown performed using statistics from Transport Canada;

(I.O.) = breakdown performed using statistics from the interprovincial input-output system of Statistics Canada;

(E1) = use of entropy model 1;

$x^{CANj}_{i'm}$ = overseas container exports originating from Canada (CAN) by commodity (m) and region of destination (j), through the port of Montreal (i');

$x^{k*}_{i'm}$ = overseas container exports by province of origin (k), by commodity (m), through the port of Montreal (i');

(E2) = use of entropy model 2;

$x^{kj}_{i'm}$ = overseas container exports by province of origin (k), by commodity (m) and region of destination (j), through the port of Montreal (i').

The Canadian traffic by commodity ($x_{i'm}^{CAN*}$) was then broken down by region of destination to get $x_{i'm}^{CANj}$, using ratios derived from Transport Canada statistics. The Canadian container traffic by commodity was then aggregated over all commodities and subsequently disaggregated by province of origin, to get $x_{i'*}^{k*}$, using ratios derived from data available at the port of Montreal for the year 1980.

Then, from $x_{i'm}^{CAN*}$ and $x_{i'*}^{k*}$, Canadian overseas container exports for the port of Montreal, by commodity and province of origin $x_{i'm}^{k*}$ were obtained by applying the entropy model described below :

Entropy Model 1

Maximize $$- \sum_{k=1}^{K} \sum_{m=1}^{M} x_{i'm}^{k*} \ln (x_{i'm}^{k*} / \bar{x}_{i'm}^{k*})$$

subjet to $$\sum_{m=1}^{M} x_{i'm}^{k*} = x_{i'*}^{k*}$$

$$\sum_{k=1}^{K} x_{i'm}^{k*} = x_{i'm}^{CAN*}$$

where the $\bar{x}_{i'm}^{k*}$ correspond to "prior values". These "prior values" were obtained by performing a naïve breakdown of $x_{i'm}^{CAN*}$ by province of origin, using for each commodity, ratios derived from the interprovincial trade flows by commodity supplied by the Statistics Canada provincial input-output system. Unfortunately, when our study was performed, the most recent data available on interprovincial trade flows related to 1974. Our estimates could clearly have been improved if more recent information had been available.

The principle of maximization of entropy may be interpreted as a means of finding the "most probable" allocation of the data, while satisfying the imposed constraints. It may also be interpreted as a way of minimizing the information content of the resulting allocation : in other words, it is a conservative strategy which minimizes the information value of the available data and therefore ensures that this value has not been exaggerated.

Finally, from $x_{i'm}^{CANj}$ and $x_{i'm}^{k*}$, the evaluation of the Canadian overseas containerized exports by commodity, by province of origin and world region of destination, for the port of Montreal, was obtained by solving entropy model 2 :

Entropy Model 2

Maximize $$- \sum_{k=1}^{K} \sum_{j=1}^{J} \sum_{m=1}^{M} x_{i'm}^{kj} \cdot \ln (x_{i'm}^{kj} / \bar{x}_{i'm}^{kj})$$

subject to $$\sum_{k=1}^{K} x_{i'm}^{kj} = x_{i'm}^{CANj}$$

$$\sum_{j=1}^{J} x_{i'm}^{kj} = x_{i'm}^{k*} .$$

Here, the prior values $\bar{x}_{i'm}^{kj}$ were simply set to 1 or zero. The fact of setting a prior value to 0 assures that the corresponding flow in the solution will also be equal to zero. Zero prior value were used to eliminate unrealistic back trackings, such as export flows originating from British Columbia and passing through Montreal to be shipped to Japan.

IV. THE U.S. HINTERLAND OF THE PORT OF MONTREAL

In the case of the Canadian eastern container ports, the U.S. components of their hinterland cannot be hypothesized to be constant, as will be shown below. This is contrary to the conditions prevailing in other ports, such as New York, where the area of the hinterland can be taken as fixed, over time†. If the areas of the hinterland components are not fixed over time, their variations must somehow be incorporated in the general forecasting model‡.

We must first show that, in the case of the port of Montreal (contrary to its competitors, v.g. the U.S. northeastern ports), its hinterland is variable and could extent or shrink over time. There are two complementary arguments to that effect :

1) a mere observation of the ports flows shows that the U.S. transit traffic was virtually inexistent in 1971 but constituted 46% of the total containerized traffic of the port of Montreal in 1980. That suggests that the territory of some American states has been gradually incorporated into the market area of the port of Montreal;

2) one may also use a performance model [a model that is supposed to explain the historical performance (traffic) of the port of Montreal] based on the assumption of a fixed hinterland and verify whether the model seems appropriate. It can be shown that such a model explains very poorly the performance of the port of Montreal*.

---

†. This is what is assumed by Sun and Bunamo (1973). Sun and Bunamo maintain that their model "is sufficiently operational and flexible to explain the competitive performance of any U.S. port district" (p. 62).

‡. The area of the hinterland governs the amounts of the various commodities that will be included in the port's flows. *Ceteris paribus* an extension of this area increases the volume of the port's flows.

*. See Appendix B.

