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INTERRELATIONSHIP BETWEEN THE ECONOMY AND TRANSPORTATION

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INTERRELATIONSHIP BETWEEN TRANSPORTATION AND THE ECONOMY

Introduction

The interrelationship between transportation and the economy in Canada is being debated by a widening circle of participants(1)(2)(3). Such interest naturally is most intense among the providers of transportation services(4)(5). However, by no means do they form an exclusive group; farmers, politicians (both federal and provincial), resource producers, and many other parties with different interests and positions, all have their unique perspective on the situation.

Transportation is one of the larger sectors of the economy. Its functioning is intertwined with every facet of our economic and social life. On the freight side it is the vital physical link between producers and their markets, both domestic and foreign. Passenger transportation provides a network of communication between people and bonds together the Canadian social fabric.

Thus, the demand for transportation services is derived from the willingness, need and ability of individuals and industry to buy goods and services. The supply side, namely the ability of the transportation industry to meet the capacity and service requirements at adequate price levels, is therefore one of the more crucial variables in any attempt to provide for smooth economic development.

However, because of long lead times required to build capacity, transportation facilities are provided in anticipation of future demand. Under this condition conflicting pressures arise: user pressure for a high level of facilities; owner pressure for a financially more cautious approach.

In an effort to overcome this financial anxiety, governments in Canada at various levels have historically provided many incentives to foster transport growth, e.g.:

- .port facilities, canals, locks, dredging, navigation aids, shipbuilding subsidies;
- .land grants to railways, local tax incentives, grain cars, subsidies on money losing services;
- .highway and road networks, policing of such;
- .urban transit;
- .airports, airline guidance and communication networks.

In short, governments have been deeply involved in the transportation sector since earliest days, with all the advantages and disadvantages that ensue from such involvement(6). On the positive side, this has meant that transportation has been a key factor in the building of the nation. On the negative side are the misallocation of resources, the existence of redundant facilities, and the growth of entrenched interests. In addition, even those initiatives which have worked out better than expected, often prove to be prime candidates for further handouts in order to improve or just maintain the level of service.

The Current Situation

This is all history. In fact, Canada now has a transportation system that meets current needs. The modal mix has responded to changing conditions. Most notably, rising energy prices have triggered many changes which are still in progress. To assist in coping with change, transportation planning groups in government and industry are using models of the economy that deal with transportation in varying levels of detail. Do we need better tools than these to cope with the changes ahead? The nature and extent of the transportation perspective emphatically calls for better understanding of problems and for system approaches in their solution. No transport

issue could be satisfactorily handled in isolation. The entire transportation system and its long term and short term perspective should be perceived.

The source of transportation demand, the economy, is undergoing important structural changes. There are serious declines in some areas; until recently, rapid growth in others; an impressive list of possible megaprojects across Canada looming in the near future; all this combined with a shift in the centre of gravity of the economy from East to West. Some of the implications of these developments are listed below.

Railways

Overcapacity exists in the eastern rail network, now and for the foreseeable future. At the same time a shortfall in capacity is forecast in the western mainlines coupled with a western branch line network of largely uneconomic lines.

Main line railroad expansion in the west is in the early construction stage, but the sources of the required capital have not yet been identified.

Electrification of the railway network is under serious consideration in some quarters.

Roads

The network of roads and major highways across the nation will need large infusions of money to be maintained. Also, new developments will require additional funds for highway construction and maintenance.

Marine

Massive expenditures are needed to enforce our extended territorial limits and to satisfy northern transportation requirements.

Energy and New Technology

The effect of energy price increases will be felt for some time to come.

Alternative fuels and engines are being investigated.

Slurry pipelines have been touted as an alternative mode for many bulk movements. They could become more competitive in the future.

Lighter than air vehicles are undergoing a revival.

