THE APPLICATION OF ECONOMIC IMPACT ANALYSIS: A CASE STUDY OF FRASER PORT

by

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Abstract

The purpose of this thesis is twofold: first, to review the literature on economic impact analysis in general, and port-economic impact literature in particular; and second, to use this background to undertake an economic impact assessment. The case study for this thesis is Fraser Port, which is located along the lower reaches of the Fraser River in British Columbia's Lower Mainland metropolitan region. The port is administered by the Fraser River Harbour Commission. This thesis is about production, people, and the economic significance of Fraser Port. This thesis is not an analysis of economic impact theory, but a review and application of port impact identification techniques. All data and impacts presented relate to 1992.

Ports perform a necessary function in a nation's trading system by providing a transshipment connection between land and water modes of transport. As such, the port is strategically connected to the production of the many goods passing through its facilities. For this thesis, the impact of the various commodities passing through the port is termed port-associated.

The port also manifests its presence through its daily operations and generates numerous employment opportunities both within and beyond the confines of the waterfront. The economic impact driven by this activity is termed port-industry and most closely reflects the impact of the working waterfront.

To complete the impact assessment of the port-industry category, a survey was undertaken to collect sales revenue and employment information. This data

was then aggregated into specific industry sectors and a total economic impact was estimated using appropriate economic multipliers. The result was a picture of direct, indirect, and induced activity resulting from the daily operations of the port.

The port-associated category was assessed in a slightly different manner. The value of each cargo was determined and, where appropriate, was assessed for the economic activity related to its production. This activity is not generated by the port, but is associated with Fraser Port through the use of its transshipment services.

The results of the assessment reveal that the port-industry category generates approximately one quarter of a billion dollars of provincial gross domestic product (GDP). This led to a total GDP impact across Canada of close to $275 million. Employment amounted to about 2,113 full-time equivalent positions in B.C. and nearly 3,400 across Canada.

In 1992, the total value of import and export cargo passing through Fraser Port was approximately $6.1 billion, $3.8 billion of which was international imports. The remainder, $2.3 billion, was made up of domestic outbound and inbound cargoes, and international exports.

It is important to recognize that these two categories of port activity are measures of different effects. The results of the port-industry and port-associated categories should not be added to produce a total Fraser Port impact. Adhering to this recommendation will ensure that the figures, and thus Fraser Port, will not be misrepresented to the public.

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INTRODUCTION.

The purpose of this thesis is to provide an understanding of the economic impact surrounding the operation of a port. Fraser Port, under the administration of the Fraser River Harbour Commission, serves as the case study.

Chapter one introduces the economic role of ports in a regional and national context. The evolutionary relationship between a port and its adjacent urban area is examined. The chapter introduces two economic roles of a port: (1) as a provider of transshipment services; (2) as an economic generator.

The second chapter examines economic impact analysis in general, and port-economic impact analysis in particular. The chapter opens by describing an economic impact and its various components. This is followed by an introduction to three techniques of multiplier identification and impact assessment. The definitions of port activity that form the basis of the Fraser Port study follow this discussion. Finally, the chapter introduces the type of multipliers chosen to estimate the economic impacts of Fraser Port.

Chapter three introduces Fraser Port by describing its location, facilities, and cargo tonnage characteristics. The intention of this chapter is to introduce the reader to Fraser Port and to provide a basis on which the results of the impact assessment may be viewed.

In 1981, an economic impact study of Fraser Port was completed. Chapter four presents a critique of this study. The chapter concludes with several

recommendations and a discussion of how the 1993 study avoids the mistakes made in 1981.

Chapter five discusses the practical methodology of the 1993 Fraser Port economic impact study. Each stage of the impact assessment is outlined from identification of the survey sample and survey process, to impact identification and presentation.

Chapter six presents the results of the impact analysis in two sections: the first shows the impacts of industries involved with the movement of cargo; the second presents the impacts of the exporters and importers who ship goods via Fraser Port. The economic impacts of industries more river related than port related (in this case shipbuilding/repair and marinas/moorage) are also provided in the second category. The chapter finishes with a comparison of this assessment with the 1981 Fraser Port study, and the 1990 Economic Impact Study of the Vancouver Port Corporation

The final chapter summarizes the relevant points of discussion and the results of the analysis. It goes on to discuss some conclusions that can be deduced from the results and the impact assessment process. The discussion includes perspectives on the application of impact assessment theory, problems encountered during research, and the validity of impact results.

Appendices present a list of companies surveyed, the questionnaires used during the research phase, the calculation of induced multipliers, the spreadsheet application and calculations of impacts, and the valuation of Fraser Port commodities.

CHAPTER 1. PORTS AND THE ECONOMY.

While ports have been in existence for centuries, providing essentially the same service then as today, they have become less of the mysterious, dark and dangerous areas as once imagined. Through changing technology, environmental and economic research, and public scrutiny and access, ports have come out from behind both physical and psychological confines. What is a modern seaport of today? Hoyle and Pinder (1981) state that "[t]ransport integration is the essential port function, but a modern seaport node within a multimodal transport system frequently develops also as a major urban centre, an industrial focus, an important source of employment, and an influential factor in national and regional development" (p. 1). This chapter expands on this theme by discussing the economic role of a port and its influence on the surrounding region.

Ports are commonly referred to as transshipment points for goods entering or leaving the country. James Bird (1971) states that a port is "best defined in terms of its function as a place where each-way changes between land and sea transport regularly take place" (p .13). Boschken (1988) describes ports as "part of a country's economic infrastructure ... [acting] ... as primary transshipment points in the allocation of goods and services" (p. 20). In any description, a port is part of a nation's transportation network, and as such has an integral role in the distribution of goods.

When discussing ports, the terms hinterland and foreland are used to describe the area served by the port (Bird, 1971). The foreland lies seaward to the port and includes all our foreign trading partners. The hinterland refers to the area of land

surrounding the port. This region is affected by the port through direct labour demand and industrial agglomeration, and can be the source and destination of cargo. A port's hinterland is bounded by the reach of its cargo shipments and, as such, can extend across the country. The immediate, or adjacent, urban area that relies on the port for its labour demand, and on its proximity to shipping facilities, is often termed the urban hinterland, while the hinterland extends to include all inland areas associated with the port.

1.1: The Evolution of a Port.

Bird's (1971) 'Anyport' model describes the evolution of a port community and its eventual development into a metropolitan centre. During the early stages of a port's development, the adjacent town is dominated by harbour activity and the port's hinterland is small, reflecting the lack of a developed trading system and transportation network (Bird, 1971). Eventually, seaborne exploration opens new markets and increases the capacity to trade, which simultaneously promotes regional economic expansion.

As port activity increases, a growing demand for port services prompts the establishment of new quays and storage facilities. Initially, the port connects with its hinterland via a perpendicular transport route -- be it a road, rail line, or river. As the economy expands, competing demands for land in the traditional port area cause further port expansion to occur along the shoreline. The port's original perpendicular penetration of the hinterland fans out in a semi-circular extension into the region. Eventually, more transport routes connect directly with the port as outlying producers and consumers attempt to minimize transportation costs. With each stage in the evolution of 'Anyport,' employment increases and generates

various spin-off benefits. This occurs through not only the expansion and operation of port facilities, but also the development of industrial activity to supply products to the port, and export and import activity dependent on the port for its services. Trade, thus, becomes an essential function and promoter of regional economic expansion. The port, through virtue of its existential presence, is one of the many beneficiaries. The employment and industrial agglomeration effects are discussed in greater detail below.

1.2: The Port as an Economic Generator.

A port acts as an economic generator providing employment and inducing numerous secondary economic opportunities throughout the region and nation. A port not only provides employment for longshoremen and port authority officials; it also requires the services of shipping agents, customs brokers, tug boat operators, and numerous other transport related services. The port community is neither a homogeneous group nor is it necessarily situated near the waterfront. Many port related services may be located far from the working waterfront in areas more amenable to their needs, such as providing access to clients and business services.

The purchase of goods and services by the port community and the payment of wages and salaries create spin-off or secondary effects beyond the web of transport related activities (see Chapter 2 for a discussion of secondary impacts). The services provided by the port community and the resulting expenditures generate economic activity not only in the region adjacent to the port, but also throughout the nation. The port community requires goods and services similar to any business activity: for example, goods such as office equipment and supplies,

and services such as accounting and communications. The employees of the port community, as part of the greater community, also generate economic activity through the spending of incomes. Without the spending associated with this port related activity, income would be removed from the local economy and the spin-off economic opportunities would be lost.

The agglomeration of industry dependent on port services is another facet of the port's role in a regional economy. As Boschken (1988) argues, "[p]orts stimulate economic development by virtue of their strategic location in the transportation network. To minimize total transportation costs of raw materials and finished goods an infrastructure of industry and commerce develops around ports ... " (p. 24). For example, the Vancouver area became an important wood processing centre with its water and rail access, and abundant supply of timber (Hardwick, 1974). The region is also a large consumer of imported goods.

The commodities shipped via a port can reveal the level of industrial impact on the region. Bird (1971) states that "[t]here are those cargoes that move 'through' a seaport considered as a gateway; and there are those that are delivered at ... terminals for immediate storage and, most often, for first processing in the port area" (p. 15). The economic impacts of the two roles will differ with the gateway port serving a larger hinterland with less local industrial development dependent on the port, while the other will be characterized by extensive industrial processing located near the port for access to foreign markets. The port's economic influence in the region is dependent on the agglomeration of port-dependent industries (Bird, 1971; Norcliffe, 1981).

For Canadian ports, this type of industrial development is not as prevalent as it is in the U.S., Japan, and Europe, for example. Norcliffe (1981) cites the dominance of staple exports (including grain, iron ore, coal, fish, and forest products) as creating less economic development near port communities than is visible at other ports where manufacturing is concentrated. The Port of Prince Rupert is a classic gateway port serving its greater hinterland more than its immediate urban hinterland. While employment is drawn from the surrounding area, little industrial development has occurred. The Vancouver area port system tends to combine functions, being predominantly a gateway for bulk and container goods. However, a specialization in the production of wood products is present, as is, for example, the use of aggregate, limestone, and gypsum in production plants located along the Fraser River.

1.3: The Post-War Growth of Trade.

The post-war boom in international trade required ports to expand and respond to the needs of shippers. Between the years 1955 and 1981, the total volume of international seaborne trade increased from 800 million metric tonnes per year to 3,320 million metric tonnes per year, although since 1984 the growth rate has declined (Beth, Hader, and Kapper 1984). In relation to total world trade, shipping activity accounts for over 80% in value terms and 99% in volume terms (Branch, 1988).

Ports respond to the requirements of shippers. The ship design and route that reaps the greatest financial return will drive the development and look of port infrastructure (Bird, 1971; Hoyle and Pinder, 1981). The containerization of general and some bulk cargoes is the most recent example of the need for ports to

provide appropriate facilities, or face declines in cargo volumes. For example, in the 1960's, some shippers changed their choice of port from San Francisco to Oakland, as a result of Oakland being the first to invest in modern container facilities (Chilcote, 1988).

The presence of new container cranes, however, does not guarantee shipping business. This reflects the changing needs of shipping liners, which in an effort to reduce costs, have concentrated on fewer ports. The prohibitively high investment needed to adapt ports to the needs of new ship design relegates many ports to secondary status, and contributes to the focus of port activity and growth at fewer ports. This phenomenon, termed 'load centring', has led to success at some ports, and to failure at others. The rapid growth of the Port of Tacoma and the loss of business at the Port of San Fransisco are relevant examples. In the mid-1970's, two container cranes were constructed at a Fraser Port terminal; however, the cranes have yet to operate at full-capacity.

In this atmosphere of increased competition and high costs, ports have become more capital intensive, thus shedding the dependency on a large labour pool. As a result, the community surrounding the port has become more independent of the port's economic influence, and the port has retained less of its original economic influence. Harrison (1978) states that ports were originally "considered to be of high economic importance to the cities in which they find themselves" (p. 2). However, he goes on to conclude that the relative economic significance of a port is diminishing and that "ports are increasingly less dependent on the urban area" (Harrison, 1978, p. 3). Writing about Canadian ports, Norcliffe (1981) notes that the traditional labour intensity of ports was never fully present in Canada because of the dominance of staple exports.

This notable lack of employment in Canadian ports of the past, has worsened in today's mechanized arena of port operations. "Nowadays Canadian port operations are remarkable for the few jobs created in handling very large volumes of cargo" (Norcliffe, 1981, p. 152). Advances in ship design and cargo handling technology has decreased the need for masses of stevedores. Bulk carriers are loaded using automated conveyances, while the container revolution in cargo transport has virtually eliminated break bulk shipping in large developed ports. As a result, the ranks of the longshoremen have been virtually cut in half (Randell, 1988).

1.4: Vancouver and Fraser Port.

In Canada, the building of the trans-continental railroad was an integral component of the increased demand for port services. For Vancouver, the arrival of the railroad in 1886 ensured that the Lower Mainland would become the focal point of regional population and economic growth (Ireland, 1978). The arrival of the railroad expanded the initially restricted hinterland to include the interior of the province, but more importantly, also the eastern regions of Canada and the United States. The Vancouver area port system was given another boost after the Federal Government takeover of the Canadian Northern and Grand Trunk Pacific Railways (incorporated into the Canadian National system), in 1918 and 1919 respectively. Soon after, federal transport policy designated the portion of track to Vancouver as the railway's mainline, at the expense of Prince Rupert (Foreward, 1984). Thus, the political will of Ottawa complemented the benefits of Vancouver's proximity to western United States markets, and ensured its dominance over any other Canadian westcoast rival.

Today, approximately 40% of all of Canada's international shipping trade takes place on the Canadian westcoast (Statistics Canada, 1992b). The Vancouver port system handles the vast majority of this cargo and has become the gateway for trade with the rapidly expanding markets of Pacific Asia.

1.5: Conclusion.

A seaport has several roles that give it regional and national importance. The description of a port as a transshipment point for goods entering or leaving a country defines its role within the transportation infrastructure of a country. As part of this transport system, the port is an integral link between the supply and demand for goods. By virtue of its location, the port becomes an attraction for industry looking to reduce shipment costs. Other industry agglomerating near the port, such as shipbuilding and repair industries, are able to offer a unique service, necessary only at water side locations near active shipping routes.

However, the port is not only part of a nation's capital infrastructure and an attraction for industry. The port is also people. Employment benefits accrue to the region as ports draw labour from surrounding communities. Ports also require various goods and services to operate, thus creating a further economic stimulus in the region. These port expenditures -- employee incomes and purchases of goods and services -- create spin-off effects throughout the regional, and national, economy.

Thus, the port community's reach extends beyond the confines of the docks and storage areas to provide benefits for the greater community. While labour activity

has declined as a result of increasing productivity in the loading and unloading of ships, the port remains an integral part of the nation's trading system, and the region's concentration of industrial activity and employment.

In the Vancouver region of British Columbia, the port system provides services to various foreign and domestic shippers, and employment to the surrounding communities. No other area on the westcoast of Canada rivals the metropolitan Vancouver region - in terms of population and economic activity. It is the designated transport hub of the Province: a transportation hub of which the port system is a major component.

CHAPTER 2. PORT ECONOMIC IMPACT METHODOLOGY.

Chapter 2 introduces the methodology of economic impact assessments, specifically in the evaluation of port facilities. The chapter begins with an introduction to economic impact assessment. The discussion distinguishes between impact and evaluation analysis, then introduces three techniques used in economic impact identification: the economic base model, income-expenditure model, and input-output model.

The second part of the chapter reviews port economic impact literature and discusses several attempts to introduce a methodological template for port economic impact studies. The objective of this section is to establish the definition of port activity upon which this thesis is based. The chapter concludes with a discussion of the impact model used in the 1981 Fraser Port economic impact study, and the model chosen for this study.

2.1: Defining Economic Impact Studies.

Two widely used economic assessment methodologies are economic impact analysis and cost-benefit analysis. A differentiation of the two will help the reader to understand the limitations of an economic impact study and the proper use of impact estimates. Each has a separate objective and distinct product.

2.1.1 Cost-Benefit Analysis.

Cost-benefit analysis attempts to evaluate public project alternatives for economic efficiency, given a prior knowledge of objectives and values (Davis, 1990).

Quantifiable economic, social, and environmental costs are subtracted from project benefits revealing a net economic value to society, be it negative or positive. Cost-benefit analysis measures the value of a project through the identification of relevant costs and benefits, as defined by the objectives of the planning authority, or society in general.

A cost-benefit study provides information to assist policy makers in choosing between alternative policies or projects. Analysis involves those costs and benefits that are quantified in similar terms, generally dollars; however, incorporating non-market costs and benefits into the assessment is possible if values can be determined. The product of a cost-benefit analysis is a comparative assessment of the values of several public project options, expressed in terms of net present value and cost benefit ratios: if the net present value (benefits - costs) is positive, the cost benefit ratio would be less than one and the particular option would produce an overall benefit to society - assuming that the analysts were able to identify and value the appropriate components of benefits and costs (van Kooten, 1993).

2.1.2 Economic Impact Assessment.

An economic impact study quantifies economic impacts produced by the expenditures of a project or activity within a given region. As Davis (1990) explains: "Economic impact studies are based on conditional predictive models of economic analysis, that is, models which are designed to produce 'if...then' statements of the type: If, under assumptions a, b, and c, a stimulus x is applied to the local economy, then impacts y and z are likely to result" (p.5). Economic impacts include employment, income, value added, and sales effects, each of which is determined and presented separately: no aggregation among the various

components is undertaken. Impact analysis estimates the positive, or negative, impacts associated with a project. The economic impact study does not, however, evaluate a project for costs and benefits, be they economic, social, or environmental.

While the two assessment theories are complementary, the components and products of each differ markedly. An economic impact assessment is a quantitative approach incorporating as few subjective values of the population, or analyst as possible. Apart from the the underlying assumptions of the impact technique chosen, no values necessarily guide the outcome of a study. Conversely, evaluation analysis requires that a prior knowledge of the planning or economic objectives (values) of the project must be known. Cost-benefit analysis then evaluates the project in terms of those objectives, or values. Impact assessment does not evaluate the merits of a project in social or investment terms (van Kooten, 1993).

A further difference between the two assessment models is that cost-benefit analysis attempts to estimate foregone opportunities and extra benefits created by a project, while impact assessment estimates the change in the economy resulting from a particular economic stimulus. Cost-benefit analysis goes beyond what impact analysis does by looking at opportunity costs and benefits that reveal a with-without picture of the project. Impact analysis examines absolute effects; evaluation analysis examines marginal effects, then compares them to other means of attaining the particular planning objectives. As Davis (1984) states "economic evaluation analysis requires the information yielded by economic impact analysis, and more. Evaluation analysis requires also the regional economic objectives relevant to the stimulus or project in question and information

regarding the extent to which these objectives are served by the project's impacts" (3-4).

When conducting an economic impact study, analysts attempt to quantify a portion of the socio-economic system. This view of a regional economy provides one foundation upon which our socio-economic relationships exist. A combined assessment of the impacts and values associated with the economy, environment, and society leads to a more accurate evaluation. Economic impact assessments reveal only one feature of the intricate socio-economic nature of a region. One should view an economic impact assessment report with this understanding.