Since such performance model has been very successful elsewhere (where conditions of fixed hinterland prevailed) it does confirm our standpoint. How could such an increase in the U.S. transit traffic occur ? Physical land distances, difficulties of winter nagivation, etc., have not changed over time. Although Montreal was never significantly inferior, it has never had any great advantage, on that basis, over Baltimore for the U.S. Midwest traffic and over New York for other U.S. traffic. The answer is that the market area of a port is a function of physical distances to markets and to other competing ports *weighted by transport costs* (land and marine) per unit of distance; if transport costs differentials† associated with competing ports vary over time for given areas, the boundaries of the hinterland of these ports may shift. Over time, transport costs differentials from given areas to competing ports can vary because of changes in the technology of transportation, changes in fuel costs or because of institutional factors‡ that modify (in a discriminating way) the pricing behaviour of shipping and railway companies. However, the first two factors (technology and fuel costs) are unlikely to have affected in a substantially different way the competing ports we are considering, during the period studied. We are thus left with the so-called institutional factors as one of the explanations of the extraordinary success of the port of Montreal during this period.

---

†. This includes not only rates, but also transaction costs, fiability, long term consideration, loyalty of a shipper to a carrier, etc.

‡. By institutional factors, we mean those industry practices fostered by certain types of organizational arrangements and behaviours allowed or encouraged by the legal framework and government regulations. They are interesting inasmuch as they lead to behaviours other than those compatible with the purely competitive model.

The institutional factors that account for ill-correlated transport costs with distances and may lead to market conditions that differ markedly from the purely competitive situation, are† :

(1) the ever changing modifications in the behaviour of the shipping companies (which are cartelized into conferences), associated with the financial or equity participation of Canadian railway companies in shipping firms or shipping consortia. This participation lead to an interaction between the marketing objectives of the shipping companies and those of the railways, to the extent that the pricing methods of railways were altered, e.g. marginal cost pricing replacing full cost pricing on key routes. Other important elements are the economies of scale, reductions in transaction costs, access to privileged information, etc. For instance, the competitive attitude of Canadian railways on the Montreal or Halifax routes to Chicago permitted to the associated shipping companies to increase considerably their business in the U.S. Midwest, from 1971 to 1982, to the prejudice of the U.S. railways linking Chicago to the U.S. East Coast;

(2) government regulations of transport companies, such as the Canadian government regulation of railways in the setting of their rates and their participation to joint ventures with Canadian and foreign firms. In the United States, the main element to consider is the peculiar regulation of foreign transport companies operating in the U.S. territory.

---

†. Since the hinterland for Eastern Canadian ports cover both the Canadian area and the U.S. Midwest market, we restrict our list of institutional factors to those that are pertinent for these regions. Our interest for the U.S. market comes from the fact that this market now constitutes almost one half of the containerized traffic in the port of Montreal and one sixth in Halifax. It is very small in St.John. It should also be understood that the discussion of institutional factors presented here is governed by our forecasting needs. It does not intend to develop a "general theory" of institutional factors.

The main institutional factors that, in the U.S., favored Canadian-based carriers from 1971 to 1981 were† :

(1) the U.S. Shipping Act‡ that does not require Canadian-based carriers to file rates with the FMC*. This provides Canadian-based carriers with much flexibility in rate setting by enabling them to discriminate among their clients. It also frees them from much governmental examination and possible legal challenges by U.S. competitors;

(2) the fact that intermodalism is less practical and efficient in the U.S. Indeed, a U.S. law forbids vertical integration of U.S. carriers [see Caves et al. (1981)]. The fact that U.S. railways and trucks were regulated up to 1981, accounts for the little use of marginal cost pricing, e.g., the Chicago-New York route had the same rate as the Chicago-Baltimore route;

(3) higher ports' costs in the U.S. including labour costs and inefficient practices, due to a set of U.S. regulations and industrial arrangements.

---

†. What follows concerns the U.S. situation up to 1981, before rail transport was deregulated. The thrust of our argument is precisely that eventually, as a consequence of this deregulation, the competitive position of the ports may change in the future.

‡. The U.S. Shipping ACT of 1916 has been replaced, in June 1984, by the U.S. Shipping Act of 1984. It is too early to determine its impact on the Canadian-based carriers but since its purpose is to reduce the bearing of antitrust laws on shipping arrangements, it might eventually reinforce the competitive position of U.S.-based carriers.

*. In the past years, the North Atlantic Ports Association, which represents U.S. East Coast ports, has recurrently pressed, without success, the U.S. Congress to pass bills closing this loophole. In September 1984, a special bill to that effect was defeated in the House of Representatives (The Gazette, December 15, 1984).

To that, we must add accessory conditions such as :

(1) the conferences behaviour which did not, up to November 1983, have authority over intermodal rates concerning the U.S. Midwest market. This prevented the formation of minibridges in the U.S. and the use of door-to-door pricing policies;

(2) the exchange rate which favours Canadian-based carriers by at least 20%.

Technically, these institutional factors account for the fact that the purely competitive solution (which underlies the workings of the Sun and Bunamo model) does not apply to containerized traffic through the Eastern Canadian ports. This traffic is transported in and through Canada under oligopolistic conditions and other institutional arrangements (especially the connections between railway and shipping companies), while bulk traffic (the main component of the Sun and Bunamo model) is transported under much more competitive conditions.