The political environment for the industry is equally complex. Transportation is not the sole responsibility of any one level of government. The right of each level to their portion of the pie is jealously guarded. Added to this are public pressures exemplified by the visceral reactions that greet proposed rail line abandonments, passenger train discontinuances, air line changes, ocean shipping arrangements, port changes. In addition, the industry is expected to live with some of the public obligations associated with incentives that have since proven to be financially inadequate. At the same time pressure is exercised to surrender the benefits of those few incentives that have proven to be unexpectedly remunerative.

In other words, a veritable tidal wave of change is overtaking Canadian transportation. What is required is a coordination of effort: firstly, to determine what transportation needs will be; secondly, how best to meet them; thirdly, what incentives may be needed to overcome the financial, regulatory, and organizational impediments; and finally how to avoid the costly mistakes of yesteryear. What analytical tools do we have to help us?

In all fairness, it is not a misinterpretation to conclude that comprehensive system analysis of tranportation is still in its infancy in Canada, - not just because of

considerable data problems, but mainly because of a lack of interrelated, in-depth research. However some foundation for broadening research work is already in place. More specifically, various macroeconomic models are available with varying forecasting capabilities. It is in this area where research appears to be most desirable. Properly functioning models, reflecting the relationships between the economy and transportation, in a sufficently detailed and reliable manner, would provide the foundation for the necessary perceptions and solutions.

It is necessary therefore to deal with the capability and limitations of existing models. In turn this will assist in clarifying the nature of the research efforts required.

Macroeconomic Models: An Overview

There are many economic models presently used in Canada. Some have been developed by industry and government for internal use, while others are offered commercially by various forecasting agencies such as the Conference Board, Data Resources of Canada, or Informetrica. These models can be classified roughly into two groups based on the information they provide:

a. Models which are used for general forecasts of the Gross National Product and its major components. Some industry detail is provided, but the transportation industry is not separated by modes. Examples of this type of model include the Conference Board's model(7) and the Data Resources model(8).

b. Input/Ouput based models which provide more detailed forecasts of GNP and of industry output. From a transportation viewpoint, a major advantage of an I/O based model is the fact that it can provide a modal split for the transportation industry. The Informetrica model(9) is an example of this type of model.

TABLE 1

COMPARISON OF SOME OF THE INFORMATION AVAILABLE FROM THE CONFERENCE BOARD AND INFORMETRICA MODELS

TYPE OF INFORMATION	THE CONFERENCE BOARD	INFORMETRICA
Industry Output (Value-added)	22 Industries	50 Industries
Transportation Output (Value-added)	Included in Transportation are Storage and Communications	Six modes of transportation are shown separately
GNP Components	(constant $)	(current and constant $)
Consumer Spending	8 categories	49 categories
Investment	20 categories	40 categories
Government Spending	4 categories	14 categories
Exports	19 categories	42 categories
Imports	19 categories	36 categories
Employment	7 sectors	12 sectors
Prices	6 raw material 10 industry and 13 consumer price indices 18 investment deflators 4 government deflators	6 consumer prices plus price deflators for all industry and GNP categories

Sources: Conference Board, December 1981 Medium Term Outlook
Informetrica, December 10, 1981 Post Workshop Forecast

Table 1 provides a brief comparison of some of the information available from the two types of models using the Conference Board model and the Informetrica models as

examples. Clearly the Informetrica type I/O based models have the most to offer transportation research, hence, careful attention should be given to this type of model. It should be noted in passing that the comparison table refers to what each model produces. While the I/O type model produces much more detailed information, it also is more complex, with more equations, and consequently requires an increased amount of data developed and fed into it.

Input/Ouput Models and Transportation Research

An I/O based forecasting model consists of two distinct components:

a) an econometric, macroeconomic model which, on the basis of statistical formulations of relationships, is used to explain the behaviour of the four final demand components: consumer spending, government spending, investment and international trade.

b) the I/O tables. These tables summarize the flow of intermediate and final goods and services in the economy; namely, all the inter-industry flows, as well as the flows between industry and final demand.