2.2: Defining Economic Impacts.

Economic impacts are the effects of regional growth (or decline) associated with a particular stimulus (positive or negative) on regional demand. Economists divide economic impacts into a primary, or direct, impact, and a secondary impact comprised of indirect and induced portions; adding the primary and secondary impacts reveals the total economic impact of the activity under study. Although the impact models in this discussion can estimate these effects, they do so with some variation. The discussion of impact techniques elaborates on these differences.

2.2.1 Direct Impact.

Direct or primary impacts include economic activity such as employment, labour income, and sales that are directly involved with the project under assessment. In the case of Fraser Port, the direct economic activity includes the employment, labour income, and sales involved with the movement of cargo.

2.2.2 Indirect Impact.

Indirect impacts result from primary businesses purchasing goods and services. To supply these products, other businesses are necessary and must employ workers, provide salaries, and pay taxes. Thus, extra business is created to meet the needs of the original primary activity.

Indirect impacts do not cease with this initial secondary spending. Suppliers to the primary business must also purchase goods and services from other firms. These other firms must employ staff and purchase further inputs to operate. Thus, indirect impacts continue through an economy: each business requires its own suppliers of goods and services, and so the spending continues.

Each successive circulation, however, is subject to leakages in the form of taxation, savings, and imports. The extra rounds of spending that result from the original direct expenditure become increasingly smaller until no further indirect impacts occur.

2.2.3 Induced Impact.

Induced impacts result from the direct employees spending their incomes. Employees purchase, among other things, groceries, clothes, and personal services throughout the year. In turn, the businesses supplying the goods and services to the employees must also employ staff, and pay incomes. The second round of activity creates further purchases, and thus the respending process

continues. The respending continues through the economy until leakages once again reduce the extra economic activity to zero.

2.2.4 The Multiplier.

An "economic multiplier" is a number that embodies all or a portion of the secondary spending described above; the multiplier is the ratio of the total (primary plus secondary) impact to direct impact. The economic growth models discussed in the next section are used by economists to estimate a multiplier, which may then be used to determine total impacts. For example, if $500 of direct gross domestic product (GDP) from an activity under assessment has a total (direct plus secondary) impact of $750, then the total GDP multiplier is equal to 1.5 ($750/$500). The secondary impact portion is equal to $250 ($750 - $500). While the use of a multiplier appears simple, its determination is much more complicated. The technique most appropriate for the assessment will be guided by the need for accuracy, the region in question, and the availability of existing multipliers.

2.3: Defining Economic Impact Models.

To determine the magnitude of regional growth and to estimate economic multipliers, hence total economic impacts, economists have created several models ranging from the less accurate and technically simple, to the more accurate, but technically difficult. Each of the models estimates economic impacts, although with some variation as indicated in the summary on page 11. The models outlined below range respectively from simple to complex: economic base analysis, income-expenditure analysis, and input-output analysis.

2.3.1 Economic Base Model.

The economic base model separates the economy into a basic, or export, sector and a non-basic, or service, sector. The principle of the model is that regional income is a function of the export sector (Richardson, 1979). Thus, regional income expands only as a result of export growth. To use the model for impact assessment, analysts must first quantify the basic portion of the regional economy. Once established, analysts can use the data to derive an employment or income base multiplier.

The economic base model rests on the assumed relationship between exports and total economic activity. When a positive or negative change to exports occurs, the total economy alters by a multiple of that change. The economy is represented in the base model by $Y = E + S$, where Y is total economic activity; E is the export, or basic, activity; and S is the service, or non-basic, activity. Further, the service sector is assumed to be a stable function of the base sector; thus $S = kE$, where k is the ratio of service to export activity (Richardson, 1979; Davis, 1990). Consequently, the original equation may be written as: $Y = (1 + k) E$. The total economy, then, is a product of the export sector and the multiplier $(1 + k)$, or $(1 + S/E)$. The size of the export base affects the multiplier; thus an accurate estimation of the basic sector translates into a more accurate multiplier. An underestimation of the basic sector leads to an overestimation of the multiplier, and subsequently, of the total impact. The technique produces a multiplier based on consumer spending, thereby estimating induced impacts.

An accurate estimation of the basic sector is a difficult task. Several methods of base identification exist, including exercising one's own judgement, conducting a

large survey of regional industry, using the minimum requirements technique, and employing the widely used location quotient technique. The 1981 study of the Fraser Port used location quotients to estimate the basic sector.

The location quotient technique assumes that if the regional percentage of employment in an industry exceeds the percentage of national employment in the same industry sector, then basic employment exists. Mathematically, the location quotient (LQ) is defined as: $LQ_i = (R_i/R) / (N_i/N)$, where R_i is the amount of regional employment in sector i; R is total regional employment; N_i is the national employment in sector i; and N is total national employment. If LQ is greater than 1, export related employment exists in the region. Basic employment is equal to $R_i - R(N_i/N)$ where R_i is the actual regional employment in sector i; and $R(N_i/N)$ is an estimate of regional employment needed to satisfy local demand in sector i. Thus, the technique estimates the portion of employment required solely for the production of exports.

Various authors have questioned the economic base theory and the location quotients technique (for example Leigh, 1970; Moody and Puffer, 1970; Davis, 1975; 1990). Leigh (1970: 205) found in his examination of the Vancouver area that location quotients "do not clearly identify or rank those industries that constitute the economic base of the city. For this reason, estimates of basic employment derived from location quotients tend to be under-estimates ... ." Only location quotients much higher or lower than 1 showed reasonable levels of accuracy in comparison to actual levels of exports. As Moody and Puffer (1970) concluded, the "statistical results [of their investigation] cast doubt on the usefulness of the urban base multiplier theory" (p. 97).

Davis (1975) found in his comparison of economic base and input-output multipliers for Vancouver, B.C. that location quotients lead to an overestimation of the multiplier. A failing of the location quotient technique is that it,

> suffers from the disadvantage that the results it produces vary substantially with the level of aggregation, or the number of economic sectors adopted. The higher the level of aggregation, the more heterogeneous is the composition of each economic sector and hence the greater is the 'product mix' problem in the determination of basic employment ...
>
> (Davis, 1975, p.3)

The "product mix" problem is similar to averaging where high and low values in a range are represented by mean values. The reason, Davis states, for the high value of the base multiplier in his study is "the understatement of exports from the metropolitan economy due to the level of aggregation" (p. 3).

Several assumptions accompany the economic base model. One, as mentioned above, is that the export sector is considered to be the prime determinant of regional growth. The model ignores possible growth sources of increased consumption, government spending, and import replacement. The existence of a strong service sector has also been found to provide a stimulus for regional growth. Richardson (1979) cites work by Green (1966) and Blumenfeld (1955) who established links between the service sector and regional growth.

A second assumption involves product homogeneity. Economic base theory assumes that each commodity exported from the region provides an equivalent growth stimulus. Thus, the production and export of one commodity would have the same linkages to the service sector as any other commodity included in the

analysis. However, as Richardson (1979) states, differences "arise from variations in inter-industry linkages associated with particular export sectors ... and variations in the consumption pattern of workers employed in particular export sectors" (p. 90). While the homogeneity problem may be somewhat remedied by producing regional multipliers for more than one industry, at some point of separation input-output analysis becomes more appropriate.

A third assumption involves the absence of inter-regional trade linkages. This assumption implies that the local economy does not respond to changes in economic activity in other regions. Exports from one region, for example, may stimulate an increase of income in the importing region, thus inducing higher demand and a further increase of exports from the first region. Obviously, many combinations of inter-regional linkages are possible.

The final assumption outlined here involves the existence of an unlimited supply of resources to respond to increased export demand. This assumption evolves from the demand orientation of economic base theory, which does not consider supply side constraints (Richardson, 1990). Constraints include not only the ability to produce and supply the inputs, but also the earth's potential to supply the necessary raw materials. Unlimited increases in demand would likely result in supply shortages in which case production would fall short of demand, input prices would rise, and imports, thus leakages, might be necessary to fulfil demand until the economy reached its new equilibrium.

Despite its various shortcomings, however, Chang (1978) and Davis (1990) find that the use of the export base technique for small resource dependent economies is an acceptable method to approximate regional economic activity. The economic

base model and location quotients technique remain attractive as simple and inexpensive methods of approximating economic impacts. However, the model is not suitable for large or economically complex regions such as metropolitan areas.

2.3.2 Income and Expenditures Model.

The Income-expenditure model is not as widely used as the economic base method. In Kaufmann's (1979) investigation into port economic impact studies, only the Port of Los Angeles/Long Beach assessment used the income-expenditure approach. However, as Davis (1983) points out, the "income-expenditure approach to impact analysis offers a number of advantages over the economic base model. In particular, it is a more flexible tool of analysis enabling the analyst to treat import-replacement in the port-region appropriately as an income generator" (64).

The income-expenditure model (the Keynesian multiplier model) is based on the spending of income. The definition of local income is equivalent to that of a national economy; that is, $Y = C + I + G + E - M$. Regional growth occurs through a change in one or more of regional income's (Y's) components. As evident in the right hand side of the equation above, consumption (C), investment (I), government expenditures (G), and import replacement (a decreasing M) join exports (E) as sources of growth. In comparison to the economic base model, the income-expenditure model incorporates more sources of regional growth.

A simple income-expenditure multiplier is based on marginal propensities of consumption, savings, taxes, and imports. Savings, taxes, and imports are leakages to further spending, therefore the greater their marginal propensities, the

smaller the multiplier. The income-expenditure model can incorporate many characteristics of the economy, making the multiplier far more complex. Similar to the economic base model, the income-expenditure multiplier is based on consumer spending, and thus produces induced impacts, given the prior knowledge of the direct and indirect impact components.

Several assumptions are inherent in the model. As with the economic base technique, the model's coefficients remain constant over the period of analysis. Marginal rates of saving, local consumption, import, and taxation remain fixed and produce a static multiplier. Obviously, this constancy does not hold in the actual economy. For example, a change in real interest rates or inflation may alter the marginal propensity to consume.

An assumption of social homogeneity is also inherent in the model. Each member of the community is assumed to have an equal propensity to consume and save. This assumption does not reflect differences between income levels or among community groups. Local producers are also considered homogeneous in that each is assumed to have identical production functions.

The model further assumes that the producing sectors face no capacity constraints. Consequently, each producing sector can meet an increase in demand with no supply constraints limiting increase to production.

2.3.3 Input-Output Analysis.

Input-output (I-O) models are intricate tables, or matrices, showing the inter-relationships between the production of goods and services (outputs) and the

purchases of goods and services (inputs) for a defined region. The father of modern input-output analysis, Wassily Leontief (1986), describes the model as "a method of systematically quantifying the mutual interrelationships among the various sectors of a complex economic system" (p19). The tables reveal, for every dollar of output, the value produced and consumed in each sector represented within the model.

Tables are constructed in a square, industry-by-industry form, or in a rectangular, commodity-by-industry form. The number of industry and commodity sectors can vary from fewer than 30 to several hundred; a greater number of sectors creates a more accurate table. The Canadian Input-Output tables, for example, are in a commodity by industry form and consist of 216 industry sectors and 627 commodities (Statistics Canada, 1991). Analysts can theoretically construct tables for areas as large or as small as desired.

A square input-output table locates the producers of goods and services along the rows, and the purchasers of goods and services along the columns (Miller and Blair, 1985). The intersection of a row and column represents the relationship between the two activities. If the producer supplies goods to the purchaser, a figure at the intersection represents the value of that industry's purchases from that producer. The tables aggregate the entire purchase and output pattern of an economy into industry sectors. The last entries in the rows of the table are final demand and total output. At the end of each column is total value added and total purchases. The total output of the rows equals the total purchases of the columns.

To identify economic impacts, the tables work as follows. Each industry sector is represented as a producer and consumer of goods and services. To produce its

output, each sector consumes various inputs. When the final demand for the output of an industry sector increases (decreases), interrelated sectors providing inputs must meet that increase (decrease) in demand by increasing (decreasing) their production. The increased production creates a further demand stimulus on producers that again requires another round of production increases, and so on. The total change in the economy is the sum of all the changes to each of the sectors, or the total change in output.

The impacts described in the preceding paragraph relate to the purchases of goods and services by business, or the indirect impact. The input-output (I-O) model producing these impacts is termed an "open" model (Miller and Blair, 1985). To estimate the impact of wages and salaries, or the induced impact, the I-O model requires the addition of a household sector. Incorporating the household sector into the model establishes human capital as producers supplying labour, and purchasers buying the necessary inputs to survive. With the incorporation of the household sector, the model is termed "closed" with respect to households (Miller and Blair, 1985).

As with the previous models discussed, the I-O model is based on several assumptions. Values used in the construction of an input-output table remain constant, relating to the particular time period when the data was collected. Technological change and the variability of prices tend to alter inter-industry relationships in the actual economy. The older the model, the more conservative (liberal) an assessment is likely to be as a result of economic growth (decline) in ensuing years.

A further complication evolves from aggregating industries and producing what is termed a "product mix problem." Industry sectors are aggregations of businesses that are similar but have different purchase and output patterns. The industries may produce similar items, but use different inputs of different value. This aggregation of business activity creates a product mix problem whereby individual business characteristics are averaged out. Thus, for example, the high productivity of an efficient producer would be represented by an average value when aggregated with the low productivity of less efficient producers.

The final assumption in this discussion involves the linearity of the production functions used in the construction of an I-O model. The model assumes that for each dollar increase of input, a constant increase of output results. Consequently, the existence of internal economies of scale are not incorporated into the model, nor the possibility of a change in the price of inputs due to increased external economies of scale or other exogenous effects.

2.4: Summary of Models.

A major difference between I-O, and economic base and income-expenditure models is that an I-O table uses production functions and yields multipliers for each industry sector represented in the model, while the latter two techniques are generally associated with one function that produces one multiplier for all industry sectors in a region. The multipliers produced also have some variation. Economic base and income-expenditure techniques produce induced, or consumer spending, multipliers, while the input-output model produces indirect multipliers, and with a closed model, induced multipliers as well. As a result, when using a multiplier, analysts must provide the appropriate information to generate the total,

direct + indirect + induced, impacts. Davis (1990) presents a clear explication of the differences:

> For both the economic base and income-expenditure models, the analyst must supply the multiplicand consisting of the direct and indirect components. The ... models then yield, via their consumer spending multipliers, the total (direct + indirect + induced) component. In contrast, the input-output model, with its focus on interdependencies between producing sectors of the economy, provides the indirect impact. Given the direct impact as the multiplicand, the I-O multiplier constructed from the open model yields the direct plus indirect impact; the closed model multiplier provides the total impact (p. 93).

Each of the theories presented involves trade-offs between accuracy and technical difficulty. The method chosen to assess economic impacts rests on the availability of existing multipliers, technical ability, time, and resources. Input-output derived multipliers provide the most accurate method when available for the region under study; however, they are the most costly and time consuming to prepare. Often national and some regional I-O tables will exist for the particular region under assessment and provide the best means of impact identification. For smaller regional assessments, however, economic base and income-expenditure models may offer the more practical solution.

2.5: Port Economic Impact Studies.

The above models can be used to assess both future and existing projects and activities. Ports are one activity that have received substantial attention from impact analysts. Primarily, port economic impact studies have been used for public relations programs (Chang, 1978); however, information gained through an impact

study may also be useful for port planning. If the latter is the objective, then much more detail is required to provide an accurate assessment of changes to port services resulting from variations in export and import demand.

Davis (1983) outlines three weaknesses of port impact studies: "1. the definition of the primary impact; 2. the determination of the total impact; and 3. the value of such studies in the evaluation of changes in the level of port services" (p.68). The 1981 and 1993 Fraser Port studies are more public relations tools than planning tools. Thus, the first two concerns are the main focus of the following section.

2.5.1 Defining the Primary Activity.

Definitions of primary port-activity vary from study to study and have resulted in problems of comparability between, or among, studies, and has raised concern over the theoretical basis of port economic impacts. The 1978 Maritime Administration (MARAD) report, entitled the *Economic Impact of the U.S. Port Industry*, stated that:

> the source of the problem has not been the lack of port studies, but rather the over-abundance of conflicting approaches, the use of vague terminology, and especially the absence of solid theoretical foundations. What is important is the fact that no official definition of a port industry exists within the governmental reporting system. Because of this void a superfluity of inaccurate definitions has emerged (p. 15).

Davis (1983) and Yochum and Agarwal (1987) question the appropriateness of some impact definitions. As Davis (1983) states: the "specific economic activities included in the primary impact vary from study to study ... [and are] ... partially attributable to the lack of a commonly accepted definition of activities necessary for

port operation" (p. 62). The 1978 study of the U.S. port industry found in its review of port impact studies that port activities follow three definitions. The first is a narrow definition that includes only stevedoring, terminal operations, and container stuffing and destuffing. The second definition broadens the first by including some production activity located within the port's area. The final definition adds all production activity that transports its goods by using the port's facilities.

Waters (1977) also presents a critical assessment of port impact studies. His main criticisms are the inability of port impact studies to act as planning tools for future facility development and the lack of examination into the incremental effect of changes to public investment. He also questions the adequacy of Keynesian and economic base multipliers. Waters considers the use of cost-benefit analysis as a more reasonable path to achieve adequate port assessments, and proposes the use of input-output multipliers, rather than economic base or Keynesian multipliers, as a means to assess the full regional impact.

Since the late 1970's, several reports have attempted to strengthen the weaknesses of port economic impact studies. Definitions have become more consistent and port impact "kits" have appeared to help standardize the port economic impact process. Input-output models have also become the chosen methodology, strengthening both the results and comparability of port studies.

The *Economic Impact of the U.S. Port Industry* (MARAD, 1978) was an initial attempt to overcome port assessment deficiencies. The study's objective was to assess the economic impact of the U.S. port industry and to establish a theoretical foundation for future port assessments. Two concepts of port activity emerged: port-industry, and other port-dependent industry.

Port-industry has a narrow focus intended to reflect the role of the port as a provider of transportation services. The study defined the port industry as "any economic activity that is directly needed in the movement of waterborne cargo" (MARAD, 1978, p.17). Included in this definition are stevedoring, water and land transportation, warehousing, freight forwarders, customs agents and brokers, finance and insurance, and government services.

Port-dependent industries are those that must use the port. Exporters and importers using the port fall into this category, as do water-related industries such as shipbuilding and repair. The 1978 *Economic Impact of the U.S. Port Industry*, as the title implies, assessed only the impact of the port-industry category.

A second report, the *Port Economic Impact Kit*, (Arthur D. Little Inc, 1979) emerged a year later in 1979. Definitions in the kit are consistent with those presented above; however, the focus on establishing a dependent relationship between port-users and the port, if a port-dependent section is to be included, is more pronounced. The kit is in the form of a workbook with sections to help define the study, conduct the survey, generate multipliers, and present the results. The estimation of economic base multipliers is discussed and the use of I-O multipliers, where available, is suggested. Each section contains sequential procedures to complete the necessary stages in the assessment process. The intention of the report is to improve the accessibility to economic impact assessments for small to medium sized ports.