The main effect of the cartelization of shipping firms into conferences associated with the accommodating behaviour of the Canadian railways has been, in the case of containers, to merge into a single homogeneous market many of the individual natural hinterlands of the Eastern North American ports†, at least from the point of view of the Canadian shippers of Ontario and Quebec as well as of those of the U.S. Midwest and Eastern seaboard. Similarly, the gradual development, over the period, of quasi-vertical integration of railways and shipping companies in the Canadian system of container transportation, has produced a coincidence of interests between the participants that resulted in common discriminating pricing strategies. Furthermore, the

†. Thus extending the hinterland of the port of Montreal.

superior coordination of the Canadian intermodal transportation system over the U.S. system puts the Canadian carriers at a definite advantage. The end result is that, with the cooperation of shipping companies, the railways can, to some extent, make or unmake the competitive position of a port, like the maritime conferences. In other words, the institutional factors explain to some extent why the hinterland of a container port such as Montreal is not a fixed area determined once and for all by a simple transport model operating under conditions of free competition, but fluctuates according to the changing modes of behaviour of transport companies and government regulations.

The recent performance (1979-1982) of the port of Montreal supports this point. Indeed, because it attracted new carriers during this period and because of the peculiar entrepreneurial behaviour of its main users, it paradoxically increased its volume in the midst of the recent recession, while competing ports, such as Baltimore, Hampton Roads and Halifax, were suffering absolute declines in traffic (see Table 1). This phenomenon suggests that the relative performance of a port, such as Montreal, is influenced by carriers' activities‡ *per se, on top of the effects of its geographical situation and of the macroeconomic conditions prevailing in the period.*

We can substantiate the above propositions by the following factual argument. The macroeconomic factors are taken into account by comparing Montreal's performance with that of the U.S. and Canadian ports which compete for the same

---

†. This is reminiscent of Friedlaender and Harrington (1979), who attributed the greater use of the piggy-back system in Canada over the United States to the vertical integration of rail and trucks in Canada.

‡. When these activities are a function of the institutional factors referred to above.

TABLE I

PORTS' TRAFFIC (1979-1983)

		1979	1980	1981	1982	1983
Port of Montreal						
containers	(000)	268,1	252,0	297,8	316,0	357,5
tonnage	(000)	3 051	3 058	3 501	3 236	3 753
without DART†						
tonnage	(000)	3 051	3 058	3 321	2 836	n.a.
Port of Baltimore						
containers	(000)	502	523	494	480	526
tonnage	(000)	4 097	4 273	3 911	3 888	4 262
Port of Hampton Roads						
containers	(000)	416	265	229	215	223
tonnage	(000)	2 275	1 800	1 738	1 566	1 694
Port of New York						
containers	(000)	1 779	1 947	1 860	1 909	2 065
tonnage	(000)	11 275	11 790	11 310	11 977	12 359
Port of Boston						
containers	(000)	83	109	95	88	n.a.‡
tonnage	(000)	508	769	758	782	n.a.
Port of Halifax						
containers	(000)	219,2	201,4	188,7	151,5	158,9
tonnage	(000)	2 083	1 935	1 786	1 419	1 506

Source : Since various sources sometimes produce different figures for the same port in the same year, we have standardized our sources by using almost only the world container ports survey of various years as published by Container News (in the month of May of each year). However, since in that source there are sometimes correction made in ensuing years, we have used the latest figures. The tonnage figures seem quite reliable. The figures for the number of containers are much less reliable.

†. The tonnage that would have been handled by the port of Montreal if DART had remained in Halifax has been constructed on the following hypothesis : -180 000 tons in 1981, and -400 000 in 1982. For the justification, see the DHM 1982 study, p. 164.

‡. Container News, September 1984, says, page 11, that the volume of Boston has increased by 14% in 1983.

markets and are affected by the same macroeconomic conditions†. Table 1 shows that from 1980 to 1982 the port of Montreal fared much better than its U.S. competitors and Halifax, especially if we take into consideration the fact that the route over which Montreal specializes (the North Atlantic route) is almost stagnant, while the other routes available to New York and Baltimore (Africa and South America) are developing‡. The institutional factors, during the period 1971-1982 were so advantageous to the Montreal-based carriers that the properly exploited traffic followed the shipping lines when they chose Montreal as their base of operations*.

†. These ports are listed in Table 1.

‡. It is important to note that our demonstration refers principally to the 1980-1982 period because the institutional conditions began to change in the U.S. after the Stagger law deregulated railways in 1980. By 1983, the Canadian Railways was facing stiff competition in the U.S. : it costed 100$ less to ship a container from Chicago to New York or Baltimore than to ship it to Montreal [Containerization International (C.I.), April 1983, p. 81]. Also secret intermodal rates are now numerous in the U.S. (C.I., July 1983, p. 66). Similarly intermodal tariffs are gradually introduced for the U.S. Midwest. They were first introduced by an outsider (TFL) in December 1981 (see C.I., February 1982, p. 22). But, the bombshell came in December 1982 when Sea-Land filed "a wide range of microbridge tariffs between a range of interior points in the U.S. and a selection of centres in Europe and the United Kingdom,...... No doubt that Sea-Land's decision to file intermodal tariffs was partly influenced by the activities of CAST and other Canadian gateway carriers...... Within days ACL, DART, Hapag-Lloyd and U.S. Lines,......T.F.L., Pol, have followed suit". (C.I., April 1983, pp. 29-30).