Within the overall model, the I/O tables are used to translate the final demand projections into estimates of industrial output measured in terms of value added. For example, an increase in consumer spending will impact directly on the automobile industry output. Furthermore, due to demand for intermediate goods by this industry, it will affect the plastic and steel industries, the oil industry, and so on.

I/O based models in their present form are already used for general forecasting purposes and for evaluating the impact of certain economic scenarios on future transport demand. In particular they have the considerable advantage of providing a modal disaggregation. In addition, the inter-industry information on the flow of goods can be used to develop linkages between the various industries and the demand for transportation of specific commodities. Nevertheless, the depth of knowledge concerning transportation demand by individual mode remains insufficient for many planning purposes. Three areas of weakness require focussed attention: the measures of output; the modal split; the regional breakdown.

Measures of Output

TABLE 2

Comparison of Growth Rates in Railway Output Measures

(Year over Year Percent Changes)

YEAR	TON-MILES	DEFLATED VALUE-ADDED
1972	5.1	4.9
1973	2.3	7.0
1974	6.5	8.0
1975	- 1.6	- 4.8
1976	0.8	3.2
1977	3.8	3.2
1978	3.0	2.3
1979	7.2	2.6
1980	2.8	- 3.9
1972-79	3.4	3.2
1972-80	3.3	2.4

Source: Statistics Canada

The transportation industry generally measures the volumes of its output in terms of tonnes, ton-miles, people carried or passenger miles. However, econometric models (including I/O models) measure industry output in terms of value-added i.e. the

value of labour and capital that is added to the other inputs in the production process. Deflated value-added can be used as a proxy for the volume of output, but it is by no means exact. For Canadian railways Table 2 shows how volume, as measured by ton-miles, differs from volume as measured by deflated value-added. In some years the divergence is quite noticeable. While some efforts have been made to introduce physical volume measures by ad hoc measures, a more in-depth approach is required.

Modal Split

The division of activity by mode in the transportation sector has, of course, changed considerably during the post-war period, and further significant changes can be expected to occur.

In forecasting traffic by mode using I/O based models, the present methodology creates some problems.

In the I/O system, as at present formulated, the transportation sector is disaggregated into six modes: rail, truck, air , marine, urban transit and pipelines. For most transportation activity, there is no assessment of which mode of transport is actually used by each industry in moving its products. As a result the modal split produced is largely the result of the market share assumptions that have to be introduced. The modal split thus is, in essence, imposed from the outside and is at best consistent with the rest of the economy only in the year the tables are compiled. In any future year these fixed modal share assumptions will create distortions of various magnitudes.

An appreciation of the extent of the distortions can be obtained from the following consideration. Since only aggregate transport output is identified, this measure alone will be affected by changes in final demand. This impact will then be apportioned to each mode on the basis of the predetermined shares. As an extreme example, an increase in exports of coal will be identified properly as affecting transportation output. However, applying the fixed modal shares assumption (without further modifications) implies that this will impact not only on the railways but also on air transportation and urban transit and all the other modes.

Forecasters do use various adjustments to prevent such major absurdities and to avoid serious misrepresentation. This, however, does not solve the problem of failing to give the modes a treatment consistent with that of other separate industries. On the face of it, such a treatment should be realizeable without any major difficulty. It is clear, however, that the major contribution to the formulation of a reliable modal split will come from an improved data base, particularly for that most significant activity, the large trucking industry. This is beyond our present scope and therefore will not be pursued further, except to say that inadequate data should not deter us from tackling other problems associated with developing adequate models.

Regional Breakdown

No transportation model can be complete without some identification of where the economic activity is taking place. This is particularly true in Canada where economic activity can and does differ widely between regions. It is even more necessary today when the centre of economic gravity shows signs of shifting westward. From the point of view of all levels of government, the producing industries, and the railways, the estimation of future traffic moves in the western provinces and through the western ports is crucial in planning for future capacity expansion.