Another study, released by MARAD in 1982, is entitled *The Regional Port Impact Model Handbook*. The report is another impact workbook; however, it presents a

more detailed discussion of port impact theory and uses a regional I-O model to assess economic impacts. The report consists of two volumes: Volume one describes the methodology and its application; Volume two is a user's guide for the regional I-O model that has been adapted for use in port impact assessment. The package includes a computer software program to lead the analyst through the assessment process.

The definition of port industry in the 1982 kit is consistent with those above. Similar to the 1978 MARAD study, this impact kit is mostly concerned with an assessment of port-industry activity. The 1982 kit refers to port-dependent industries as port-users and stresses the need to establish dependency. To include port-users in an assessment requires that the "locational dependence of an industry on a port can be established ... [and that port dependent users] ... would be presented in the context of an analysis of industries which are located in the region due to the existence of the port" (MARAD, 1982, p. 18). The study acknowledges that the level of port-user dependence would be difficult to establish, and further considers that the port-industry category provides the most relevant picture of the role and impact of a port.

The report attempts to provide improved access to economic impact analysis for non-economists and non-mathematicians. The computer package and input-output model, however, is designed for the U.S. economy and is not useful in a Canadian context: inter-industry linkages differ between U.S. and Canadian regions, thus making the multipliers inappropriate for Canadian analyses.

The final report reviewed here, the *Port Economic Impact Kit* (Temple, Barker, Sloane, 1985), is an update of the 1979 kit. The 1985 version attempts to address

some of the complexities and ambiguities of the 1979 impact kit. The report addresses problems with the economic base methodology, industry definitions, and data requirements by providing alternatives to the survey, and an I-O software package to generate total impacts.

To overcome the problem of establishing port dependency, the kit re-defines local port-user. The kit recommends that analysts examine all producers who use the port, irrespective of their dependency. The objective is to examine the activity that does exist, and that provides employment and generates business activity in the region. Industry dependency on a port becomes irrelevant. The kit acknowledges that determining port-dependency is difficult, especially when alternate ports exist in the region. Often the shipper's choice of port is determined by cost or other business considerations such as diversification of transport services, connection to land transportation, cargo handling facilities, and ship turn around time (Kargl, 1993).

While the 1985 package is instructive in terms of how to prepare and analyse the direct impact and how to present the results, the kit's input-output software package is not useful in Canada, again due to its U.S. focus.

Each study stresses that if an impact study is to include port-industry and port-dependent, or port-user, industry, the categories must be assessed separately. The 1982 study states that the "port industry deals only with the movement of cargo and does not include production by exporters or other production that takes place in factories located on the waterfront ... The regional impact of such activities should be measured separately" (pp. 16-17). The *Port Economic Impact Kit* (Arthur

D. Little Inc, 1979) states that "port-industry firms should always be included and treated separately from port-dependent firms" (p. 24).

Two reasons are behind this need for separation. One is that the objective of the analysis should be to evaluate the functions that are specific to ports; the study should assess those activities that relate directly to the existence of the port. The second reason is that adding the two categories in order to provide a total impact double-counts the port-industry sector. The transactions flow of an exporter includes expenditures for transportation. For example, the exporter purchases shipping services from a shipping agent who arranges for rail, truck and/or water transport. Thus, the assessment of a producer in the port-dependent category includes, in its indirect impact, the services of the port-industry.

Unfortunately, the possibility of double-counting may be more deeply rooted in I-O port impact studies. Double-counting in transport related input-output analysis may also occur within the port-industry category, once again as a result of indirect impacts being included in the direct impact of a project or activity. Included in the port-industry sector are various activities directly involved with the movement of cargo (e.g. the terminals, customs brokers, stevedores, shipping agents, and port-dedicated rail activity). The expenditure patterns of these activities may be inter-related such that one is an indirect impact of the other.

For example, a producer contracts a shipping agent for $100 to ship its cargo overseas. If the shipping agent were to retain the entire $100, the direct sales impact of the shipment would be $100; however, the agent may arrange for other port services on the producer's behalf. The shipping agent may pay the terminal a $25 passage fee. Stevedores are hired by the shipping agent, or terminal, for $25.

Finally, the shipping agent pays the Harbour Authority $30 for the ship's harbour dues. Each of these businesses comprises the port-industry category. As a result, the original $100 of direct payment made by the producer rises to a direct impact of $180. But $80 is actually part of the original $100, so double-counting has occurred. Generating indirect and induced impacts accentuates the error.

Unfortunately, the above scenario is only one possible pattern of exchange. In another scenario the problem may not appear because the producer pays for each service separately. The difficulty in eliminating the source of double-counting, or establishing the extent of the problem, is due to the multitude of possible expenditure scenarios (Kargl, 1993), and that no input-output sector exclusively treats port-industry activity.

No specific discussion of a method to eliminate or reduce the port-industry double-counting problem is available. Without a detailed study into the magnitude of double-counting within transport related input-output studies, an adjustment of the impacts is difficult. Such an analysis is beyond the scope of this study; thus, only an acknowledgement of the problem is possible. Necessarily, the figures in this assessment, and any economic impact assessment, should be taken with caution.

2.6: Economic Impact Model Used in the 1981 and 1993 Fraser PortStudies.

The 1981 economic impact study of Fraser Port uses the economic base methodology to derive multipliers. The study also uses input-output multipliers for the Vancouver Lower Mainland (see Davis, 1974) and then compares the two results. A critique of the 1981 study is the subject of Chapter 4.

Input-output multipliers were chosen for the 1993 assessment of Fraser Port for several reasons. Two reasons are the accuracy of the methodology and its accessibility. Statistics Canada maintains a national and inter-provincial I-O model, and the Central Statistics Branch in Victoria, B.C. maintains an I-O model for the Province of B.C. Input-output has also become the most widely used methodology for port economic impact assessments. Consequently, the results of this study should be more accurate and comparable to other port studies.

A further reason is that using an economic base or income-expenditure model requires the calculation of multipliers. Insufficient time and staff were available to derive such multipliers for the Fraser Port study. Finally, both the economic base and income-expenditure techniques are inappropriate for large and complex economies such as the Vancouver Lower Mainland. As a result, I-O multipliers were used for reasons of accuracy, appropriateness, and available time.

The impact study assesses two categories of port activity. The first follows the definition of port-industry as outlined previously; the second, termed port-associated, follows the port-user definition of MARAD's 1985 *Economic Impact Kit*. Establishing port-dependency in the Vancouver region would have been difficult with alternate transport facilities available nearby. The study acknowledges that the impacts of port-users are not a result of Fraser Port, but are impacts associated with cargo transshipped via Fraser Port. The two categories are discussed in full in Chapter 5.

CHAPTER 3: INTRODUCTION TO FRASER PORT.

3.1: Location of Fraser Port.

Fraser Port is located in the Lower Mainland of British Columbia, near the city of Vancouver. The region is home to approximately one half the population of British Columbia, or over 1.6 million*, and is the third largest metropolitan area in Canada. According to the 1991 Census of Canada, an estimated 750,000 people were employed in various goods and services industries - an increase of over 150,000 from 1986. Business and personal services dominated the local economy accounting for approximately 44% of total labour, while transportation, communications and utilities represented 11% of regional employment.

The jurisdiction of the Fraser Port covers the Fraser River as outlined in Figure 3.1. Bordering on nine municipalities, the Port extends eastward from the Strait of Georgia along the Fraser River's central and lower arms to Langley, and also includes the Pitt River. The following municipalities are adjacent to Fraser Port:

Coquitlam	Pitt Meadows	Surrey
Delta	Port Coquitlam	Maple Ridge
Langley	Richmond	New Westminster

* The population estimate is for the Vancouver Census Metropolitan Area comprised of Vancouver, Richmond, Delta, Burnaby, District and City of North Vancouver, West Vancouver, Lions Bay, Bowen Island, Surrey, Belcarra, Anmore, Port Moody, Coquitlam, Port Coquitlam, Pitt Meadows, Maple Ridge, White Rock, and the City and Township of Langley.

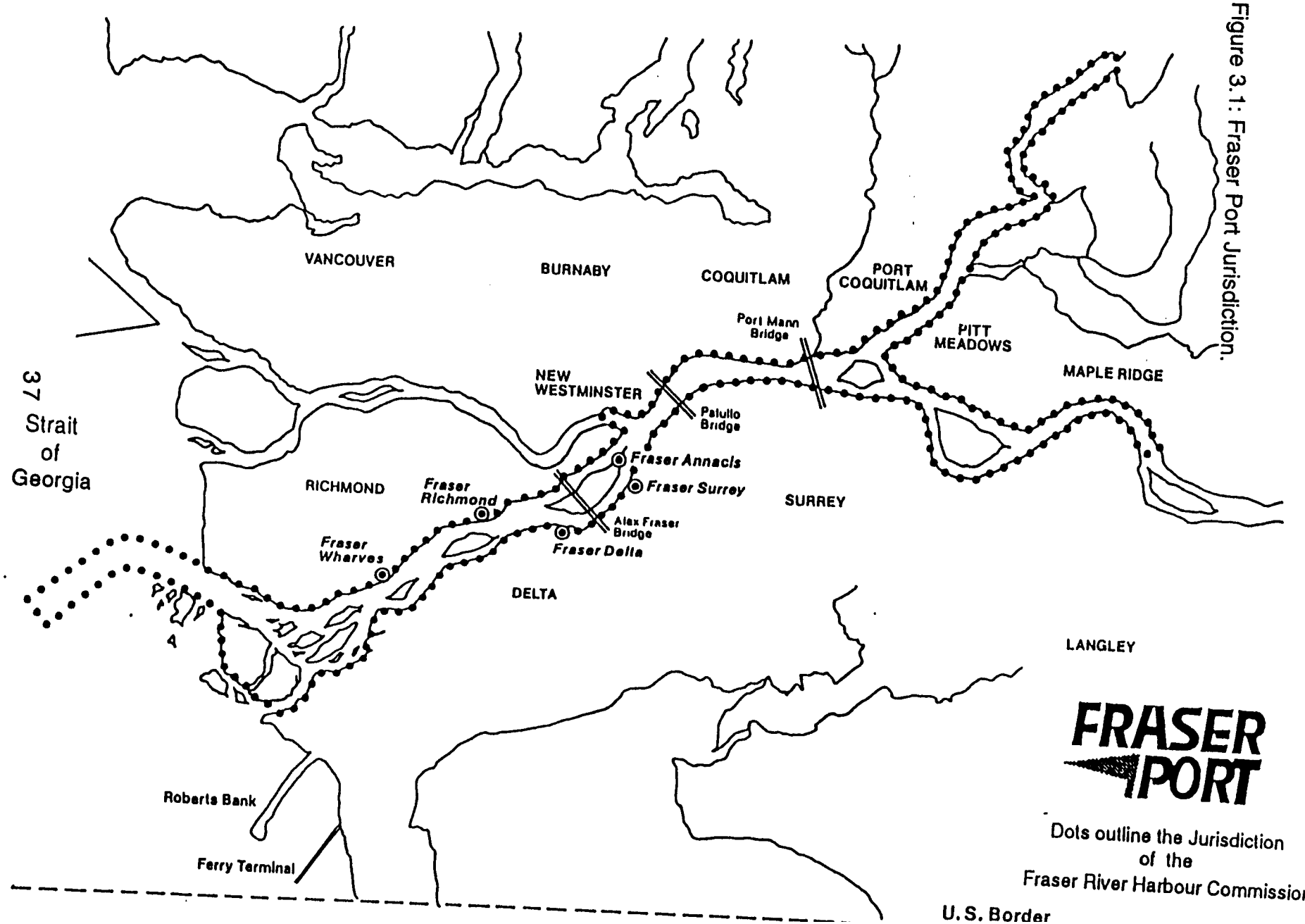


Figure 3.1: Fraser Port Jurisdiction.

3.2: The Lower Mainland System of Ports.

Fraser Port is administered by the Fraser River Harbour Commission (FRHC) and is part of a regional port system that also includes the North Fraser Harbour Commission (NFHC), and the Port of Vancouver administered by the Vancouver Port Corporation (VPC). The two Commission Ports are dwarfed by the VPC, whose jurisdiction includes Vancouver's inner and outer harbour, and extends to Roberts Bank near the mouth of the Fraser River's south arm.

The Vancouver Lower Mainland is known as the Pacific Gateway and its ports are the focal point of Canada's shipping trade with the Pacific. Together, the three ports handled over 100 million metric tonnes of cargo in 1992. Table 3.1 provides a comparison of tonnages handled at Lower Mainland ports. A more comprehensive description of Fraser Port cargoes is presented in Section 3.7.

Table 3.1: Comparison of Lower Mainland Ports, in metric tonnes, 1992.

Cargo	Fraser Port*	North Fraser Port**	Vancouver Port Corporation***
Inbound tonnage	10,823,044	10,786,150	5,817,000
Outbound tonnage	8,887,749	6,933,823	57,489,000
Total tonnage	19,710,793	17,719,973	63,306,000

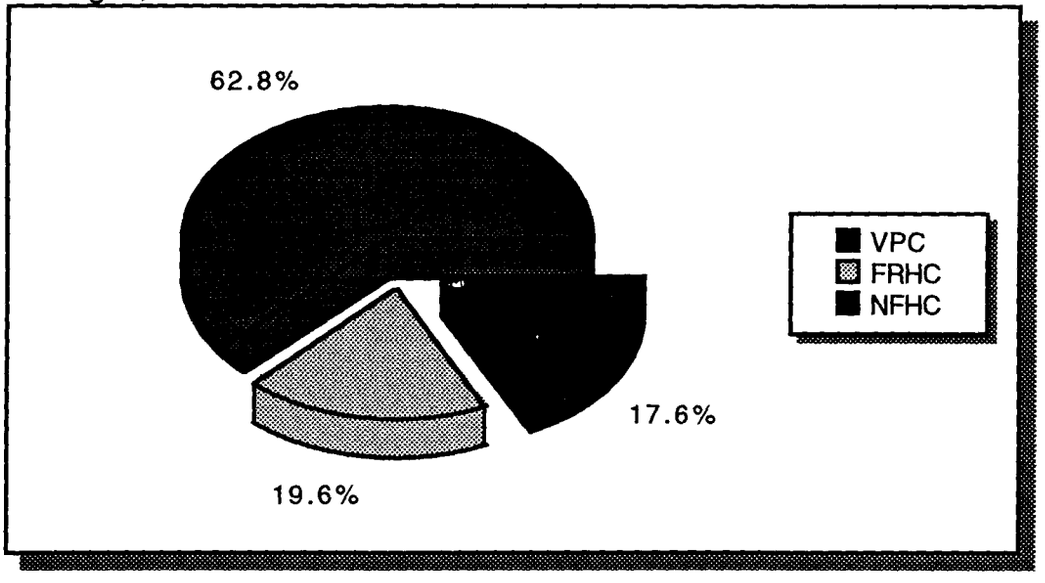
* Fraser River Harbour Commission Statistics, 1992.
** North Fraser Harbour Commission: 1992 Annual Report.
*** Vancouver Port Corporation: 1992 Port of Vancouver Fact Sheet.

Evident is the overwhelming dominance of the VPC in local port activity. The VPC is dominated by bulk export shipments of forest products, coal, potash, and wheat. The North Fraser Harbour Commission handles mainly domestic shipments of

wood products and aggregate. Figure 3.2 illustrates the dominance of the Port of Vancouver and the relative position of each of the Lower Mainland ports.

Several reasons explain the dominance of the Port of Vancouver. First, Vancouver Port became the focal point of shipping activity with the arrival of the Canadian Pacific Railway in 1887 (Ireland, 1978). While each regional port benefited from the arrival of rail, the Port of Vancouver clearly emerged as the dominant facility. Vancouver Port's potentially largest competitor was Prince Rupert; however, financial difficulties and demand shortages led to a Federal takeover of the Canadian Northern and Grand Trunk Pacific Railways (incorporated into the Canadian National system) in 1918 and 1919 respectively. This takeover was soon followed by the designation of the rail's mainline to Vancouver, thus relegating Prince Rupert to branch line status (Forward, 1984).

Figure 3.2: Percentage distribution of Lower Mainland shipping tonnages, 1992.



A second reason for Vancouver's dominance is its water depth and shelter that provided a logical focus for the development of the inner harbour, as opposed to the Fraser River, which was and remains prone to silting. Third, the large harbour did not restrict ship movement and allowed for longer term anchorage while awaiting cargo. Fourth, Federal Government interest in the Port of Vancouver as the region's central port, combined with local initiatives (notably the Canadian Pacific Railway's focus on the City of Vancouver as the focal point of regional growth and activity), ensured the port's dominance over its Fraser River rival (MacDonald, 1982). Today, the Port of Vancouver is congested and constrained by the size of its natural harbour. As a result, each of the region's ports (including Prince Rupert) has enjoyed growth. Each port provides service to specific domestic and international markets; however, the Port of Vancouver remains dominant in terms of total tonnage specializing in international bulk and container cargo.

Ports in the U.S. Pacific Northwest also vie for the region's shipping traffic. The ports of Tacoma and Seattle focus heavily on container activity. In 1991, the Puget Sound ports handled over 2 million TEU (twenty foot equivalent unit) containers (Port of Tacoma Annual Report, 1992; Port of Seattle Annual Report, 1991). The ports also handle wood products, automobiles, and general break bulk cargo. In contrast, the Port of Vancouver handled just over 441 thousand TEU's, while Fraser Port handled only 14,000 TEU's.

3.3: History of Fraser Port.

The birth of non-aboriginal trade and shipping activity on the Fraser River dates back to the mid-1800's. During the 1850's-60's, shipping traffic on the river was kept busy transporting people and goods between Victoria and the mainland

(Gresko and Howard, 1986). The gold rush of 1858 brought a rash of fortune seekers who travelled via the Fraser River en route to gold fields in the Caribou. During this period, cargoes shipped via the Fraser River included furs, timber, and agricultural products.

For many years, the city of New Westminster vied with Victoria and Vancouver for greater port activity, and to become the focal point of regional development. However, the arrival of the Canadian Pacific Railway, at first to Port Moody in 1886, then to Burrard inlet a year later, ensured that Vancouver would become the dominant city on British Columbia's westcoast (Ireland, 1978). Growth of shipping activity on the Fraser River was hampered by recession and war from the early 1900's to the Second World War. World trade did not increase and provide growth and prosperity for Lower Mainland ports until after 1945 when economic growth returned.

3.4: Fraser Port Administration.

Jurisdiction over Canadian ports was assumed by the Federal Government through the British North America Act of 1867. Today jurisdiction is controlled through the 1981 Constitution Act (Transmode, 1988). Fraser Port received its original Commission status by Federal legislation in May of 1913 under the title New Westminster Harbour Commission. In 1964, the Federal Government passed a new Harbour Commission Act. The new act gave Harbour Commissions greater local control over port development (Goss, 1983). A year later, the New Westminster Harbour Commission was renamed the Fraser River Harbour Commission (Gresko and Howard, 1986). The Harbour Commission Act was last amended in 1982. Today, five Commissioners govern the Harbour - three

appointed federally, while the Port's nine municipal neighbours appoint the remaining two.