Recently, the FMC, in November 1983, conferred to the conferences the "intermodal rate-making authority" [Journal of Commerce (J.C.), December 12, 1983, p. 13c]. Not only did that restore the power of the conferences, but compared to the previous institutional situation, it eliminated one of the loopholes which favored Canadian-based carriers operating in the U.S. Midwest for the last 14 years.

*. The converse would be true if the institutional factors would become unfavorable to Monteal. In that case, Montreal would have its competitive power reduced.

All this means that for forecasting purposes, we must distinguish two types of traffic :

i) a traffic that can be fully predicted by the gravity model (which usually leads to a fixed hinterland solution);

ii) a traffic which follows the carrier. It is a traffic which appears to resist the commercial logic of a straightforward relationship between distance and costs†. In our case, that means that there exists some U.S. traffic which comes to Montreal only because of institutional factors, as incorporated into the business characteristics of the Canadian-based carriers. Much of the U.S. traffic and some Canadian traffic that goes through Montreal is in this category.

One can further support this point empirically by pointing out that in the middle of 1981, DART (a shipping line) moved from Halifax to Montreal. Accordingly, Montreal's volume surged upward in 1981 while Halifax decreased. In 1982 (a year of recession), Montreal's traffic was 6% superior to its 1980 volume while Halifax was down 26%‡.

Montreal is the only port in Table 1 to increase considerably its traffic in 1981 over 1980. This definitely suggests that a shipping line can bring new traffic to a port*. Furthermore, all the increase in Montreal's

†. See an example in <u>C.I.</u>, January 1979.

‡. Source : computed from figures of Table 1. It is estimated [see Dagenais, Hamelin et Martin (D.H.M.), 1982] that DART added 181 000 tons to Montreal in 1981 and 400 000 tons in 1982.

*. This is not what classical transport models say. Usually shipping lines go where there is traffic, not the other way around. When DART was in Halifax, where there is little local traffic, it was bringing additional traffic to that port.

volume for 1981 is not due exclusively to the arrival of DART†, but also to the extraordinary increase in volume of another large shipping line (CAST) already based in Montreal‡ and accounting for one third of Montreal's container traffic. This shipping line which is reputed to have been an aggressive price leader up to 1983*, incorporated in a very typical way, in its marketing strategies, the power of the institutional factors that favored Montreal in

---

†. DART brought only 180 000 tons while the increase in the volume of Montreal (over 1980) was around 442 000 tons.

‡. CAST container traffic in the port of Montreal has been estimated as follows :

	1879	1980	1981	1982**
total traffic (in tons)*	1 059 850	1 077 813	1 341 720	796 650
U.S. traffic (in tons)*	582 917	592 797	737 946	438 157

* The source is confidential. Determining the volume of containers transported by a particular carrier is always an hazardous task both for economists and for trade journalists. See : "Just who is lifting what, and what percentage of their slots they are managing to load with remunerative freight, is generally a closely guarded secret". (C.I., April 1983, p. 27)

Our computations are consequently estimates. They are detailed in Dagenais, Hamelin, Martin, Parkievici (D.H.M.P.), 1984.

** The decrease from 1981 to 1982 is partly imputable to the fact that from September 1982 to August 1983, former key employees of CAST had set up a rival shipping line called SOFATI. Presumably, they recuperated a portion of CAST's clientele.

*. Its success in the U.S. Midwest (up to 1983) was due to the fact that the conferences had not yet authority over intermodal rates in the Midwest. Furthermore it did not have to file rates with the FMC, and could thus quote door-to-door FAK rates and even discriminate among its clients. Besides that, CAST could reap the economies of conbulkers operations, count on the Canadian efficient intermodal transport system with quasi-vertical integration with the CN railway, and capitalize on Montreal's port low user costs. Its association with the CN has been beneficial in many ways : extraordinary good credit conditions (La Presse, September 22, 1983), secret commission (7%) on the Montreal-Chicago route from 1979 to 1981 (The Gazette, November 19, 1983), etc. CAST ran into financial difficulties in 1982. It was eventually (La Presse, September 21, 1983) taken over by its main creditor : The Royal Bank of Canada. At that time, the CN Railways also owned 18% of CAST. CAST joined the conferences as of January 1, 1984.

that period. The above argument is well illustrated by the fact that the annual increase in the volume of containerized traffic of the port of Montreal, in 1981, which amounted to 442 000 tons, is largely explained by the arrival of DART (180 000) and by the increase of volume (from 1 077 813 to 1 341 620 tons) of CAST.

CAST was successful in getting more traffic by extending the market area of Montreal to the U.S. Midwest. Actually CAST probably overestimated the possibilities of extending that hinterland through the institutional factors, especially during a recession†. This means that even without any further change in institutional factors the sudden disappearance of this particular carrier might somewhat reduce, in a permanent way, the attractive power of the port of Montreal‡.