At present the I/O based models in Canada deal with the national economy as a whole. The Conference Board has already attempted rather elementary provincial separations of its national model. Such a move should be considered a major breakthrough in the

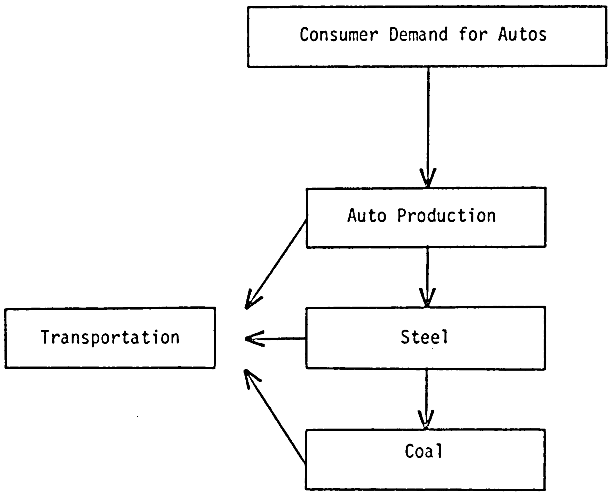
the actual flow can be demonstrated with a simple example which shows the impact of an increase in consumer demand for autos on the auto, steel, coal and transportation industries. This example is simple also in that it deals only with first round effects, ignoring feedback of increased production on consumer spending, etc.

In a real life situation, (Figure 1.) consumer demand affects auto production directly, which in turn gives rise to a demand for steel. Both the new shipments of autos and of steel require further transportation services. In addition, the requirement for steel gives rise to coal production and hence associated transportation.

FIGURE 1

THE FLOW OF ACTIVITY IN THE ECONOMY

SIMPLIFIED REAL LIFE SITUATION



attempt to establish an ongoing regionally oriented research base. Such a simple regionalization process can be adopted rather easily for use by the existing I/O models. In turn this will add considerably to the depth of understanding of the functioning of the transportation sector within the Canadian economic environment.

Other Problems

The current state of the art enables us, with some limited research, to deal with the three problems addressed above: the measure of volume vs value-added, modal split, and the regional breakdown. However, the models have other shortcomings which relate to their basic structure and they are not easy to overcome.

Typically the general forecasting orientation is to seek an answer to the question: "What impact does economic change have on a particular industry segment?" Quite often industry experts or policy makers, however, have to face questions of a different nature. Dealing with the problems of transportation capacity, be it highways, the railways' western expansion plans, or investment in new airport facilities the following questions are normally also asked: "What is the impact of these investments on the economy as a whole or on the provincial economies? What will be the impact if such investment is not put in place? Furthermore, what will be the impact on industries which this new capacity, (or lack of it) will affect most directly?"

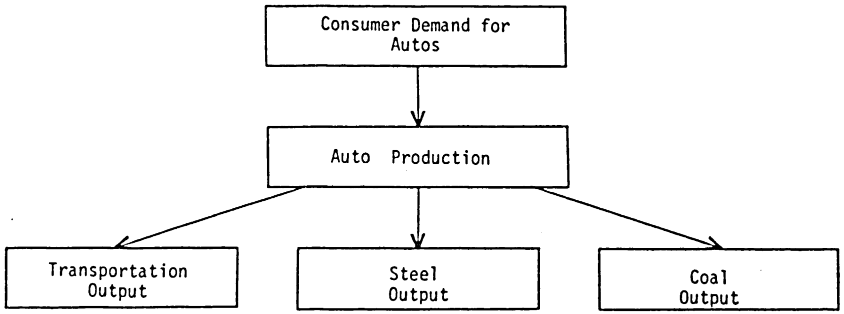
It is felt that when dealing with the transportation sector and its unique industrial nature, none of the above questions will be answered in a satisfactory manner by relying solely on existing models. Such difficulties stem from the basic structure of these models.