The Harbour Commission Act of 1982 designates the terms and conditions of Harbour Commissions (Transmode, 1988). Harbour Commissions are responsible to the Federal Minister of Transport. However, Commissions are not an agent of the Crown and as such are not subject to the Financial Administration Act; thus, spending authority rests with the individual Harbour Commission. In contrast, Port Corporations are Federal Crown Corporations and are subject to the Financial Administration Act. Borrowing capital and investment is also restricted for the Port Corporations. Harbour Commissions are authorized to retain profits, and raise funds either through chartered bank lending, or the issuance of debentures. This structure allows Port Commissions to pursue its own development and land use goals more easily. A Commission may also invest in bonds at the Federal, Provincial, and Municipal levels. Administrative powers given to Commissions include the regulation of navigation and cargo handling, land development and expropriation, collection of fees and tolls, and the ability to enter into contracts.

3.5: Fraser Port Facilities.

Fraser Port terminals include Fraser Surrey Docks, Annacis Terminals, and Fraser Wharves. The Fraser River Harbour Commission is a landlord port; thus, its facilities are not operated by the Commission, but are leased on a long term basis to private operators. The Harbour Commission also administers over 600 hectares of industrially zoned land.

Fraser Surrey Docks is located on the south bank of the river opposite New Westminster and operates under a long term management agreement. Its facilities include two container crane berths, plus four berths used for other general and bulk cargo. Several storage sheds combine to provide 245 thousand square feet of storage space. Rail and truck switching yards are also located adjacent to the docks. Commodities shipped via Fraser Surrey Docks include forest products, steel, and various general cargoes.

Annacis Terminals and Fraser Wharves are automotive import facilities. Over 300 thousand automobiles and trucks arrive annually from Japan, Korea, and Mexico. The automobiles are off-loaded and temporarily stored while awaiting shipment to points across Canada. At any one time Annacis Terminals is capable of storing up to 25,000 vehicles, while Fraser Wharves can store up to 18,000 automobiles. Annacis Terminals operate under a long term agreement while Fraser Wharves operates independently on private land, thus under no long term agreement with the Harbour Commission. However, its cargo is shipped via Fraser Port, and as such, the facility is closely tied to the Harbour Commission.

The remainder of Fraser Port cargoes are shipped directly to production plants and mills along the Fraser River shoreline. Lafarge Cement and Tilbury Cement import large amounts of aggregate and gravel for the production of cement products. Texada Lime and Island Paper import limestone directly to their facilities via Fraser Port. Various forest products, ranging from raw logs to sawdust and hogfuel, are shipped to various mills located near the Fraser including International Forest Products, MacMillan Bloedel, and Canadian Forest Products Ltd.

3.6: Transportation Infrastructure.

An integral component of a port's facilities is its access to rail and road services. Five railways provide service to the region. Burlington Northern provides access to the United States, while Canadian Pacific and Canadian National Rail service destinations within Canada. British Columbia Railway and the Southern Railway of B.C. provide access to additional points in B.C. Major highway arteries are nearby, extending south into the United States, and north and east within Canada.

3.7: Physical Characteristics.

Fraser Port is constrained by its natural environment. River ports are noted for their generally shallow draft that limits the size of vessels (Bird, 1971). As a result, the larger bulk and container ships are unable to enter the port. Fraser Port's ability to attract the fast growing and lucrative container service market or larger bulk vessels is hampered by the restrictive water depths of the Fraser River. At present, the maximum draft of vessels entering the Fraser River is 10.7 meters. Ongoing dredging is required to ensure that sufficient depths are maintained. In areas prone to heavy silting, training walls have been constructed to narrow the river's main channel, thus increasing the current and allowing the river to flush itself. In future, while improved dredging and channelling technology may lead to greater river depths, the George Massey Tunnel ultimately restricts the size of vessels entering the south arm of the river, as a result of its 12.5 meter low water allowance. In comparison, the Port of Vancouver has a low tide depth of 15 meters in the Inner Harbour, and 20 meters at the Roberts Bank facility.

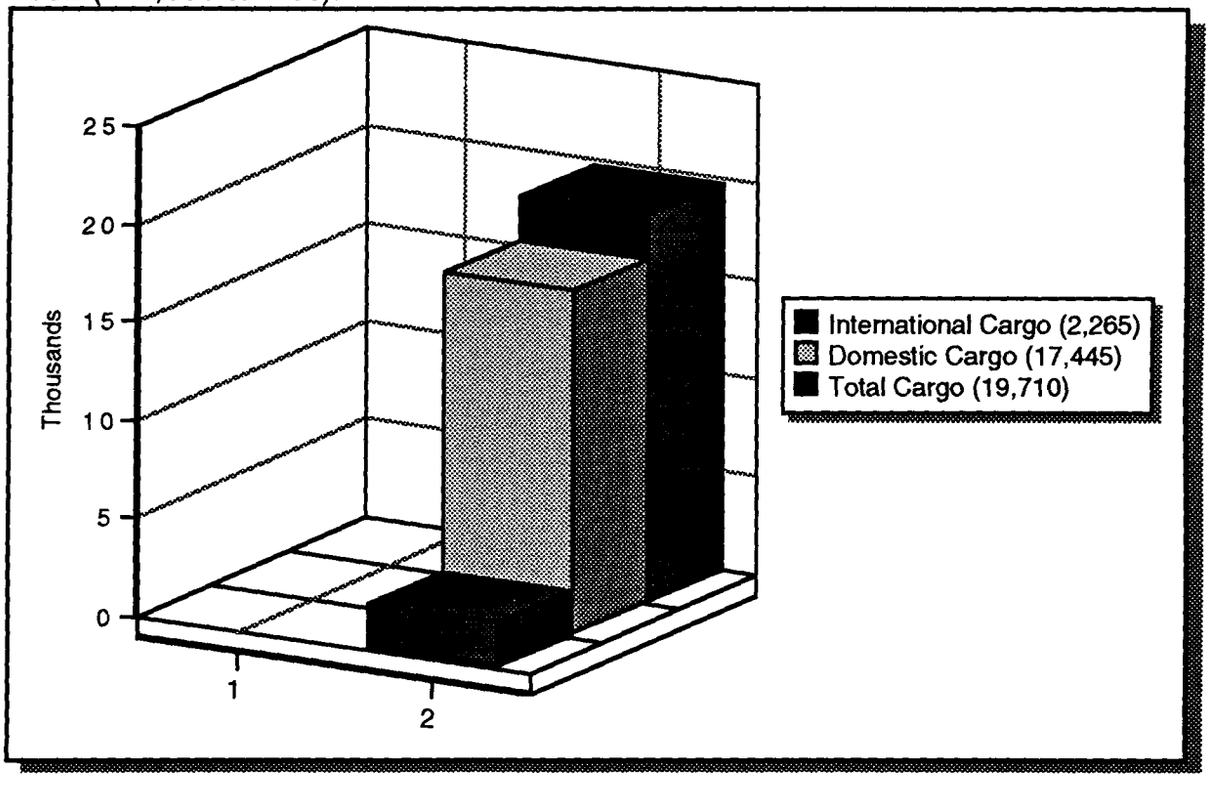
3.8: Fraser Port Cargo Statistics.

Fraser Port handles numerous domestic and international commodities. The following section describes various characteristics of Fraser Port cargoes. The section is divided into international and domestic shipments. All data in the following illustrations are from the Fraser River Harbour Commission statistics for 1992.

3.8.1 Total International and Domestic Shipments.

In 1992, Fraser Port handled 19,710,793 metric tonnes of cargo, 88.6% of which was domestic. Figure 3.3 compares domestic and international cargoes shipped via Fraser Port. The overwhelming dominance of domestic tonnages is evident.

Figure 3.3: Domestic and international cargo shipped via Fraser Port, 1992 (in 1,000 tonnes).



3.8.2 International Shipments.

In 1992, international cargo shipments totalled over 2.2 million metric tonnes. Commodities are shipped to, or received from, the United States, Central and South America, Europe, Africa, the Mid-East, Asia, and the Pacific. Table 3.2 shows the various international commodities shipped through Fraser Port and their corresponding tonnages.

Table 3.2: Fraser Port international export and import shipping statistics, 1992 (in metric tonnes).

EXPORTS	1992
Cement	103,487
Chemicals	5,592
General Cargo	37,109
Heavy Equipment	1,137
Lumber	775,847
Metal (Non-Ferrous)	4,335
Other	942
Paper	28,825
Pulp	193,209
Steel	70,184
Wood Products	43,002
Wood Chips	79,055
TOTAL	**1,343,084**

IMPORTS	1992
Autos*	308,391
General Cargo	359,141
Heavy Equipment	4,197
Metal (Non-Ferrous)	551
Other	7,434
Steel	239,300
Wood Products	3,242
TOTAL	**922,256**

Outbound Tonnage	1,343,084
Inbound Tonnage	922,256
TOTAL INTERNATIONAL TONNAGE	**2,265,340**

* Reported by number of automobiles.

International exports:

In 1992, a total of 1,343,084 metric tonnes of international exports passed through Fraser Port facilities. Outbound cargo dominated the international category accounting for almost 60% of total tonnages.

Forest products dominated the Port's international exports. Lumber, plywood, chips, pulp, and paper combined to represent approximately 83% of all international export cargo. Lumber alone comprised 58% of international exports. Pulp and paper, accounting for over 200,000 tonnes, also contributed substantially to that total.

International imports:

In 1992, Fraser Port international imports accounted for over 922 thousand metric tonnes. Automobiles, and steel products are the two largest single commodities entering the port. General cargo imports accounted for 360 thousand tonnes, or 39% of international import tonnages. General cargo includes ceramic tiles, furniture, alcohol products, food products, and various household goods. Steel imports (including plate, beam, pipe, coil and wire rod) accounted for a further 26% of international imports.

3.8.3 Domestic Shipments.

Domestic cargo is the largest category of Fraser Port tonnages. In 1992, total inbound and outbound domestic cargo approached 17.5 million tonnes. Table 3.3 outlines the various domestic commodities shipped through Fraser Port in 1992.

Domestic Outbound:

In 1992, domestic outbound cargo amounted to almost 7.5 million tonnes. Forest products dominated the category, accounting for approximately 88% of domestic outbound cargo tonnage. Cement and aggregate combined for a further 6.7%.

Table 3.3: Fraser Port domestic outbound and inbound shipping statistics, 1992 (in metric tonnes).

OUTBOUND TONNAGE	1992
Aggregate	286,700
Cement	218,957
Chips	3,841,580
General Cargo	291,313
Hogfuel	377,710
Logs	2,157,240
Machinery	300
Pulp	22,500
Sawdust	213,765
Steel	134,600
TOTAL	**7,544,665**

INBOUND TONNAGE	1992
Aggregate	1,618,601
Chips	519,485
Coal	10,100
General Cargo	365,954
Gypsum	191,893
Liquids	7,501
Limestone	1,162,567
Logs	5,707,487
Lumber	7,700
Paper	121,275
Pulp	83,066
Shakes	12,020
Steel	4,100
Fish	28,758
TOTAL	**9,900,788**

Outbound Tonnage	7,544,665
Inbound Tonnage	9,900,788
TOTAL DOMESTIC TONNAGE	**17,445,453**

Domestic Inbound:

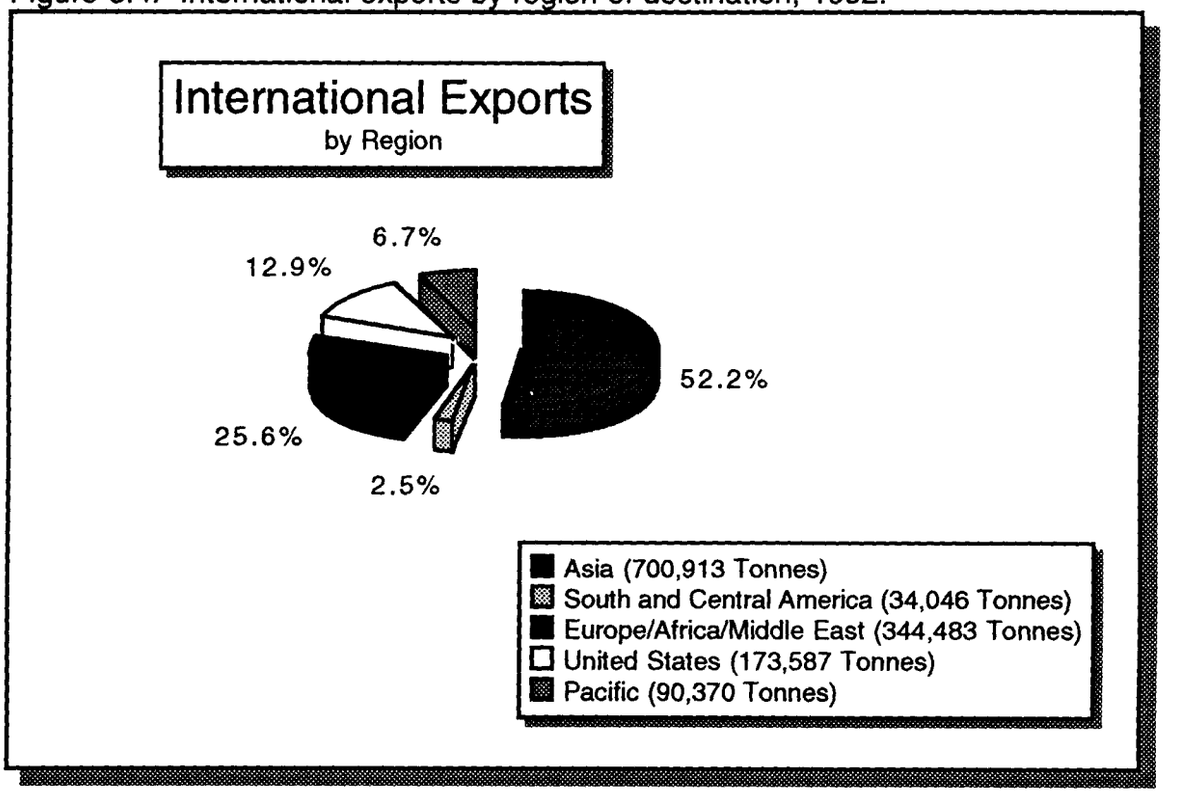
Over 5.7 million tonnes of logs passed through Fraser Port in 1992. Wood products - including logs, chips, lumber, and paper - dominated the category with a 66% share. Aggregate and limestone combined for 2.78 million tonnes, or a 28% share. Inbound tonnages dominated the total domestic cargo category with a 66% share.

3.8.4 Exports by Region.

Asia dominated the international export category in 1992. Over 52%, or 700,913 metric tonnes, of total export activity occurs with Japan, South East and East Asia. The majority of exports to this region are forest products. European, African, and Middle Eastern countries received 344,483 tonnes of cargo shipped via Fraser Port

for a 25.6% share of export activity. The U.S. received almost 13%. Figure 3.4 presents the regional destinations of Fraser Port international cargo exports.

Figure 3.4: International exports by region of destination, 1992.



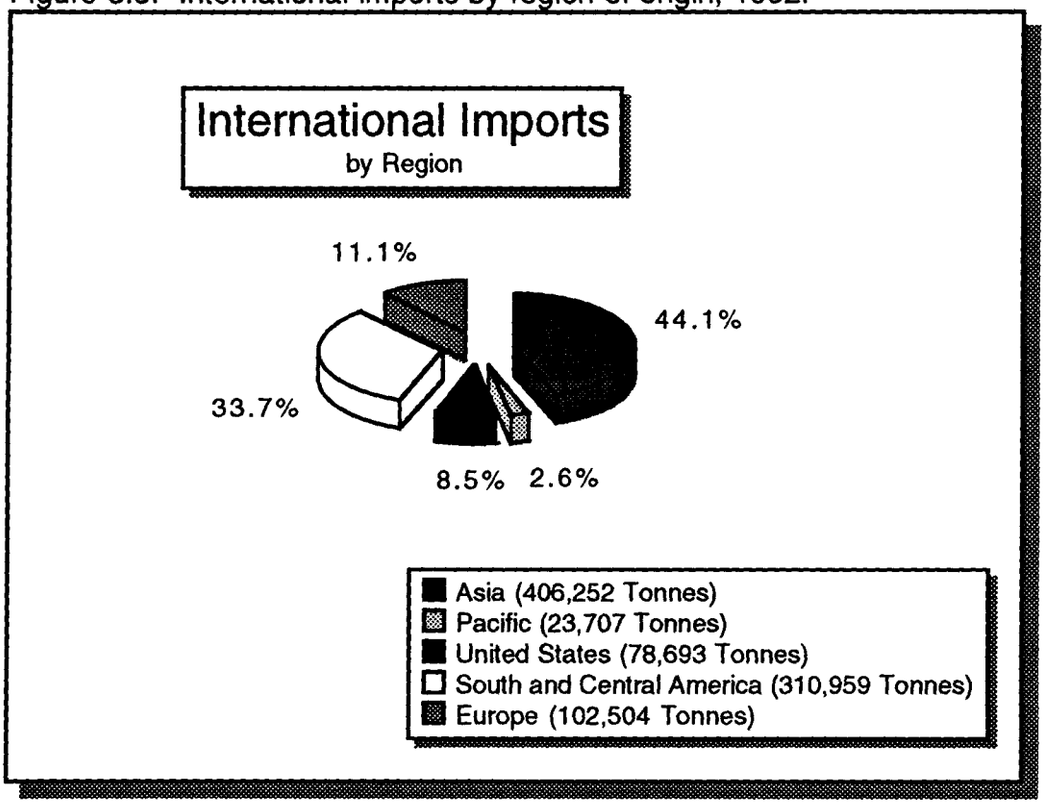
3.8.5 Imports by Region.

Asian countries also dominated the import category with a 44% share of total international imports. The majority of cargo of Asian origin included automobiles and steel products. Figure 3.5 presents the regional origins of Fraser Port international cargo imports.

South and Central American countries accounted for close to 34% of international imports entering Fraser Port. Imports from this area included automobiles from

Mexico, heavy equipment and machinery from Brazil, and steel from Trinidad. Various regions ship general cargo consisting of numerous items including ceramic tiles from Italy, alcohol from France, Spain, and Italy, and furniture from Italy.

Figure 3.5: International imports by region of origin, 1992.



3.9: Conclusion.

Fraser Port contributes to the trade and commerce of Canada through its transport role. While the Port appears to specialize in domestic cargo, and forest products in particular, it also serves as an important automotive import centre. As well, the

mills and processing plants depend on the Fraser waterway to ensure the movement of their goods.

Fraser Port also functions as an economic generator in the regional and national economy. The spin-off effects of port activity and spending extend the economic impacts of the Port across the nation. The following chapters quantify those economic impacts related to the operation of Fraser Port facilities and the various industries associated with Fraser Port cargoes.