We conclude that in trying to explain the past performance of a container port and/or forecasting its future, the area of the hinterland should not be viewed as a fixed factor but as a variable factor which could be relatively important. A complete forecasting model should consequently make room not only for the commodity and trading partner effects, but also and foremost for the institutional factors that shape the operational hinterland of ports.

---

†. It hypothesized that the institutional factors would remain either stable or that an increase in general economic activity would compensate for any reduction in the priveleges confered to Canadian-based shipping lines. With hindsight, we know that is was wrong on both counts. This is what brought its financial demise. However, CAST is not the only company loosing money on the North Atlantic route. DART and CP ships have also been loosing money for many years. It is also impossible to determine the profitability of other contenders such as Polish Ocean Lines and Morflot Freightliners (a Soviet firm). In the end, it is difficult to determine whether or not all the U.S. Midwest traffic which actually goes through Montreal, is fundamentally an economically profitable business in the long run.

‡. We are implying that there exists a residual of U.S. and Canadian clients of CAST that made economic sense only to CAST because of its internal cost structure and because of its rate wars with the conferences.

V. THE FORECASTING SCENARIOS

Since we have demonstrated that the performance of a port depends, amont other things, upon the ability of its shipping lines to cover and/or extend its market area, i.e., its hinterland, and that the capacity of these carriers to do so depends upon the institutional factors that condition their activities, any port forecasting model must incorporate a forecast about the evolution of these institutional factors. This is done by adapting the forecasting formulas presented in Section III, to various scenarios accounting for the expected evolution of the institutional factors (in Canada and United States, in our case), and of the behaviour of the conferences. A large number of scenarios are possible. Two simple ones, which are considered below, are :

1) the status quo in the institutional factors, plus the survival of CAST as an outsider to the conferences;

2) the disappearance of CAST, with its assets being disseminated among several buyers.

Understandably, there exist more extreme scenarios such as the one envisaging simultaneously (1) the disappearance of most of U.S. legislation favoring indirectly Canadian-based shipping lines, (2) significant changes in the market behaviour of Conferences operating in the U.S. Midwest, (3) the vertical integration of the deregulated rail and truck carriers based in the U.S., (4) a wider use of marginal cost pricing in inland transportation in the U.S., (5) compulsory filing of rates with the FMC by Canadian-based carriers, (6) a reduction of the gap between U.S. and Canadian port costs.

We have not considered such an extreme scenario mainly because of the lack of solid information on these matters from marketing experts in the field† and because it is unrealistic to imagine that many of these adverse eventualities would simultaneously materialize within the next decade.

The forecasts corresponding to the two retained scenarios can be computed in the following way :

i) for scenario 1, the formulas of Section II are used without any modification;

ii) for scenario 2, we first compute the possible annual loss of traffic and then, substract it from the level established in scenario 1‡.

The results of our computations for the port of Montreal are summarized in Tables II to IV*. According to scenario 1, the total overseas traffic passing through the port of Montreal would attain 5 639 255 thousand tons in

†. Indeed it is difficult to obtain unanimity from these experts on such sweeping institutional changes. For instance, there are people who think that the fact that the conferences have recently obtained the authority to set door-to-door intermodal rates in the U.S. is far from enough to stop the "Canadian diversion" (see Journal of Commerce, December 12, 1983, p. 16c). On the other hand, Canadian experts from the port of Halifax predict that if Canada does not bestow on the Canadian railways the same advantages that the Stagger Law gave to their American counterparts, the Eastern Canadian ports are bound to loose a large portion of their market (see La Presse, September 28, 1984, p. C3).

‡. In a previous exercise (see DHMP, 1984), we estimated that amount at 383 000 tons/year for the port of Montreal. This estimate was established after consultation with marketing experts from ports, railways and shipping lines.

*. Source : the D.H.M.P. (1984) study.

1995, a 68,4% increase over the traffic of 1981 which amounted to 3 348 169 thousand tons. This represents on the average a growth rate of 3,8% per year. Scenario 2 is more conservative; it shows a traffic of 5 256 620 thousand tons in 1995, a 57,0% increase over 1981, representing an annual increase of 3,3%.

More detailed forecasts were actually made by commodity (78 commodity groups) and by individual province of origin or destination. It must be noted also that the forecasts presented here were made during the first semester of 1984, using the Canadian and U.S. external trade forecasts available at that time. Changes in these forecasts due to more recent information would clearly produce changes in the results presented in our tables.