This can be illustrated as follows. The causal flow in the I/O models is from final demand almost directly to the various industries involved. The way this differs from

As shown in Figure 2 the I/O models themselves do not allow explicitly for the existing interaction between final demand, final output and the various intermediate industry demands. In this example the increase in consumer spending on autos determines the amount of auto production which in turn directly determines steel, coal, and transportation outputs - i.e., there is no explicit connection between, say, the steel industry and the coal industry.

FIGURE 2

I/O MODELS REPRESENTATION



This shortcoming does not affect the reliability of those forecast components which flow directly from any of the four final demand components. For example, the use of an I/O model could quite consistently identify the capacity requirements facing the transportation sector as a result of increased exports. Furthermore, the accuracy of such predictions will increase as more regional information becomes available or as the modal split is further refined.

Similarily, the impact of major transportation investment programs, on the economy and even on specific industries and regions, could also consistently be assessed since investment is a final demand component.

However, a cost/benefit analysis of the merits of such a major investment plan would also ask the question "What would be the consequences on all industries if the required investment were not put in place?" Only when the consequences are known, of both carrying out the investment program and of limiting transportation capacity below the level required, can a true cost/benefit analysis be attempted.

Another major shortcoming arises from some special characteristics of the transportation industry. Shortages cannot be dealt with in the normal way since, as a service industry, its output cannot be stored and neither can it be substituted for by imports. Moreover, even though it is an industry reflecting derived demand, it is also the main channel for interaction between industries, between countries, and between industry and consumers. These features of the industry, however, are presently ignored.

This is not to say that thoughtful research will be completely unable to deal with such problems. However, the solutions such research produced would likely be highly subjective, and primarily outside the theoretical framework of the I/O system.

Finally, with some hesitation, consideration should be given to the standard textbook criticism of the I/O models - that of the constant technology assumption. This is obviously detrimental to forecasting properly the prospective roles of different transportation modes.

Presently, even the most sophisticated models run the risk of pushing us increasingly further away from the real life situation. Various ad hoc adjustments by forecasters to the basic fixed technology assumption prove that at least some attention is being given to this area. The injection of expected technological trends is a major task and probably should be undertaken by research groups presently not associated with the development of econometric models. Only such interdisciplinary effort (and a continuous one) could lead to improved forecasting of transportation outputs, changes in modal shares and investment requirements.

Conclusion

The interrelationship between the economy and transportation requires continuous research and improvements in the understanding of it to improve our ability to foresee and comprehend future transportation milieus. This will aid in providing resources and stimuli for orderly economic growth and/or the well-being of society. Towards this end present advances in the area of economics and economic modelling aimed at advancing the understanding of our own industry should be broadened and strengthened. Specifically designed transportation models are invaluable tools for planning by industry, government and other institutions. They should provide for better comprehension of the costs and benefits of various policies and regulations that impact on transportation.

The existing economic models provide a good foundation and a proper background for a modest start. Specific areas of Input/Output models require immediate attention and priority in research efforts. These are the volume-value added relationship in measuring transportation outputs, the modal split, and the regional disaggregation issues. Other improvements will be difficult to come by as they relate to the basic structure of the present models.

In the drive for extending the use of models, a note of caution is called for. Models are merely a framework for predicting some of the economic consequences of

various scenarios. They are helpful for an understanding of the future and to deal effectively with its problems. The improvement of such models require careful, coordinated and interdisciplinary research. One should remember that some 20 years ago a few regression analyses served as topics for Ph.D. dissertations in economics. Since then the continuous search for better data collection techniques, improved econometric tools, and for better theoretical understanding, combined with the advent of the computer revolution, have changed the economic modelling scene entirely. Sophisticated models, often containing thousands of equations, are now available for our assistance in many areas.

Major challenges are facing forecasting institutions, research centres and universities. The resulting individual and joint efforts of all transportation researchers will provide the necessary instruments for the solution of transportation problems of profound importance.

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