CHAPTER 4: A CRITIQUE OF THE 1981 FRASER PORT ECONOMIC IMPACT STUDY.

The purpose of this chapter is to critically examine the 1981 Fraser Port Economic Impact Study (Austin and Powell, 1981) and to propose methods of avoiding such recurrences. The chapter focuses on the application of port economic impact theory, as outlined in Chapter 2. However, the 1981 report is not assessed in terms of the assumptions and theoretical shortcomings of economic impact methods present in all impact studies. Rather, the chapter examines the problems specific to the 1981 impact report.

The 1981 economic impact study of Fraser Port used the 1979 (Arthur D. Little Inc.) *Port Economic Impact Kit* as its template. The procedures of the impact kit involve identification of port-industry and port-dependent industries, a survey of firms for revenue, expenditure, and employment data, determination of the economic base of each industry sector, calculation of economic base multipliers, and the presentation of results. The kit also recommends the use of input-output multipliers where available.

4.1: Results of the 1981 Fraser Port Economic Impact Study.

The Fraser Port study assesses ten industry sectors based on 1980 data. Each industry sector is evaluated for its employment, labour income, and sales impacts. Initially, the report divides port activity into port-industry and port-dependent

categories; however, no such categories appear in the final results section. The following industry sectors are assessed and impacts presented as shown below:

1. Business and engineering services
2. Chemicals
3. Fishing
4. Manufacturing
   boat building, seafood processing
5. Metal fabricating industries
6. Non-metallic industries
7. Other services
   marinas, moorage
8. Trade
   automobile importers, importers, sales
9. Transportation
   customs brokers, freight forwarders, railroads, shipping agents, stevedoring, terminals, towing, trucking,
10. Wood products
    wood manufacturing, log storage

The economic base technique was used to determine employment and labour income multipliers. Location quotients identified basic activity. Employment multipliers estimated by using the base technique range from 1.45 for wood industries to 3.48 for other services. Port-industry related multipliers include 1.39 for shipbuilding and repair, 3.07 for transport industries, and 2.57 for trade related industries. Income multipliers were also estimated and were identical to the employment multipliers. Following the assessment of a total impact for each sector, the results were combined to produce total employment and income impacts of Fraser Port. The study did not provide separate results for port-industry and port-dependent categories.

A total sales impact was determined from the results of the economic base analysis based on labour income to sales ratios. Ratios were calculated for each sector by

using direct income data from the study's income impact calculations, and direct sales data from the survey results. Total sales impacts were then determined by dividing total labour income by the income to sales ratio.

Input-output sales multipliers from *An Interindustry Study of the Vancouver Lower Mainland* by Davis (1974) were also used to estimate total sales impacts, which were then compared to the economic base results. Davis' multipliers include 1.69 for trade and transport industries, and range from a low of 1.49 for wood industries to 1.97 for non-metallic products. Note that the Davis I-O multipliers produce both indirect and induced impacts while an economic base multiplier produces only induced impacts. The economic base results exceeded the I-O impacts by 40%.

The total economic impact figures from the 1981 Fraser Port Economic Impact Study are:

direct employment impact	10,897
total employment impact	33,211
(in full-time equivalent positions)	
direct income impact	$250,603,000
total income impact	$767,314,000
direct sales	$2,104,964,000
total sales	$5,149,758,000
total sales (I-O multipliers)	$3,442,766,000

4.2: Review of the 1981 Results.

Do the results of the 1981 report overstate the economic activity of Fraser Port? An economic impact is a result of a project or activity that injects or sustains a monetary flow into a region. Economic impact studies estimate the direct and

secondary effects of that flow. In 1981, Fraser Port was said to create over $5 billion of total sales, over $767 million of total labour income, and over 33 thousand total employment positions. The study implies that these impacts occurred as a result of the operation of Fraser Port. While the production and service activity assessed in the study may produce such impacts, the Port is not the creator as the economic impact assessment implies. The operation of the wood industry in B.C., for example, is not an indirect or induced result of Fraser Port. In short, the 1981 Fraser Port study overstates the economic impacts generated by the operation of the port.

The overstated impact estimates of the Fraser Port study are the result of several errors. To begin, the aggregation of port-industry and port-dependent categories was incorrect. Second, the analysts did not rigourously establish the existence of dependency between the port and its "port-dependent" producers. Third, the report erroneously presented the results as total, direct and indirect impacts by misunderstanding the product of base multipliers. A final concern involves the estimation of secondary impacts. The analysts were faced with a lack of employment and income data for several industry sectors. To overcome this problem, previous growth rates were used to update the last available figures. This procedure produced several incorrect base estimates and subsequently produced inaccurate base multipliers. The following discussion expands on these problems.

4.3: The Division of Port Activity.

The 1979 *Port Economic Impact Kit* instructs analysts to divide primary, or direct, activity into port-industry and port-dependent categories, and to maintain the separation during and after the assessment (Arthur D. Little Inc., 1979). The final

results then reveal the economic impact of the port divided into port-industry and port-dependent portions. Problems created by aggregating the two categories are twofold: (1) the assessment does not reveal impacts related to the expenditures of port activities; (2) the port-industry impact is double-counted when it is added to port-dependent industry.

The formalization of the port-industry definition provides a basis upon which port analysts can effectively focus on activity directly related to port operations. As stated in the MARAD 1978 *Economic Impact of the U.S. Port Industry* the "definition [is] based on a new system concept which [takes] into account the total function of ports as providers of specific and distinguishable services in the movement of waterborne cargo" (p. 17). The definition provides an identification of activities to include in the primary impact of a port. From this primary base, an assessment can then estimate impacts related to the expenditures of "port activity."

The 1981 study did not retain the definitions of port activity outlined in the impact kit. Subsequently, what is actually assessed in the report is not clear. Port activity mixes with production activity, business activity, and primary activity. An understanding of the flow of impacts is not apparent in the analysis, and creates a high probability of double-counting as each activity relies on the other for goods and services and the spending of incomes flows into various sectors.

Double counting is the result of adding the same impacts twice. Expenditure flows follow indirect and induced channels until leakages deny any further spending. If activity from those indirect or induced channels is considered part of the direct impact, then estimating the spin-off effects through multiplier analysis will double count the indirect activity and all its secondary spending. For example, if activity A

has secondary impacts of b, c, and d, then the total impact of activity A = A + b + c + d. If activity b is also assessed for its impacts and added to the total impact of A, then b and all its secondary impacts are counted twice: i.e., the total impact would be A + b + b + c + d. Assessing and presenting A and b's impacts separately avoids this problem.

This double-counting scenario occurs in the 1981 Fraser Port study. Transportation, business, engineering, and other services are indirect impacts of the producing sectors that make up the port-dependent category. Adding port-dependent impacts to port-industry impacts double-counts the impact of port-industry activity.

4.4: Port Dependency.

The object of assessing port-dependency is to determine the portion of a business' activity that relies on the existence of the port (Port Authority, 1978; 1982). To include an industry in the port-dependent category, a dependent relationship must be established between the port and industry, that is, without the port, dependent activity would cease to operate. If dependency is not established, the port-dependent results cannot be attributed to the port. As the 1982 port impact handbook states: "if the locational dependence of an industry on a port can be established, then ... analysis can be used to assess the impacts of that industry on the region" (MARAD, 1982, p. 18).

Port dependency, strictly defined, assumes that alternate port facilities or transport modes are unavailable. In Vancouver, where alternate ports exist, this dependency is extremely difficult to determine. The 1981 report did not sufficiently

justify dependency between industry and Fraser Port. The survey questionnaires used in 1981 queried businesses about the amount of business activity that occurred with Fraser Port, but not about activity that occurred because of Fraser Port. The report attributed $5 billion of sales activity to Fraser Port, yet the processing activity was not dependent on the port. In consequence, the impacts should not be presented as resulting from port operations.

Fraser Port does not create the production, export, and import activity that uses its facilities. However, Fraser Port does generate the activity directly related to the movement of cargo, or the port-industry activity. While production activity results from the port's demand for goods and services, this portion is captured in the assessment of the port-industry activity. The port-dependent activity in the 1981 Fraser Port study should have been presented separately and in the context of impacts related to, or associated with, Fraser Port.

4.5: Incorrect Presentation of Results.

The study presents the results as total (direct plus indirect) impacts. However, an economic base multiplier does not estimate indirect impacts. The multipliers used in the study generate induced impacts. Thus, the study's representation of the results is inappropriate and misleading.

The base model produces, through its "consumer spending multiplier, the total (direct + indirect + induced) component" (Davis, 1990, p. 93). However, the report states that the results are the total (direct and indirect) impacts. When using a base multiplier the multiplicand should consist of the direct and indirect impacts associated with the activity under assessment. The direct and indirect activity is

then multiplied by an induced multiplier, thereby deriving the total (direct, indirect, and induced) impacts. Omitting the indirect impacts from the analysis underestimates the full extent of the total impacts.

The input-output multipliers used in the study are from a closed version of the Vancouver Metropolitan I-O model; thus, they include indirect and induced portions of the secondary impact (Davis, 1974).

For non-economists this difference may seem trivial; however, if the goal is a proper understanding of Fraser Port impacts, the figures are misleading. Economists reviewing the impact figures, but not the methodology, would assume that the total, direct plus indirect plus induced, impact of Fraser Port would significantly exceed the $5 billion figure presented in the study.

The preceding three arguments - separation of port-activity, dependency between port and industry, and presentation of impact results - can be taken a step further: the final Fraser Port figures do not reflect the impact of Fraser Port, but the total impact of the exporting sectors assessed in the report. As stated, the direct and indirect impacts belong in the multiplicand of an economic base multiplier analysis; the result being the total impact of direct activity. The so-called port-dependent industries purchase goods and services necessary for their operation. This spending creates the indirect impacts of the exporter category. Included in these indirect impacts are the services of shippers and transportation activity. Thus, Fraser Port is an indirect impact of the study's port-dependent industries. Combining the two groups and applying base multipliers yields the total (direct, indirect, and induced) impact of the exporter group, not the Port. Thus, the $5

billion attributed to Fraser Port is the impact of the industries considered port-dependent.

A separate treatment of port-industry and port-dependent industries would have established truer results. The importance of this separation was apparently not fully understood by the 1981 analysts. Perhaps, however, the 1979 Impact Kit did not stress or explain the importance sufficiently. A separate treatment of port-industry activity reveals a more realistic portrayal of Fraser Port activity.

A separation of the 1981 results is undertaken in section 6.11 of Chapter 6. The results are then compared with the 1993 estimates. While the adjusted results are not corrected for their upward bias due to the higher base multipliers, a cautious comparison is possible.

4.6: Calculation of the Secondary Impact.

A problem encountered by the analysts was a lack of regional employment and income data for five of the ten industry sectors. To overcome this deficiency, the analysts used industry employment and population growth rates for the 1961-1971 period to update employment figures from 1971 to 1980. This assumes that the 1971-1980 period enjoyed economic conditions and growth levels similar to the 1960's. This assumption is unwarranted and resulted in an incorrect estimation of base activity and subsequent multipliers.

The estimated 1980 employment figures were used to determine the export base using location quotients. Location quotients were introduced in Chapter 2. A location quotient (LQ) is defined as:

$$LQ_i = (R_i/R)/(N_i/N),$$

where R_i is the amount of regional employment in sector i; R is total regional employment; N_i is the national employment in sector i; and N is total national employment (Davis, 1990).

The following growth formula was used to estimate 1980 industry employment levels from 1971 employment data. A ratio of the percentage growth in employment of industry i from 1961-1971, to the percentage growth in population for 1961 to 1971 was multiplied by the population growth for the years 1971 to 1980. The product is the percentage increase in industry employment in that sector from 1971 to 1980. The percentage increase was then applied to appropriate industry employment levels of 1971 to produce an estimated 1980 employment figure. The process mathematically is:

$$\%L_{i(61\text{-}71)} / \%P_{(61\text{-}71)} * \%P_{(71\text{-}80)} = \%L_{i(71\text{-}80)}$$

where $\%L_{i(61\text{-}71)}$ is the percentage change in employment in industry i from 1961 to 1971; $\%P_{(61\text{-}71)}$ is the percentage change in population from 1961 to 1971; $\%P_{(71\text{-}80)}$ is the percentage change in population from 1971 to 1980; and $\%L_{i(71\text{-}80)}$ is the estimated percentage change in employment in industry i from 1971 to 1980. The estimated level of employment is then calculated as:

$$\%L_{i(71\text{-}80)} * L_{i71} = L_{i80}$$

where L_{i71}, L_{i80} is the level of employment of industry i in 1971 and 1980 respectively.

Using non-metallic industries as its example, the 1981 study estimated the 1980 level of non-metallic industry employment at 3,787. The LQ was estimated to be 1.2, hence basic employment was thought to exist.

Basic employment is equal to $R_i - R(N_i/N)$ where R_i is actual regional employment in sector i, and $R(N_i/N)$ is an estimate of regional employment needed to satisfy local demand (Davis, 1990). The estimate, $R(N_i/N)$, was estimated as 3,187. Thus, the basic portion of non-metallic industries equals 600 (3,787 - 3,187). A multiplier of 2.7 was derived using this data.

That the above calculation is in error can be inferred from the 1981 Census results. Non-metallic industry employment in 1981 was 3,115 for the Vancouver Census Metropolitan Area. The location quotient for non-metallic industries equals 0.83*. Therefore, according to the technique, no base activity exists. The accuracy of the location quotients used in the analysis is questionable, especially given the extrapolation of data from previous growth rates. The study's 1980 non-metallic employment estimate is based on a 1961-1971 growth rate of 32.4%. However, from 1971 to 1981, employment growth based on Census data for non-metallic industries was 8.9%. Also, the average rate of GDP growth in the 1970's was 5%, while the 1960's increase was over 6% (Statistics Canada, 1988).

4.7: Conclusion and Recommendations.

Numerous academic articles exist that question the assumptions, and attempt to overcome the deficiencies, of the techniques used in the 1981 study (Leigh, 1970; Waters, 1977; Chang, 1978; MARAD, 1978; 1981; Arthur D. Little Inc., 1979; Davis, 1985; Yochum and Agarwal, 1987). Unfortunately, inadequate attention was given by the 1981 Fraser Port assessors to the critiques available.

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* $LQ_i = (R_i/R)/(N_i/N) = (3,115/632,191) / (71,295/11,877,035) = 0.83$

The generation of base multipliers contributed to the overstated impacts; however, more damaging was the treatment of the port-industry and port-dependent activity. Taking greater care in defining, categorizing, and assessing the industries included in the study, and in organizing the final direct impact would have contribute to greater accuracy. The port-industry and port-dependent industry must be assessed and presented separately to avoid double-counting the port-industry sector, and consequently misrepresenting the port's role in the region.

Attributing the impacts of port users to the port, without establishing a dependent relationship, implies that the port is essential for production. The 1981 study did not establish that dependency. To have done so would have been a difficult task in the Vancouver region where alternate ports exist. One approach that avoids the need to establish dependency is to admit the impossibility (for most ports) of determining dependency and include all port users. The impact study for this thesis replaced the port-dependent category with a port-associated category. While terminology does not alter a relationship, a caveat accompanying the term is that the impact figures should not be considered a result of port operations, but simply as economic activity associated with the port. The 1985 (Temple et al)*Port Economic Impact Kit* suggests this approach after acknowledging the probable unlikelihood of establishing port-user dependency.

CHAPTER 5: FRASER PORT ECONOMIC IMPACT STUDY METHODOLOGY.

5.1: Purpose and Scope.

The purpose of this thesis is to assess the economic impacts that resulted from the operation of Fraser Port in 1992. The following discussion introduces the definitions of port activity used and presents a practical explanation of the assessment process.

The impact assessment of Fraser Port considers two distinct categories of port activity. The first follows the definition of port-industry discussed in chapter 2. Port-industry is defined as activity that facilitates or is involved in the movement of cargo. The following list presents those businesses considered port-industry:

Terminals	Customs brokers	Shipping agents
Dredging activities	Harbour Commission	Tugs and towing
Pilotage services	Ship chandlers	Ship brokers
Stevedores	Port-dedicated transport	

The second category of port activity is termed port-associated and involves industry activity associated with Fraser Port, but not involved with the movement of cargo. This definition follows the recommendations of the 1985 economic impact kit.

Port-associated activity is comprised of, first, exporters and importers who ship goods via Fraser Port, and second, shipbuilding/repair, and marinas/moorage - activities that are more water related than port related. Because the 1985 impact kit's definition rejected the need to establish a dependent relationship between the

port and its users, no dependency is assumed; thus, attributing impacts to the existence of the port would be erroneous. Port-associated impacts related to imports and exports represent activity that results from the production or distribution of goods shipped through the port; the port's contribution to that impact is through its transshipment function.

Marinas/moorage, and shipbuilding/repair are placed in the port-associated category because they are not necessary for the transshipment of goods. However, these activities are often located at, or near, ports.

All business activity in the port-industry category is located in the Vancouver Lower Mainland. However, the input-output multipliers used to determine the various economic impacts produce estimates at the provincial and national levels. As a result, the derived impact figures relate to B.C. and Canada. But, because the primary port-industry data originates from the Vancouver Lower Mainland, a majority of the B.C. impacts relate to the Vancouver region. The secondary impacts also occur predominantly in the Vancouver area owing to the high concentration of port-related service activity.

Port-associated producers of various food and agricultural products, forest products, mineral products, and chemicals are located across Canada. Shipping agents were unwilling to provide the necessary information to identify the originating province of all exports. To attribute any portion of the goods exported via Fraser Port to any particular province would have been erroneous. Consequently, only the national impacts were determined; no provincial impacts are presented for the port-associated sector.

5.2: Evaluation of Port-Industry and Port-Associated Impacts.

The port-industry and port-associated categories are assessed and presented separately. All collected data and the presented economic impacts relate to 1992. Port activity in the ensuing years will reflect the impacts derived in this study, given stability in cargo tonnages and port handling productivity.

The data required for the study consisted of sales revenue and employment figures, commodity tonnage statistics, commodity price information, and impact multipliers. Data sources included direct survey information, Statistics Canada import and export data, the Statistics Canada Input-Output Division, and the Fraser River Harbour Commission and its associated terminals.

5.2.1: Port-Industry Methodology.

Estimating the economic impacts of port-industry activity involved identifying firms with business connections to Fraser Port facilities, surveying the firms for employment, income, and corporate tax data, and analyzing the data for the total impact on the province and nation.

The following steps were used to determine the direct and secondary impacts of the port-industry sector:

1.) Identification of Port-Industry Firms:

Sources for the port-industry company data base include the 1981 Fraser Port economic impact study survey list, selected issues of Harbour and Shipping

Magazine, the Fraser River Harbour Commission, and Fraser Port terminals. The initial list contained approximately 200 firms. Telephone contact was made with each company to determine its relevance to the study. The final number of companies included in the port-industry category totalled 128 (see Appendix 6).