TABLE II

TOTAL OVERSEAS CONTAINER TRAFFIC 1981, IN THOUSAND METRIC TONS

PORT : MONTREAL

	Atlantic Provinces	Quebec	Ontario	Prairies Provinces	British Columbia	United States	Total
North Atlantic	11 800	801 195	718 645	72 243	52 886	1 547 305	3 204 07[illegible]
Mediterranean	1 338	33 270	22 608	6 007	1 750	0	64 97[illegible]
Middle East	1	50	24	27	4	0	10[illegible]
Far East	0	6 544	3 468	0	0	0	10 01[illegible]
Oceania	0	0	0	0	0	0	0
Africa	497	8 606	5 990	2 786	446	0	18 32[illegible]
Central and South America	723	28 257	15 683	4 977	1 039	0	50 6[illegible]
Total	14 359	877 922	766 418	86 040	56 125	1 547 305	3 348 1[illegible]

TABLE III

SCENARIO 1

TOTAL OVERSEAS CONTAINER TRAFFIC 1995, IN THOUSAND METRIC TONS

PORT : MONTREAL

	Atlantic Provinces	Quebec	Ontario	Prairies Provinces	British Columbia	United States	Total
North Atlantic	25 505	1 407 643	1 173 080	140 019	99 601	2 428 334	5 274 182
Mediterranean	2 660	85 593	40 369	10 985	4 103	0	143 710
Middle East	1	80	33	54	7	0	175
Far East	0	16 265	6 147	0	0	0	22 412
Oceania	0	0	0	0	0	0	0
Africa	1 015	22 387	14 036	5 550	1 042	0	44 030
Central and South America	1 474	96 790	41 873	11 152	3 457	0	154 746
Total	30 655	1 628 758	1 275 538	167 760	108 210	2 428 334	5 639 255

TABLE IV

SCENARIO 2

TOTAL OVERSEAS CONTAINER TRAFFIC 1995, IN THOUSAND METRIC TONS

PORT : MONTREAL

	Atlantic Provinces	Quebec	Ontario	Prairies Provinces	British Columbia	United States	Total
North Atlantic	25 505	1 361 089	1 130 049	140 019	99 603	2 135 332	4 891 597
Mediterranean	2 660	85 593	40 369	10 985	4 103	0	143 710
Middle East	1	80	33	54	7	0	175
Far East	0	16 265	6 147	0	0	0	22 412
Oceania	0	0	0	0	0	0	0
Africa	1 015	22 387	14 036	5 550	1 042	0	44 030
Central and South America	1 474	96 790	41 873	11 152	3 457	0	154 746
Total	30 655	1 582 204	1 232 507	167 760	108 212	2 135 332	5 256 670

APPENDIX A

NATIONAL HARBOUR BOARD COMMODITIES

1) Live Animals
2) Meat and Meat Prepara tions
3) Fish Other Marine Products
4) Milk Powder
5) Dairy Products Eggs and Honey
6) Wheat
7) Rye
8) Barley
9 Oats
10) Corn
11) Cereal Grains Unmilled
12) Wheat Flour
13) Cereal Grains Milled
14) Fruits Vegetables and Preparations
15) Raw Sugar
16) Molasses
17) Sugar Cocoa Margarine Other
18) Fodder and Feed
19) Alcoholic Beverages
20) Beverages Tobacco
21) Flaxseed
22) Rapeseed
23) Mustardseed
24) Soya Beans
25) Rubber and Allied Gums Natural
26) Crude Vegetable Products Inedible
27) Logs and Bolts
28) Pulpwood Pulpwood Chips
29) Crude Wood Materials
30) Textile and Related Fibres

31) Iron Ores, Concentrates
32) Aluminum Ores, Concentrates
33) Copper Ores, Concentrates
34) Nickel Ores, Concentrates
35) Nickel Copper-Matte
36) Zinc Ores, Concentrates
37) Manganese ores, Concentrates
38) Metal Ores, Concentrates
39) Scrap Metals
40) Coal (Bitumious, Anthracite and Coking Coal)
41) Crude Oil
42) Asbestos Unmanufactured Crude and Fibre
43) Sand and Gravel
44) Fluorspar
45) Gypsum
46) Phosphate Rock
47) Rock Salt
48) Sulphur Crude and Refined
49) Crude Non-Metallic Minerals
50) Lumber and Sawn Timber
51) Veneer and Plywood
52) Wood Fabricated Materials
53) Wood Pulp
54) Newsprint
55) Paper and Paperboard
56) Tallow Inedible
57) Oils Fats Waxes...and Vegetable
58) Potash
59) Explosives Fuses and Caps
60) Fertilizers and Materials
61) Chemicals and Related Products (Dry)
62) Chemicals and Related Products (Liquid)
63) Gasoline

64) Fuel Oil
65) Propane Gas
66) Coke
67) Other Petroleum and Coal Products
68) Iron Steel and Alloys
69) Non-Ferrous Metals
70) Cement and Concrete Basic Products
71) Non-Metallic Mineral Basic Products
72) Machinery
73) Road Motor Vehicles
74) Motor Vehicle Engines, Accessories
75) Transportation and Communication Equipment
76) Other Equipment and Tools
77) Personal and Household Products
78) Miscellaneous Products

APPENDIX B

An Analysis of the Performance of the Port of Montreal in Containerized Traffic (1971-1980)

This analysis is directly inspired from the Sun and Bunamo (1973) study of the port of New York. The Montreal case if specified in the following manner. The dependent variable is Montreal's share of containerized traffic of the Eastern Canadian ports†. To make the comparison meaningful between Montreal and New York, we have, as far as possible, used the same variables as those used in the case of New York‡.