2.) Survey Questionnaire Process:

A survey of the 128 firms was necessary to obtain relevant employment and labour income data (see Appendix 1 for a list of companies surveyed). Each of the companies received a survey by mail or fax. All 128 companies were contacted with 94, or 73.4%, providing the requested information. The remainder were either not involved with Fraser Port, or not interested in completing the survey questionnaire. This response rate is considered high. Discussion with Commission officials determined that the majority of Fraser Port business activity was captured in the 73% response rate. Information from non-response companies deemed important was extrapolated from returned survey information, or was estimated by Harbour Commission officials.

The port-industry survey questionnaire was designed for simplicity to ensure a high response rate. The questionnaire was developed after reviewing several port questionnaire formats and through discussion with port officials, industry specialists, and analysts at the Input-Output Division of Statistics Canada. The questionnaire contained three questions: operating or sales revenue, employment, and corporate taxes paid to government. The port-industry questionnaire is presented in Appendix 2.

After two weeks from the original date of mailing, companies who had not responded were contacted by telephone. Each subsequent week, contact was made with non-response companies to obtain the survey data. The entire process took approximately eight weeks to complete. To ensure confidentiality, all survey responses were destroyed following the transcription of data.

3.) Aggregate Firm Responses:

A Lotus 123 spreadsheet was used to organize and aggregate the survey responses. The data was compiled into seven Standard Industrial Classification (SIC) categories: SIC 455, services incidental to water transport; SIC 412, highway and heavy construction; SIC 453, railway transport industries; SIC 454, water transport industries; SIC 456 truck transport industries; SIC 459, other services incidental to transportation; and, SIC 779, business services. The spreadsheet was designed to aggregate the data and estimate the direct, indirect, and induced impacts. See Appendix 2 for the summary aggregation and multiplier calculations.

4.) Statistics Canada GDP, Employment, and Labour Income Multipliers:

Direct and indirect GDP, employment, and labour income multipliers were obtained from Statistics Canada. The GDP and labour income multipliers are based on one dollar of output while the employment multiplier is based on one thousand dollars of output.

Unfortunately, Statistics Canada no longer produces a closed version of the input-output model that would generate induced multipliers. "[I}t appears preferable ... that Statistics Canada not offer mechanical impact solutions with partial closure on

consumption. Such an analytic tool is too simplistic, and the results may be doubtful and debatable" (Statistics Canada, 1991b, p. 15).

Several reasons for the use of a open I-O model are given by Statistics Canada. One is that only consumer spending is considered within the closed model. Thus, the spending effects of increased profits that can lead to greater capital spending, or research and development is ignored. A second problem involves the homogeneous propensity to consume that is inherent in the I-O model. People of different incomes, different debt loads, from different regions, and with different cultural spending habits reduce the likelihood of a constant propensity to consume. Statistics Canada concludes that "in a more general context ... [t]he value of such a[n induced] multiplier may in fact not be very credible when we consider dimensions such as monetary policy, inflation, interest rates, and exchange rates' (Statistics Canada, 1991b, p. 15).

Induced multipliers were estimated from results of a previous impact study of a Lower Mainland port. The results from the 1990 Vancouver Port Corporation (VPC) economic impact study provided the necessary information to generate induced multipliers for three general categories: terminals, port related services, and transportation. Fraser Port port-industry categories were assessed using the appropriate VPC induced multiplier. While this method provides only an approximation, it does help to reveal the total impact of Fraser Port. However, the reader should be aware of the unsophisticated method used to derive the induced multiplier and the potential for inaccuracy. Please see Appendix 3 for the calculation of the induced multipliers.

5.) Calculation of port-industry impacts:

The sales revenue data provided by the respondent firms was sufficient to generate GDP, employment, and labour income direct and indirect impacts. The provincial and national GDP and labour income multipliers are based on $1.00 of an exogenous industry output shock. The direct and indirect employment multipliers are based on $1,000 of an exogenous industry output shock. Sales figures for each industry sector were multiplied by the appropriate I-O coefficient. For example, to estimate the direct GDP impact of water transport and related services (SIC 455) in B.C., the total sales revenue from that sector, $88,150,347, was multiplied by the direct GDP multiplier of 0.45678. The result, $40,265,315, equals the direct GDP impact generated by the sale of goods and services by water transport industries. The direct plus indirect impacts were estimated using the appropriate impact multipliers provided by Statistics Canada. Induced employment impacts are based on one full-time equivalent position, while induced GDP and labour income impacts are based on $1.00 of direct GDP and labour income respectively. See Appendix 4 for the calculation of provincial and national impacts of the port-industry category.

5.2.2: Port-Associated Methodology.

Port-associated activity is separated into two sections: (1) exports and imports; (2) marinas/moorage and shipbuilding/repair. The port-associated methodology section proceeds first with the export and import categories, followed by marinas/moorage and shipbuilding/repair.

Export and Import Methodology:

The commodities shipped through Fraser Port arrive from, and are destined to, various locations within Canada. Due to the difficulty of accurately determining these locations, the study focuses on the national impacts only. Also, the study presents only direct and indirect impacts of the export and import commodities due to the unavailability of induced multipliers for each industry sector. As a result, the figures given are conservative. The VPC induced multipliers used in the port-industry evaluation are for terminal operations, port-related transportation, and port-related services; thus, they were considered to be inappropriate to use with various commodity producing sectors. The VPC induced multipliers are based on income levels and spending patterns of port related employment and would not accurately reflect the many producing sectors under assessment.

To determine the impacts related to imports and exports, it was first necessary to identify and value the commodities shipped via Fraser Port.

Harbour Commission statistics provided commodity tonnages for domestic and international cargoes. For several commodities - general cargo, chemical, steel, and metal products - the published Fraser Port statistics were too aggregated and lacked descriptive detail to assign values. In order to gain a more detailed account, shipping manifests for 1992 were examined. The manifests provided information that allowed chemicals to be disaggregated into specific organic and inorganic descriptions; steel products were disaggregated by type of steel product, such as plate, rods, or beam. The general cargo category proved most difficult to determine. General cargo consisted of food products, alcohol, construction

materials, household goods, and other miscellaneous products. In some cases, general cargo was described simply as 'general cargo.'

Several sources were used to value the export and import commodities. A survey of producers located along the Fraser River was used to obtain average values for cement, limestone, aggregate, fish, and some forest products. Seventeen producers were surveyed with 100% providing information (see Appendix 1 for a list of surveyed companies). The port-associated questionnaire is found in Appendix 1. The majority of the remaining values were available from Statistics Canada *Export by Commodity* (1992b) and *Import by Commodity* (1992c) releases. Where no exact matches or insufficient commodity detail was possible, an average value of similar products was used. The Council of Forest Industries (COFI) also provided some forest product information. Finally, commodities that could not be valued from the above sources were assessed using an average value of all Fraser Port cargo. See Appendix 5 for a presentation of commodity values and impact calculations.

Estimating port associated impacts:

To determine economic impacts associated with the commodities, a producing sector had to be identified. Domestic outbound, international exports, and domestic inbound cargoes were assessed for their backward linkages to the nation's production process. This was done in two stages: first, the commodity values were assigned to an appropriate producing industry; second, the employment, labour income, and GDP impacts associated with the cargo were estimated using Statistics Canada multipliers. The producing sectors that ship goods via Fraser Port consist of forest products, cement products, chemical

products, agricultural products, non-ferrous metal production, non-metallic mining products, and other export products.

The domestic inbound results should not be added to the impacts of the export sector in order to determine a total impact of port-associated industries. Combining the impacts of inbound commodities with those of outbound commodities would cause partial double-counting of the domestic import results. In 1992, approximately 66% of Fraser Port's total domestic cargo shipments were inbound. Included in this percentage are aggregate, logs, limestone, and gypsum, much of which is processed and later exported via Fraser Port. Subsequently, various imports contribute to the value added of Fraser Port exports.

To estimate impacts related to international imports, the forward production linkages of commodities arriving at Fraser Port would have to be identified. The difficulty in determining the economic contribution of international imports stems from the virtual impossibility of tracing their final destination, or forward linkage, to the economy. Imports such as steel products, for example, are used in the fabrication of numerous articles whose final shape is indeterminable at the semi-processed stage. Commission statistics did not reveal final or intermediate destinations, and shipping agents would not provide specific customer information; thus, international imports could not be assigned to any one receiving sector of the economy. As a result, international imports are only presented for their value

Marinas/Moorage and Shipbuilding/Repair Methodology:

The assessment of marinas/moorage, and shipbuilding/repair activity was similar to the method used for the port-industry category; however, only direct and indirect

impacts are presented The relevant businesses were surveyed for their business activity and GDP, employment, and labour income impacts were calculated using Statistics Canada direct and indirect multipliers. All companies in this category provided the necessary information. A list of these port-associated companies can be found in Appendix 1. Caution should be taken when interpreting the results of the shipbuilding category because of the yearly fluctuation in shipbuilding activity. For example, in 1992, a Fraser River shipyard was engaged in the construction of a B.C. ferry and employed an unusually large workforce.

5.3: Conclusion.

The port-industry assessment focuses on the economic impacts generated by the daily operations of Fraser Port. The assessment provides an insight into the port's operation, the magnitude of its role as an economic generator, and specifically its economic contribution to the local, provincial, and national economies. The most appropriate reflection of Fraser Port's economic role in the region evolves from the port-industry assessment.

The results of the port-associated section reveal economic impacts in the national economy that various commodities shipped via Fraser Port generate. Fraser Port's significance in this impact results from being a component within the transportation network. The port takes part in the transportation and distribution process, but one should not consider it essential for the production or existence of an industry producing or receiving a good. The port-associated analysis quantifies the economic activity that the port is associated with, not what the port creates as a result of its daily operation.

CHAPTER 6: FRASER PORT ECONOMIC IMPACT ASSESSMENT RESULTS.

The results of the Fraser Port economic impact assessment are presented in two parts: port-industry impacts, and port-associated industry impacts. The chapter continues with a comparison of the current 1992 Fraser Port results with the 1981 study of Fraser Port, and the 1990 economic impact study of the Vancouver Port Corporation.

The port-industry category includes those industries directly involved with the movement of cargo, whether this be handling, brokering, or providing the ability for ships to call at the port. Port-industry includes:

Terminals	Railways
Stevedoring companies	Trucking
Shipping agents	Dredging activities
Tugs and towing	Ship brokers
Pilotage services	Customs brokers
Harbour Commission	Ship chandlers

6.1: Provincial Impacts of Port-Industry Activity.

Direct sales revenue for the port-industry community totalled $258,755,484 in 1992. This revenue translated into payments for services, goods, and wages that produce secondary impacts. Table 6.1 shows the GDP, employment, and labour income impacts for port-industry firms in 1992 (all figures shown are in 1992 dollars).

Table 6.1: Economic impact of the port-industry sector, B.C., 1992.

	GDP ($)	Employment*	Labour Income ($)
Direct Impact	124,625,526	2,113	93,601,119
Indirect Impact	63,307,019	801	40,688,239
Induced Impact	60,272,072	474	35,343,143
Total Impact	248,204,617	3,389	169,632,501

Gross domestic product (GDP):

The port community contributes to the value of goods shipped and as such, adds to the GDP of the region and nation. In 1992, Fraser Port contributed over $124.6 million of direct GDP to the province of B.C.

The successive rounds of secondary economic activity increased the GDP impact of Fraser Port by over $123.5 million . The total GDP impact in B.C. of Fraser Port reached approximately a quarter of a billion dollars in 1992.

Employment:

The various businesses included in the port-industry category provide direct employment for 2,113 full-time equivalent positions. The largest employers are terminal operators, followed by tug and towing companies operating on the Fraser River.

The expenditures of port-industry businesses for goods and services, and for wages and salaries create numerous opportunities for the non-port community. This spending created an additional secondary impact of 801 indirect jobs and 475

* Measured in terms of full-time equivalent positions.

induced employment opportunities. In 1992, the total employment impact in B.C. of port-industry activity was 3,389 full-time equivalent positions.

Labour income:

The port community provided its workers with over $93 million of direct wages and salaries. That payroll provided, on average, a salary of approximately $44,000 per direct worker. A further $76 million of secondary labour income brought the total impact of the port-industry community to over $169.6 million.

6.2: National Impacts of Port-Industry Activity.

The economic impacts of the port-industry community extend across Canada. Table 6.2 shows the B.C. and Canadian impacts for port-industry firms.

Table 6.2: Total economic impacts for B.C. and Canada.

	Total GDP ($)	Total Employment*	Total Labour Y ($)
B.C.	248,204,617	3,389	169,632,500
Canada	274,082,396	3,764	187,758,391

* Measured in full-time equivalent positions.

In 1992, port-industry activity contributed over $274 million of GDP to the Canadian economy. The total employment impact across Canada resulting from the operation of the port was approximately 3,764 full-time employment positions. The total labour income impact exceeded $187.7 million, or over $49,000 per port related employee.

6.3: Economic Impact of the Port-Associated Sector.

The port-associated sector includes the many importers and exporters who use Fraser Port to ship goods. The commodities arrive from and are destined to various locations throughout Canada. Establishing the final destination of any commodity is problematic as such specific cargo information is unavailable. Consequently, the impacts discussed below reflect Canada as a whole. Further, international imports are presented for their value only, because of the inability to accurately determine a final or intermediate destination.

The port is also associated with activity attracted to the area for water access, though not directly related to the movement of cargo. Shipbuilding/repair, and marinas/moorage are not directly involved in the movement of cargo, thus are more river related than port related. Nevertheless, they are part of the port or harbour community, and are assessed accordingly in the port-associated section.

6.3.1: Export and Import Commodity Value.

In 1992, over 19 million tonnes of cargo passed through Fraser Port with an estimated value of close to $6.1 billion, $4.2 billion of which results from international exports and imports. Table 6.3 shows the export and import tonnages and dollar values for 1992.

6.3.2: The Export Sector.

As shown in table 6.3, international and domestic outbound cargoes exceeded 9 million tonnes with a value of over $1.3 billion. The economic activity required to produce these commodities is substantial. In terms of direct and indirect GDP

impact, the export cargo contributed over $1.3 billion to the Canadian economy (see Table 6.4). Direct and indirect employment neared 19,000 with a labour income impact of over $641 million (see Tables 6.5 and 6.6).

Table 6.3: Total inbound and outbound tonnages and values, 1992.

	Tonnes	$ Value
Total Outbound		
Domestic	7,544,665	925,706,056
International	1,459,266	378,719,967
Total	9,003,931	1,304,426,024
Total Inbound		
Domestic	9,900,788	940,830,802
International	806,073	3,853,770,006
Total	10,706,861	4,794,600,808
Total Outbound and Inbound		
Domestic	17,445,453	1,866,536,858
International	2,265,340	4,232,489,973
Total	19,710,793	6,099,026,831

Forest products:

In 1992, the forest products sector accounted for the largest share of outbound cargo. Forest products include logs, chips, hogfuel, sawdust, plywood, lumber, shakes and shingles, pulp, and paper. Forest products commanded 83% of all international outbound cargo and 88% of domestic outbound cargo. A total value of approximately $1.1 billion was calculated for this sector (see Table 6.4).

In 1992, the processing of forest products passing through Fraser Port generated over $442.6 million of direct GDP and a further $480.5 million of indirect impacts for a total GDP impact of over $923 million.

Table 6.4: Export sector distribution of port-associated GDP impacts for Canada, 1992.*

Industry Sector	Sector value ($)	Direct GDP Impact ($)	Indirect GDP Impact ($)	Total** GDP Impact ($)
Forest products	1,097,641,655	442,688,475	480,574,443	923,262,918
Cement products	18,180,525	8,921,365	6,229,739	15,151,104
Chemical products	18,868,669	6,689,959	7,515,568	14,205,527
Agricultural products	36,226,325	15,333,517	12,604,333	27,937,850
Non-ferrous metals	11,637,060	3,353,102	5,377,253	8,730,355
Non-metallic mining	4,694,892	2,802,881	1,197,345	4,000,226
Other export products	117,176,898	52,261,344	39,319,877	91,581,221
Total	1,304,426,024	532,050,643	552,818,558	1,084,869,201

* Appendix 5 presents the multiplier calculations of these impacts.
** Total impact includes direct and indirect impacts only.

In terms of employment, the forestry sector associated with Fraser Port generated over 7,900 direct full-time equivalent positions. Indirect employment increased the total number of positions to over 16,000. Table 6.5 shows the industry sector employment for 1992.

Direct labour income in the forest products sector equalled approximately $288 million, or over $36,000 per employee per year. The indirect impact totalled in excess of $280 million for a total direct and indirect labour income impact of approximately $568.2 million (see Table 6.6).

Cement products:

Cement products had a total domestic and international export value of approximately $18 million in 1992. The direct GDP impact associated with this

production activity was $8.9 million; the multiplier effects contributed a further $6.2 million for a total direct and indirect impact of over $15 million.

Table 6.5: Export sector distribution of port-associated employment impacts for Canada,1992 (in full-time equivalent positions).*

Industry Sector	Direct employment	Indirect employment	Total** employment
Forest products	7,934	8,803	16,737
Cement products	160	109	269
Chemical products	108	108	216
Agricultural products	296	228	524
Non-ferrous metals	47	79	126
Non-metallic mining	39	22	61
Other export products	1,015	709	1,724
Total	9,599	10,058	19,657

* * Appendix 5 presents the multiplier calculations of these impacts.
** Total impact includes direct and indirect impacts only.

The direct employment impact of the production of cement passing through Fraser Port was approximately 160 and contributed to a total employment impact of 269. Direct labour income in the cement products category bettered $5.5 million and led to a further $3.5 million of indirect impacts for a total labour income impact of over $9 million.

Chemical products:

Approximately 5,422 tonnes of chemicals were shipped through Fraser Port in 1992 with a value of over $18.8 million. The direct GDP impact of the chemical production approached $6.7 million with a total direct and indirect GDP impact of $14.2 million.

In terms of employment, the chemical industry associated with Fraser Port provided over 100 direct jobs and over 200 direct and indirect full-time equivalent opportunities. The direct labour income of the associated chemical products industry surpassed $3.4 million with a total labour income impact nearing $7.1 million.

Agriculture and food products:

In 1992, Fraser Port agriculture and food product exports included lentils, canary seeds, canned seafood, sugar, and other processed and semi-processed goods. A total of approximately 46,000 metric tonnes of food were exported via Fraser Port in 1992. The approximate value of the food products was in excess of $36 million.

The direct GDP impact in Canada associated with the food products reached $15.3 million. Adding the indirect multiplier effects brought the GDP contribution to a total impact of approximately $28 million.

In 1992, direct employment related to the agriculture and food products reached 296, with a direct labour income impact of approximately $9.5 million. The total direct and indirect employment impact surpassed 500. Direct and indirect labour income in the agricultural sector was greater than $18 million.

Non-ferrous metal production and non-metallic mining:

Non-ferrous metal products include nickel, zinc, and other non-iron based metals. Approximately 4,865 tonnes of non-ferrous mineral products were shipped through Fraser Port in 1992. The value of these products was $11.6 million.