The variables* used in the different models to explain performance are :

TM/T_c = the share of Montreal traffic in Eastern Canadian ports for containerized traffic;

FL/X_c = the share of fruits and vegetables in Canadian exports (oceanborne and airborne);

ASB/X_c = the share of asbestos in total Canadian exports (oceanborne and airborne);

---

†. More precisely : Montreal, Quebec City, St.John and Halifax for the period 1971-1978, and the ports of Montreal, St.John and Halifax for 1979 and 1980. The break from 1979 is due to the move of a container carrier from Quebec City to Montreal. This led to the closing of the port of Quebec City to containers. Note also that we are not taking the port of Vancouver into consideration because Montreal's immediate competitors in the container traffic, even for Far East trade, are St.John and Halifax, not Vancouver.

‡. Since our main purpose is to explain containerized traffic, we have replaced the bulk commodities (grain, coal, lumber, etc.), which are not containerized, by the most important containerized traffic in the port of Montreal : asbestos and fruits and vegetables. In that, we take the same approach as Sun and Bunamo who chose the commodities most compatible with their main traffic : bulk. Consequently, if there is a lack of success of the model, it cannot be imputed simply to a disaggregation process by types of traffic. Furthermore, for the independent variables representing the commodity effect, we have used export data only. This is because the data on the import side was more difficult to collect; furthermore the influence of the import variables was expected to be less marked if we rely on the Sun and Bunamo experience.

*. The first three independent variables are alternative proxies to account for the "commodity effect", the fourth variable is the "hinterland effect", while the fifth and sixth are alternative measures of the "trading partner effect".

FA/X_c = $(FL + ASB)/X_c$;

V_{QO}/V_c = the share of the value of shipments of Canadian manufacturing industries accounted for by Quebec and Ontario;

Y_e/Y_j = the ratio of real income of Northern European countries over the real income of Japan.

Northern Europe includes : Ireland, United Kingdom, France, Belgium, West Germany, Luxembourg, The Netherlands, Norway, Denmark, Sweden;

IP_e/IP_j = the ratio of the production index of Northern European countries over the production index of Japan.

The estimated equation has the following form :

$$S_{Mt} = a_1 + a_2 C_t + a_3 H_t + a_4 T_{pt} + u_t$$

where

S_M = Montreal's share of the containerized traffic in the Eastern Canadian ports;

a_1 = the intercept;

C_t = variable representing the commodity effect;

H = hinterland effect;

T_p = trading partner effect;

u = the residual term reflecting the combined effect of omitted variables;

t = designates the time period to which the variables refer.

The estimations have been carried out under alternative specifications. A last regression has been added utilizing only H (hinterland) as the explanatory variable. Furthermore, two estimation procedures have been used : ordinary least-squares and the Hildreth-Lu method to cope with first order serial correlation†.

The results of the regression analyses are provided in our Tables V and VI. Only our Table V is strictly comparable with the Table 3 of Sun and Bunamo (1973, p. 160). In general, our R^2's are much lower than those of the New York case and, what is more important, the signs of the coefficients of variable V_{QO}/V_c (the hinterland) are predominantly negative; this is in opposition to the results of Sun and Bunamo. Furthermore, in the Montreal case, the explanatory power of the hinterland alone is not significant (in Table V) or small (in Table VI; see regression no. 7), while for the port of New York, the correlation between the hinterland (when used as the only independent variable) and the performance of the port is much better‡ (R^2 = .66).

We show a poor performance of the model for Montreal, especially since we end up with a negative coefficient for the hinterland. Since we cannot logically accept that the original fixed hinterland hindered containerized traffic in Montreal, we must conclude that the zone of influence of the port has been transformed during the period.

---

†. We resorted to the Hildreth-Lu method because the Durbin-Watson statistics fell in the zone of indeterminacy, in five regressions out of seven. Note that some of the Durbin-Watson statistics derived from the least-squares results of Sun and Bunamo also fell into that zone.

‡. This figure has been computed by us from the Sun and Bunamo data of their Table 3.

TABLE V

Estimates of the determinants of Montreal's Share of the Containerized Traffic of Eastern Canadian Ports (Period 1971-1980) (Least-Squares Method)

Regression No.	Constant	FL/X_c	ASB/X_c	FA/X_c	V_{QO}/V_c	Y_e/Y_j	IP_e/IP_j	R^2	F	D.W.
1	0.345	-12.238 (-0.934)o			-1.026 (-1.115)o	0.881 (3.455)		0.741	5.74	0.341
2	0.162	-15.80 (-0.889)*			1.804 (0.896)*		-1.145 (-1.953)	0.518	2.15	1.457
3	0.336		-4.119 (-1.091)o		-1.038 (-1.155)o	0.883 (3.65)		0.75	6.10	2.714
4	0.155		-3.78 (-0.685)*		1.763 (0.838)*		-1.121 (-1.186)o	0.495	1.96	1.342
5	0.442			-4.198 (-1.272)o	-1.075 (-1.229)o	0.865 (3.657)		0.76	6.58	2.82
6	0.269			-4.22 (-0.871)*	1.619 (0.780)*		-1.083 (-1.828)	0.51	2.13	1.372
7	1.323				-1.181 (-0.791)*			0.72	0.621	0.965

Data source : Appendix

R^2 = Coefficient of determination.
F = Fisher "F" distribution.
D.W. = Durbin-Watson statistic.
( ) = Student "t" statistic.

*Means a lack of significance at the 80% confidence level, using a one-tail test.

oMeans a lack of significance at 90% but significant at 80% confidence level, using a one-tail test.

TABLE VI

Estimates of the determinants of Montreal's Share of the Containerized Traffic of Eastern Canadian Ports (Period 1971-1980), assuming serial correlation

Regression No.	Constant	FL/X_c	ASB/X_c	FA/X_c	V_{QO}/V_c	Y_e/Y_j	IP_e/IP_j	R^2	F	ρ
1	0.75	-11.29 (-0.798)*			-1.45 (-1.346)°	0.797 (2.96)		0.735	4.62	-0.20
2	1.54	-5.91 (-0.320)*			-0.303 (-0.136)*		-0.952 (-1.840)	0.671	3.411	0.10
3	1.32		-7.39 (-3.494)		-2.015 (-3.929)	0.763 (5.795)		0.891	13.69	-0.60
4	2.352		-7.08 (-1.875)		-1.455 (-0.818)*		-0.736 (-1.767)	0.801	6.71	0.05
5	1.276			-6.574 (-3.514)	-1.906 (-3.80)	0.747 (5.649)		0.892	13.81	-0.60
6	2.192			-5.764 (-1.683)	-1.19 (-0.659)*		-0.769 (-1.783)	0.783	6.03	0.05
7	3.423				-3.92 (-1.973)			0.476	7.37	0.30

The symbols are the same as the ones of Table 1.

ρ = Serial correlation coefficient.

<u>Note</u> : The computations of the Table are done with the Hildreth-Lu method, using steps of .05 for $-1 < \rho < +1$.

REFERENCES

Caves, D., L. Christensen and J. Swanson, 1981, "Economic Performance in Regulated and Unregulated Environments : a Comparison of U.S. and Canadian Railroads", Quarterly Journal of Economics, 4, November.

Containerization International, 1979, "Routeing from Central Europe", January

Containerization International, 1982, "TFL's Intermodal Initiative Could Change Transatlantic Trades", February.

Containerization International, 1983, "Latest North Atlantic Rate War Could Usher in a Period of Peace", April.

Containerization International, 1983, "Just Who is Lifting What, and What Percentage of Their Slots They Are Managing to Level with Remunerative Freight, is Generally a Closely Guarded Secret", April.

Containerization International, 1983, "Baltimore Battles to Protect its Own Backyard", July.

Container News, 1980, "World Container Ports Survey '80", May.

Container News, 1981, "World Container Ports Survey '81", May.

Container News, 1982, "World Container Ports Survey '82", May.

Container News, 1983, "World Container Ports Survey '83", May.

Container News, 1984, "World Container Ports Survey '84", May.

Container News, 1984, "Boston Spends $ 50 million on improvements, investments", September.

Dagenais, M.G., P. Hamelin, F. Martin and D. Paskievici, 1984, "Updating the Evaluation and Forecast of COFC Traffic, in Canada", rapport de recherche # 10, Centre de recherche sur les transports, Université de Montréal.

Dagenais, M.G., P. Hamelin and F. Martin, 1982, "Evaluation and Forecast of COFC/TOFC Traffic, in Canada", rapport de recherche fait pour Transports Canada.

Friedlander, A.F. and I. Harrington, 1979, "Intermodalism and Integrated Transport Companies in the United States and Canada", Journal of Transport Economics and Policy, September, 247-267.

Gilbert, J. and A. Ilan, 1976, "New Planning Tool for Cargo Transportation in Foreign Trade", Transportation Research Record 591, Transportation Research Board, National Academy of Sciences, Washington, D.C.

Haven van Rotterdam, 1980, How to Invest - And Stay Competitive : the Rotterdam System.

Journal of Commerce, 1983, "Intermodal Rate Making to Cause Major Change in N. Atlantic Box Trades", December 12, p. 13c.

Journal of Commerce, December 12, 1983, p. 16c.

La Presse, 1984, "Déréglementation des transports ferroviaire et portuaire réclamée", September 28, p. C3.

La Presse, 1983, "CAST a bénéficié de condtiions de crédit exceptionnelles", September 22, 1983.

La Presse, 1983, "CAST comptabilisait les commissions du CN", September 21, 1983.

Perloff, H.S., E.S. Dunn, E.E. Lampard and R.F. Muth, 1960, _Regions, Resources and Economic Growth_, Resources for the Future, John Hopkins Press, Baltimore.

Studiecentrum Voor de Expansie Van Antwerpen, 1981, _Haven van Antwerpen Tendensen in het Maritiem Massagoeden Stukgoedverkeer 1980-1985_.

Sun, N.C. and M.C. Bunamo, 1973, "Competition for Handling U.S. Foreign Trade Cargoe : the Port of New York's Experience", _Economic Geography_, April, 156-162.

The Gazette, 1984, "Slower Growth Foreseen at Port After 12% Gain", December 15, 1984, p. E3.

The Gazette, 1983, "CN Paid Commissions to Keep Business : CAST head", November 19, 1983.