Table 6.6: Export sector distribution of port-associated labour income impacts for Canada, 1992.*

Industry Sector	Direct labour income ($)	Indirect labour income ($)	Total** labour income ($)
Forest products	288,164,056	280,067,879	568,231,935
Cement products	5,572,513	3,472,455	9,044,968
Chemical products	3,431,743	3,646,488	7,078,231
Agricultural products	9,497,093	8,520,745	18,017,838
Non-ferrous metals	1,819,803	2,564,013	4,383,816
Non-metallic mining	1,339,286	697,366	2,036,652
Other export products	33,216,151	26,469,704	59,685,855
Total	343,040,645	325,438,650	668,479,295

* Appendix 5 presents the multiplier calculations of these impacts.
** Total impact includes the direct and indirect impacts only.

As Tables 6.4 - 6.6 indicate, the production and distribution of these metals contributed $3.3 million direct GDP and $8.7 million total GDP to the nation's economy. The production was made possible by 47 direct and 126 total full-time positions, with a direct labour income of $1.8 million and a total labour income impact exceeding $4.3 million.

Non-metallic mineral products exported via Fraser Port include aggregate, gravel, rock salt, and limestone. The cargo had a value of approximately $4.7 million with a direct GDP impact of $2.8 million and a total GDP impact across Canada of over $4 million. Direct employment was 39 and total employment reached 61. Direct labour income was over $1.3 million and contributed to a total impact of $2 million.

Other export products:

Other export products include scrap steel, machinery, equipment, and other unspecified cargo shipped in containers. An approximate value of these cargoes is $117 million. An estimation of the contribution to the economy includes $52 million in direct GDP across Canada, over 1,000 direct full-time equivalent jobs, and over $33.2 million in direct labour income.

6.3.3: Fraser Port Imports.

In 1992, 10,706,861 tonnes of international and domestic imports passed through Fraser Port. The total value approached $4.8 billion with international imports accounting for 80% (see Table 6.3).

International Imports.

In 1992, the value of international imports reached over $3.8 billion. Automotive imports led the international import sector with a value of approximately $3.5 billion. The second largest import category was steel products with a total landed value of approximately $209.9 million. An estimated $10.4 million of food products entered Canada through Fraser Port. Food products ranged from soft drinks, to wine and other alcohol products, to pasta and coffee. The remainder of the international import commodities includes $2.4 million of non-ferrous metals, wood products valued at $855 thousand, $20.5 million of heavy equipment, and approximately $52 million of general cargo. Table 6.7 presents the values of Fraser Port international imports.

Table 6.7: Commodity value of international imports shipped via Fraser Port, 1992.

Import	Value ($)	Import	Value ($)
Automotive Products	3,566,085,530	Non-ferrous Metals	2,448,531
Food Products	10,406,076	Wood Products	855,432
Steel Products	209,910,735	Heavy Equipment	20,558,082
General Cargo	52,506,691	**Total**	**3,862,771,077**

Domestic Inbound Commodities.

The domestic inbound category includes forest products, aggregate and gravel, gypsum, limestone, coal, steel, fish, and general cargo. In 1992, a total value estimated for this sector was over $940.8 million. Forest products dominate the category with a 90% share of the total value. The figures provided relate to production in B.C. The domestic inbound results should not be added to results of the export category. For example, gypsum, aggregate, gravel, and limestone are used in the production of goods that are later exported via Fraser Port. Thus, the export impact includes portions of the domestic inbound impacts. Because the commodities are arriving via the water, it is assumed that the originating and impacted province is B.C. Statistics Canada (1992a) reveals that domestic waterborne trade in B.C. is virtually all intra-provincial with an almost 1-1 relationship between domestic outbound and inbound shipments. Table 6.8 shows the domestic inbound commodity values and GDP, employment, and labour income impacts for 1992.

GDP impact:

In B.C., the direct GDP contribution of industries producing domestic inbound products was approximately $315.7 million. The total direct and indirect GDP

impact of the domestic inbound sector approached $656.5 million. The direct GDP impact of the forest industry was $282.8 million, with indirect impacts contributing to a total impact of $596.8 million.

Table 6.8: Domestic inbound commodity values and GDP, employment, and labour income impacts for B.C., 1992.

Commodity	Value	Direct GDP Total GDP	Direct Employ. Total Employment	Direct Labour Y Total Labour Y
Forest products	848,359,055	282,817,378 596,782,865	6,051 11,992	249,014,727 433,796,876
Aggregate/gravel	11,330,207	3,274,883 7,711,452	143 211	3,274,883 4,990,956
Gypsum	4,797,325	1,386,619 3,265,107	61 89	1,386,619 2,113,222
Limestone	4,500,000	1,300,680 3,062,745	57 84	1,300,680 1,982,250
Coal	505,000	240,309 339,754	6 8	161,019 223,473
Steel	3,664,033	1,118,593 1,742,321	19 31	850,019 1,296,042
Fish	53,202,300	21,153,767 33,862,732	503 751	16,799,158 24,507,959
General cargo	14,472,882	4,445,490 9,681,538	114 218	3,992,312 6,583,505
Total	940,830,802	315,737,719 656,448,515	6,954 13,389	276,779,418 475,494,282

Employment impact:

The number of full-time equivalent workers directly employed by the associated industries was 6,954. A indirect impact of 6,435 employment opportunities brought the total direct and indirect impact to 13,389. The forests sector related to Fraser Port domestic imports contributed 6,051 direct jobs and 11,992 direct and indirect jobs to the B.C. economy.

Labour income impact:

In terms of labour income, the direct impact of domestic imports was approximately $276.8 million. The total direct and indirect labour income impact neared $475.5

million. Direct labour income related to the forest industry accounted for $249 million in B.C. with a further $184.8 million in indirect labour income.

6.3.4: Shipbuilding/Repair and Marinas/Moorage.

The following section outlines the impacts of shipbuilding/repair, and marinas/moorage. The figures for shipbuilding/repair should be viewed with caution due to the yearly fluctuations in construction activity. Vitos' Shipyard activity included construction of a superferry for the B.C. Government that substantially increased shipbuilding activity within Fraser Port in 1992 and 1993. Impacts are provided for B.C. and Canada, and the secondary impact includes indirect portions only. Table 6.9 shows the GDP, employment, and labour income impacts for B.C. and Canada.

Table 6.9: Economic impacts for B.C. and Canada, 1992.

	GDP Impact ($)	Employment Impact*	Labour Income Impact ($)
Direct (BC)	16,779,738	421	16,172,768
Indirect (BC)	3,487,971	90	2,477,297
Total B.C.	20,267,709	511	18,650,065
Total Canada	35,581,246	819	24,591,344

*Full-time equivalent positions.

GDP impact:

In 1992, the provincial direct GDP impact of this port-associated category reached approximately $16.8 million. The total direct and indirect GDP impact in B.C. was $20.3 million. Across Canada, this port-associated activity contributed $35.6 million to the nation's GDP.

Employment impact:

Direct port-related activity employed 421 persons, with shipbuilding/repair jobs accounting for the greatest share at 367. Indirect impacts consisted of 90 employment positions, bringing the total employment impact in B.C. to 511. Further opportunities across Canada brought the national total to 819 full-time equivalent positions.

Labour income impact:

The provincial direct labour income impact of these port-associated activities approached $16.8 million. Shipbuilding/repair accounted for $15.3 million. Total labour income in B.C. reached $18.6 million and close to $24.6 million across Canada.

6.4: Comparison of the 1981 & 1992 Fraser Port Economic Impact Studies.

A comparison of the 1981 and 1993 studies is possible if the port-industry impacts from 1981 are separated from the report's tables. Caution must be taken when interpreting the results given the use of different multipliers. Also, the figures generated for the 1981 study are based on 1980 data and relate to the Vancouver Census Metropolitan Area (CMA), while the 1992 results reveal provincial impacts. However, as stated in Chapter 5, with sources of primary data and a concentration of service activity centred in the Vancouver area, a majority of the 1992 B.C. impacts are attributable to the Lower Mainland. Figures are adjusted to 1986 dollars based on the Statistics Canada Consumer Price Index for the Vancouver CMA (Greater Vancouver Regional District, 1993).

In 1980, port-industry activities generated approximately $169,343,460 in direct sales revenue compared to $188,891,503 in 1992. A 12% increase in sales revenue occurred over the eleven years.

From 1980 to 1992, direct Fraser Port employment increased by 17% from 1,810 to 2,113. Direct labour income increased by 22%, from $55,958,910 to $68,328,817. In terms of direct labour income per employee, workers employed in port-industry activities earned an average wage of approximately $30,917 in 1980. By 1992, the average wage had increased by 5% to $32,337.

6.5: Comparison of Fraser Port and Vancouver Port Corporation Port-Industry Results.

In 1990, the Vancouver Port Corporation (VPC) released an economic impact study (Coopers and Lybrand,1990). The definition of port-industry used in the VPC study is identical to that used for the Fraser Port study. Both studies also used the Statistics Canada Interprovincial I-O model to generate direct and indirect impacts; induced impacts used in the Fraser Port study were estimated using VPC study results (see Appendix 3). The comparison is made here to examine the relative position of Fraser Port in the region, and to assess the accuracy of the Fraser Port results.

As shown in Chapter 3, VPC handles over 3 times the tonnages as Fraser Port, with 63 million tonnes compared to 19.7 million tonnes respectively in 1993. In terms of total GDP, the VPC generated approximately $923.1 million in B.C., compared to 248.2 for Fraser Port. Across Canada, the total GDP impact of the

VPC and Fraser Port reached $1,028.8 million and $274.1 million respectively. The results can be compared by looking at the ratio of GDP per tonne. The VPC ratio, using the figures for B.C., reveals a GDP per tonne of $14.65; the Fraser Port figures for B.C. produce $12.60 of GDP per tonne. The difference between the two ratios may be explained by the variability in cargo type and commodity value associated with each port. The relative closeness of the ratios, hence, lends justification to the Fraser Port results.

Further comparisons between the studies are possible. Examining labour income reveals that the studies have comparable impact results. The average direct income impact from the Fraser Port study is approximately $44 thousand compared to a VPC average direct wage of approximately $46 thousand. Tables 6.10 compares labour income and employment impacts for the Vancouver Port Corporation and Fraser Port.

Table 6.10: Comparison of VPC and Fraser Port port-industry employment and labour income impacts for B.C., 1992.

	Direct employment	Total employment	Direct labour income*	Total labour income	Average direct income
Fraser Port	2,113	3,389	$93.6	$169.6	$44,298
Port of Vancouver	9,165	14,501	$427.5	$775.3	$46,645

*In millions.

6.6: Conclusion

This chapter reveals the economic significance of Fraser Port in terms of its contribution to the employment, labour income, and gross domestic product of B.C. and Canada. The port-industry category describes the day to day operation of port services, from the loading and unloading of cargo to the many services essential

for the movement of cargo. The port as a generator of economic activity is reflected through the port-industry activity.

The chapter also discusses the many goods that are transshipped via the port. The value of these shipments and the economic activity required to produce them is described in the port-associated category. This activity, however, should not be attributed directly to the existence of Fraser Port. With the location of the Port of Vancouver, North Fraser Port, Prince Rupert Port, and the port system of Washington State, it is unlikely that the demise of Fraser Port would entirely disrupt the production of its port-associated customers.

In comparison to the Port of Vancouver, Fraser Port is dwarfed in terms of quantity and value of cargo. However, the relative contribution of Fraser Port is comparable, although that may be more a reflection of regional union cohesiveness and employer organizational collaboration than for any reasons of productivity. The comparability between results perhaps best serves as a check for the Fraser Port figures.

CHAPTER 7. SUMMARY AND CONCLUSIONS.

This chapter summarizes the relevant points of discussion and the results of the analysis. It also discusses some conclusions that may be deduced from the results and process of impact identification. Included in the conclusion are perspectives on the application of impact assessment theory, and problems encountered during research.

7.1: Summary.

The purpose of this thesis is twofold: first, it is a study of the practical application of economic impact analysis; and second, it is an examination of economic impact methodology in general, and port economic impact analysis in particular. Fraser Port, located in the Lower Mainland of British Columbia, serves as the case study. The thesis attempts to quantify the economic activity directly related to the port's operations. How many jobs does the port help to create? How much income is generated by port related businesses? What is the port's contribution to provincial and national GDP? From an understanding of the direct economic activity of the port, one is then able to estimate, using economic multipliers, the extra, or spin-off, economic activity associated with port related business and personal expenditures.

A port's role in a nation's trading system is to provide transshipment services for exporters and importers. Ports are one of many links in the process of goods production and goods consumption. As such, a port is associated with many industries whose goods are traded around the world. The placement of ports in

this transportation and trading network also creates an attractive location for industries looking to tap into the overseas demand for goods. Thus, the agglomeration of industries near port facilities can be significant. However, a port is also a provider of employment and an important member of the greater regional community.

7.1.1: Port Activity Definitions.

Attempts to define direct port activity have resulted in a standardized port-industry category, and a second more liberally interpreted category of port-users. The definition of port-industry has become accepted as most related to the general operations of the port. Port-industry includes the businesses involved with the movement of cargo and is comprised of shipping terminals, stevedores, Harbour Commission, shipping agents, customs brokers, ship brokers, pilotage services, port-dedicated land transportation, tugs and towing, harbour maintenance services, and ship chandlers.

Port-user activity can have a broader interpretation, thus making its impact figures less comparable across studies. Port-users can include importers, exporters, and other activity not involved with the movement of cargo, but in some way associated with the port, for example found within the port's jurisdiction. Interpretation on this point can be broad from including industry located within the ports jurisdiction and using the port's shipping services to activity located in industrial parks operated by the port, but in no way associated with the cargo entering or leaving the port. An optimal method of assessing the port's contribution to, or impact on, this category remains unclear. Studies by MARAD (1978, 1982) suggest that an industry's dependence on a port must be established prior to assessment. This belief stems

from the perceived intent of a port impact study, which is to determine the economic activity created, or driven, by a port through its daily operation of providing transshipment services. Most ports, however, no longer have a captive shipping market that could be termed dependent. Extensive transportation networks in highly industrialized countries combined with today's competitiveness for the provision of port services means that no one port has a captive market. In British Columbia, several ports vie for cargo activity, while Washington State ports, namely in Seattle and Tacoma, compete directly with B.C. ports for business. As a result, determining any industry-port dependency is difficult.

The position of this thesis, as recommended by the Port Economic Impact Kit of 1985, is to assess the level of activity associated with the cargoes transshipped through the port and to clearly state that dependency should not be assumed. The port-associated category used in this report follows this approach (the latest economic impact study of the Vancouver Port Corporation also adopted this approach, although it calls the activity "port-facilitated"). The port-associated category is comprised of all exporters and importers who ship goods via the port. Two other non-cargo related activities included in the port-associated group are shipbuilding and repair, and marinas and moorage -- activities that, while not involved with shipping or producing cargo, remain related to the port.

7.1.2: Fraser Port.

The Fraser River has been a focal point of shipping activity for over 150 years. Shipping activity at the New Westminster port has waxed and waned over the years, through peace time and war, economic booms and busts. Today, the Fraser River Harbour Commission overseas the operation of the port, its three terminal

facilities, and various commercial land holdings. In 1992, Fraser Port cargo throughput approached 20 million metric tonnes. Automobiles, forest products, steel, lime, gravel, and numerous food products are shipped via the port. In relation to other local ports, Fraser Port is the second largest, being heavily overshadowed by the Port of Vancouver. The operation of the port provides numerous employment opportunities for local workers, and contributes substantially to the GDP of the province and Canada.

7.1.3: Lessons of the 1981 Fraser Port Economic Impact Study.

Prior to commencing the study for this thesis, an examination of an earlier economic impact study of Fraser Port was completed. Several lessons were gleaned from the study. The economic impact study of Fraser Port in 1981 has three major faults: first, it added the port-industry and port-dependent results, thus attributing an overestimated impact to the port. The result was that the study presented an impact related more to the industry shipping goods via Fraser Port, than the port itself. Second, it did not rigourously establish dependency between industry and the port: a requirement suggested by the impact kit that provided direction, and accepted by the 1981 analysts. Third, some of the multipliers used were inflated as a result of the use of a growth model to update ten year old employment data.

To avoid the mistakes made by the previous analysts the following steps were taken. First, the two categories of port-industry and port-associated (equivalent to the 1981 study's port-dependent category) were separated by the method of analysis, and presentation of results. Further, it was clearly stated that the two categories should not be combined to form a total Fraser Port impact. The result

was one presentation of impacts generated by the operation of the port, and another of the industrial activity associated with the movement of cargo through Fraser Port terminals. The second mistake was, thus avoided by analyzing the impacts as discussed. The third problem was overcome by using input-output multipliers from Statistics Canada. By taking these three steps a more accurate and representative picture of Fraser Port activity should result.

7.1.4: Port-Industry Results.

The Fraser Port study uses the most accurate economic impact multipliers available, but they provide only provincial and national perspectives and do not reveal specific regional impacts. As a result of the central location of both the port and its suppliers of goods and services, however, one can assume that a majority of the provincial impacts occur in the Vancouver Lower Mainland. All data collected for this study is for 1992.

To determine the economic activity resulting from the operation of Fraser Port a survey of companies identified as port-industry was undertaken. The survey provided the necessary sales revenue and employment information to produce direct sales and employment impacts. Corporate taxation information was also asked for; however, the response to this question was very poor, and thus not included in the results section. Statistics Canada national and interprovincial direct and indirect GDP, labour income, and employment multipliers were applied to sales revenue data to produce direct and indirect impacts related to Fraser Port operations. To estimate the induced impacts of the direct activity, induced multipliers were determined using the results of the 1990 economic impact study of the Vancouver Port Corporation.

In 1992, Fraser Port directly contributed approximately $125 million to provincial GDP, and a further $124 million of indirect and induced GDP for a total provincial impact of close to a quarter billion dollars. These impacts generate activity throughout Canada. The total, direct, indirect, and induced GDP impact in Canada related to Fraser Port operations surpassed $274 million. Provincial direct employment was approximately 2,113; a further 1,276 indirect and induced jobs brought the total employment impact to roughly 3,389. Across Canada, total employment resulting from Fraser Port operations was close to 3,800 The direct labour income associated with the provincial activity was $93.6 million, and approximately $170 million in total income. The total labour income impact across Canada was approximately $188 million.

7.1.5: Port-Associated Results.

The results of the port-associated category include direct and indirect impacts only, as no industry specific information was available to help determine an induced impact coefficient. The assessment and presentation of port-associated export and import activity is separated into further sub-categories. Domestic and international outbound cargoes comprise one category. Production linkages to this group were easily identified and multipliers were available for each producing sector. Domestic inbound cargo could be easily traced to production activity in B.C., where the relationship between domestic outbound and inbound cargoes is almost 1-1 (this reflects B.C.'s relative isolation from other coastal areas of Canada). International inbound cargoes could not be traced to forward production or consumption with any accuracy. As such, only the dollar value of imports entering Canada via Fraser Port is given.

The above categories should be assessed and presented separately. To aggregate the results to produce a total Fraser Port impact would misrepresent the economic role of Fraser Port and would incorrectly inflate the results. Combining the impacts would cause portions of the results to be double-counted. For example, domestic inbound cargo includes aggregate rock and gravel used in the production of cement products. A portion of the cement products made from those inputs are then shipped out of Fraser Port. Totalling the two impacts would double-count the inbound portion. Combining port-associated and port-industry results is also not recommended, again for reasons of double-counting.

In 1992, Fraser Port's domestic and international outbound cargos were valued at approximately $925.7 million and $378.7 million respectively, for a total outbound cargo value of $1.3 billion. Domestic and international inbound cargoes were valued at $940.8 million and $3.8 billion respectively, for a total of about $4.8 billion. The total value of all commodities passing through Fraser Port in 1992 approached $6.1 billion.

Domestic and international outbound cargo includes forest products, cement products, chemical products, agricultural goods, non-ferrous metals, non-metallic mining products, and various other general cargo goods. The direct and indirect economic activity associated with the production of these commodities includes approximately $1.1 billion of GDP, 19,657 jobs, and an associated $668.5 million in labour income.

Domestic inbound cargoes were associated with $656.5 million of GDP, 13,384 jobs, and $475.5 labour income. The domestic inbound category is comprised of

aggregate and gravel, coal, gypsum, limestone, steel products, fish, and other general cargo. International imports, valued at approximately $3.8 billion, included automobiles and parts, steel, non-ferrous metals,food products, wine and spirits, heavy equipment, wood products, and general cargo.

Shipbuilding/repair, and marinas/moorage businesses located within Fraser Port's jurisdiction added to the economic impact associated with the port. In B.C. in 1992, a total of 421 direct jobs and 90 indirect jobs were associated with this activity. A direct labour income impact of $16.2 million, and a direct plus indirect labour income impact of $18.7 million was associated with this employment. The direct GDP contribution of this activity to the B.C. economy was over $16.8 million, with a further $3.5 million of indirect GDP. Across Canada, the total economic activity associated with the shipbuilding/repair, and marinas/moorage businesses located within Fraser Port's jurisdiction accounted for over 819 direct and indirect jobs, $24.6 million of labour income, and contributed $35.6 million to the nation's GDP.

7.2: Conclusion.

7.2.1: Application of Port Economic Impact Theory and the Legitimacy of Results.

A shortcoming of earlier port economic impact studies was due to the lack of an accepted definition of port activity. The result was an inability to compare assessment results across ports because of a wide a variety of interpretations of port activity, and a less than full understanding of the economic activity generated by port operations. Efforts of the late 1970's and 1980's have helped to focus the many approaches. The port-industry category adopted for this study now appears to be accepted as most appropriately representing the economic activity associated

with the daily operation of a port and the movement of cargo. Other related activity, such as port users, may be assessed, but should be separated from the port-industry activity. The greatest future contribution to port economic impact methodology would be a specific port industry sector in national and regional input-output tables.

Other problems and questions regarding port economic impact approaches may lessen the accuracy of results. A significant contribution to the quality of an assessment rests with the ability of the analyst, the time frame involved, and the cooperation of the community being studied. The following discussion introduces some of the problems encountered during the analysis and how they may affect the final results.

If the Fraser Port assessment results are to be used for public relations purposes, then the approach used in this study is acceptable. The use of a port-industry and a port-associated category to organize the various economic impacts of port-related activity provides port managers with a 'macro' view. However, if the desire of the port authority is a detailed analysis of the marginal effects of changes related to imports and exports for port planning purposes, then more detailed work is necessary. For the latter type of study, a fuller understanding of the relationships between cargo throughput and economic activity is required. The intent of the Fraser Port study is to provide information to be used for public relations purposes, thus the less rigourous assessment should provide a general picture of port activity.

The quality of the results depends to a large degree of the quality of information provided by the port community. The survey used for this study attempted to infringe on the respondents as little as possible, and so to help ensure accurate

and prompt returns. A high response rate, 73%, was obtained through diligent follow-up and clarification. However, the possibility does exist that the more recalcitrant respondents provided rough guesstimates, which could reduce the accuracy of the final figures. Data were checked with other related responses and if any glaring discrepancies were found clarification was sought. Unfortunately, no greater control was available; however, few problems were encountered.

The interprovincial and national multipliers provided by Statistics Canada may also lessen the accuracy of the final figures. The interprovincial model was last updated in 1984, while the national model is from 1987. However, while somewhat old they are the most accurate available to analysts, given time and budget constraints. Because the Statistics Canada models only provide direct and indirect impact multipliers, the induced impacts for this study were estimated using multipliers derived from the 1990 Vancouver Port Corporation (VPC) economic impact study. The VPC study used 1984 interprovincial and 1987 national multipliers, supplemented with induced multipliers derived using an econometric approach. For the Fraser Port study, the induced multipliers were estimated by subtracting the Statistics Canada direct plus indirect multipliers from a total impact multiplier derived from the results of the VPC study. Once again, a degree of error is likely introduced; however, the method provided a rough estimate of the induced activity.

To calculate the port-associated import and export impacts, a total dollar value for each commodity had to be determined. Per tonne values were obtained from either the producers, or through the use of Statistics Canada export and import information. The use of Statistics Canada sources required a detailed description of each commodity. Harbour Commission statistics were highly aggregated; thus, in many cases the necessary level of detail was not readily available. For example,

the most difficult category to value was general cargo. Shipping manifests revealed much of the necessary information; however, exact commodity matches were sometimes difficult to achieve. For some minor tonnages, even when the necessary detail was available, Statistics Canada sources provided only a total value of the cargo entering Canada, but not total units, thus an average per tonne estimation was impossible to determine. The commodities and unaccounted tonnages that could not be assigned specific dollar values were assessed using average values of imports and exports. This process leads to a less accurate assessment of the impacts associated with the commodities.

Finally, the impacts relate to a given time period -- in this case, 1992. The fluctuation in port throughput will have an effect on the impact of port activity from year to year. However, the results should remain fairly robust until such time as a change in port productivity, port growth, or inter-industry relationships alters the magnitude of impacts.

7.2.2: Fraser Port Methodology Revisited

The purpose of this final section is to highlight particular areas of the methodology that, given the opportunity, might be handled differently.

An estimation of port-industry impacts specific to the Vancouver Lower Mainland is one potential area where more research could have improved the results. This study assumed that, because of a concentration of Fraser Port's activity in the immediate region, a majority of the provincial port-industry impacts occurred in the Lower Mainland. Statistics Canada employment and income information by occupation could be used to estimate appropriate regional weights for port-industry

categories. Chapter 6 could then include Lower Mainland impacts along with provincial and national impacts.

The port-associated category proved the most difficult and time consuming to assess. This, to a great extent, was due to a lack of detailed cargo information and at times inappropriate groupings. While a highly detailed accounting of cargo throughput may not serve the port's needs, it would have saved numerous hours of searching through shipping manifests. The usefulness of a detailed cargo accounting was not understood at the onset of the study. In future, if a detailed listing of cargoes is not readily available, a first order of business would be to produce the required listing of cargo following Statistics Canada classifications. Where Statistics Canada commodity value information is not available to estimate per tonne values, a survey list would be compiled to obtain average price information from importers and exporters.

Finally, the port-associated assessment became (necessarily) disjointed in both its analysis and presentation. The impact of international imports had to be kept separate from other port-associated results, as did the impacts associated with domestic inbound cargoes. This port-associated approach stems from a difficulty in port studies to show industry dependence on a particular port's operations. For the general reader, the plethora of numbers and impacts is, understandably, an area of confusion.

In future, it would be instructive to examine only the port-industry sectors and then their relationship to both outbound and inbound cargoes. A simple method of doing this could be to determine per tonne estimates of labour activity for each port-industry sector. This approach would likely need more than one year of data in

order to smooth any irregularities, and may, unfortunately, make this approach difficult. Further, tonnage statistics may not be consistent over a specific period of time. Nonetheless, by using the data available, it may be one simple method of revealing the relationship between economic activity and port throughput.

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Appendix 1. Survey List: Port-Industry and Port-Associated Businesses

Port-industry

1. ABC Customs Brokers
2. Adanac Custom Brokers Ltd.
3. Allworld Shipping Ltd.
4. Anchor Shipping Limited
5. Anglo Canadian Shipping Company
6. Annacis Auto Terminals Ltd.
7. Arnold Brothers
8. Arrow Transportation Systems Inc.
9. Arya Marine Supply
10. Asia Trading Co. Ltd.
11. Auto Haulaway (West) Ltd.
12. British Columbia Railway
13. Blaicklock Bros. Ltd.
14. Burlington Northern Railway
15. Burnaby Tugboats Ltd.
16. Burrard Towing Co. Ltd.
17. Burton Delivery Service
18. Canaan Shipping Co. Ltd.
19. Canada Maritimes Agencies Ltd.
20. Canadian Freightways Co. Ltd.
21. Canadian National Railway
22. Canadian Pacific Railway
23. Canadian Stevedoring Co. Ltd.
24. Canadian Transport Company Ltd.
25. Cargomaster Services Inc.
26. Cascadia Container Line
27. Catherwood Towing Ltd.
28. Chemainus Towing Ltd.
29. Cole Freight International
30. Cole McCubbin Ltd.
31. Columbia Customs Brokers Ltd.
32. Compass Marine
33. Courtney Agencies Ltd.
34. CTL Westrans
35. Canada Customs: Marine Operations
36. Davidson & Sons Custom Brokers
37. Delta Aggregates Ltd.
38. Delta Catalytic
39. Empire International Stevedoring Ltd.
40. Empire Shipping Co. Ltd.
41. Federated Customs Brokers Ltd.
42. Firebird Trucking

43. Fraser River Harbour Commission.
44. Fraser River Pile & Dredging Ltd.
45. Fraser Surrey Docks Ltd.
46. Fraser Tugboat Ltd.
47. Fraser Wharves Ltd.
48. G.M. Patry Ltd.
49. Global Marine Canada Ltd.
50. Greer Shipping Ltd.
51. Borgerson Co. Ltd.
52. Hanlon Construction Ltd.
53. Icecorp
54. Inchcape Shipping
55. International Chartering Services Ltd.
56. International Longshoreman's & Warehousemen's Union
57. J.B. Ellis & Co. Ltd.
58. Jagro International Inc.
59. K. Line Canada Ltd.
60. K. Barre, Montreal Shipping
61. Kerr Steamship Co. Ltd.
62. Kuehne & Nagel Inter. Ltd.
63. Ladner Tug and Barge Ltd.
64. Lamina Pile Driving Ltd.
65. Landmark Customs Brokers Ltd.
66. LEP International Inc.
67. Livingston International
68. Lygon Shipping Group Ltd. (DBA Lygon Group)
69. Maersk Canada Ltd.
70. Manhattan Shipping (Canada) Ltd.
71. Mariner Towing Ltd.
72. Maritime Operations Canada Ltd.
73. Miller Contracting Ltd.
74. Milne & Craighead
75. New Westminster Dept: Canada Customs
76. Nippon Express Canada Ltd.
77. Nootka Shipping International Ltd.
78. Norsk Pacific Steamship Can. Ltd.
79. North Pacific Shipping Co. Ltd.
80. Northwest Pile Driving Ltd.
81. Pacific Central Carriers
82. Pacific Coast Shipping & Agency Co. Ltd.
83. Pacific Customs Brokers Ltd.
84. Pacific Pilotage Authority
85. Pacific Rim Stevedoring
86. Pacific Rim Waterways Inc.
87. Pacnord Agencies Ltd.
88. Peace Bridge Brokerage Ltd.
89. Prefered Service
90. Probyn E.R. Ltd.
91. Public Works Canada Ltd.

92. Ranger Transport
93. Reimer Express (Pacific) Ltd.
94. Riverside Towing Ltd.
95. Rivtow Marine Ltd.
96. Robinson Heath Western Ltd.
97. Saga Forest Carriers Intl. (Can.) Inc.
98. Schenker of Canada Ltd.
99. Seaboard Shipping Co. Ltd.
100. Seaport Pacific Services Ltd.
101. Seaspan International
102. Seatrade Shipping Ltd.
103. Seawood Shipping (B.C.) Ltd.
104. Shields Navigation Ltd.
105. Sinotrans Canada Inc.
106. Southern Railway of B.C. Ltd.
107. Spence & Young (Can.) Simpson
108. Star Shipping (Canada) Ltd
109. Swiftsure Towing Co. Ltd.
110. T S E Ship Chandler
111. Tidal Towing Ltd.
112. Tri-Line Expressways
113. Union Tug and Barge
114. United Maritime Suppliers Inc.
115. Valley Towing Ltd.
116. Van-Kam Freightways Ltd.
117. Vancouver Customs Brokers Ltd.
118. Vancouver Harbour Ship Supply Ltd.
119. Well-Worth Trading Co. Ltd.
120. Western Navigation Ltd
121. Western Stevedoring Co. Ltd.
122. Westminster Tugs
123. Westward Shipping Ltd.
124. Wheatly Bros.
125. Williams Moving International

Port Associated

1. Bella Coola Fisheries Ltd.
2. Canadian Forest Products
3. Cleanwood Preservers Ltd.
4. Columbia Bitulithic Ltd.
5. Con-Force Products Ltd.
6. Construction Aggregates Ltd.
7. Delta Cedar Products Ltd.
8. Domtar Chemicals Group, Wood Preserving Div.
9. Domtar Const. Materials,Gypsum Div.
10. International Forest Products

11. Lafarge Canada Inc.
12. Long Beach Shellfish
13. MacMillan Blodell
14. B.C. Packers Ltd.
15. Shearer Seafood Products Ltd.
16. Teal Cedar Products Ltd.
17. Texada Lime
18. Tilbury Cement Ltd.
19. Captain's Cove Marina
20. Deas Harbour Marina
21. Ron Francis Marine Ltd.
22. Shelter Island Marina
23. Speed's Industrial Marine Parts Ltd.
24. Trites Marine Services Ltd.
25. Wes Del Marina
26. West Bay Boat Builders
27. Vito Steel Boat & Barge Const. Ltd.

Appendix 2: Survey Questionnaires

Port-industry Questionnaire.

Fraser River Harbour Commission: Economic Impact Study Questionnaire
All information will be held in the strictest confidence by the Project Coordinator.

* Please answer the following questions for your latest fiscal year.
* Please provide information only for those operations associated with the Fraser River Harbour Commission, or those which relate to operations within the Fraser Port's jurisdiction.

Respondents Name: _____ Position: _____

Company: _____ Telephone: _____

Type of business/ SIC code if known _____

1. Total sales revenue: $_____
2. Average number of full-time equivalent employees: _____
   (two half-time positions would equal one full-time position)
3. Annual taxes paid to: local government(s) $_____
   " " provincial government $_____
   " " federal government $_____

Comments: _____

_____

Thank you for your cooperation.
Would you like a copy of the final results of the survey? yes_____ no_____

All information is confidential and used in determination of industry aggregates only.

Please return in the self-addressed stamped envelope provided in the package to the Fraser River Harbour Commission. For more information please contact Sinclair Tedder at the Fraser Port, 524-6655, or at The University of British Columbia, 822-4409.

Fraser River Harbour Commission: Economic Impact Study: Port-Associated Industry Questionnaire

All information will be held in the strictest confidence by the Project Coordinator
Data is for determination of industry averages only.

* Please answer the following questions for your latest fiscal year (1992).

* The aim of this questionnaire is to determine the tonnages and average value of commodities which move via the Fraser River. If any of your imports or exports are transported via the Fraser, please list the commodities below. The commodities can be domestic and international. If neither imports nor exports move via the river please indicate "no river dependency" and return the questionnaire in the envelope provided.

* The statistics you provide should be disaggregated by specific commodity. For example, hydrated and quick lime or crushed limestone, gravel, gypsum, pulp and paper, lumber, shingles rather than lime or forest products.

* If you require further space please use the back of the questionnaire. Any comments would also be appreciated.

Respondents Name:_____ Position:_____

Company Name:_____ Telephone:_____

Type of Business/SIC code if known:_____

1. Commodity statistics: Exports only

Domestic cargo exports - please list the types of cargo, tonnage, and value.

Commodity	Tonnage	Value

International cargo exports - please list the types of cargo, tonnages, and value.

Commodity	Tonnage	Value

2. Commodity statistics: Imports only

Domestic cargo imports - please list the types of cargo, tonnages, and value.

Commodity	Tonnage	Value

International cargo imports - please list the types of cargo, tonnages, and value.

Commodity	Tonnage	Value

3. Please indicate if any of the commodities listed are shipped via the Fraser Surrey Docks, or if they are transshipped directly to or from the river at the production facility. If a mixture exists please attempt to estimate the value shipped directly and through the Fraser Surrey Docks or other facility.

Thank you for your cooperation.
Would you like a copy of the final results of the survey? yes_____ no_____

All information is confidential and used in determination of industry aggregates only.

Please return in the self-addressed stamped envelope provided in the package to the Fraser River Harbour Commission. For more information please contact Sinclair Tedder at the Fraser Port, 524-6655, or at The University of British Columbia, 822-4409.

Appendix 3: Calculation of Induced Multipliers.

To calculate a set of induced induced multipliers appropriate for use in the Fraser Port study, information from Statistics Canada and the 1990 economic impact study of the Vancouver Port Corporation (VPC) was used. The VPC study used the 1984 Interprovincial I-O model to determine direct and indirect impacts., and the 1987 National I-O model for Canada wide direct and indirect impacts To estimate induced impacts, a multiplier was estimated using an econometric model of the Canadian economy, maintained by Data Resources of Canada.

For the Fraser Port study, labour income and employment induced multipliers were found by subtracting Statistics Canada direct plus indirect multipliers from total, direct plus indirect plus induced, multipliers derived from the VPC study. Estimates of total (direct, indirect, and induced) employment and income multipliers used in the VPC study were found by dividing direct activity by total activity. To determine GDP multipliers, the relationship between GDP and labour income in national income accounting was used. GDP induced multipliers were calculated based on a ten year average 77% ratio of labour income to GDP. Induced employment, labour income, and GDP multipliers were generated for B.C. and Canada.

Calculations were determined for three groups of activity based on the 1990 VPC study: terminals, port related services, and port related transportation. The VPC study uses an identical definition of port-industry. While the three categories aggregate industry sectors and may affect the accuracy of the multipliers, the estimates were the best available at the time. The following are those activities included in the three VPC categories: comprising the VPC terminal sector are tugs

and towing (SIC 454),stevedoring, terminals, Harbour Commission, pilot services, ship brokers, and ship agents (SIC 455); comprising the VPC port related transportation sector are railway (SIC 453) and trucking (SIC 456); and comprising the VPC study port related services sector are dredging (SIC 412), freight forwarders (SIC 459), ship chandlers (SIC 599), and customs brokers (SIC 799) .

Employment Multiplier Calculation:

		B.C. Multipliers	Canada Multipliers
Terminals			
SIC	Per VPC study	1.72970	1.97514
454,455	Per Stats Can	-1.68034	-1.65590
	Induced mult.	0.04936	0.31924
Port related transportation			
SIC	Per VPC study	1.5376	1.68914
453, 456	Per Stats Can	-1.3114	-1.51195
	Induced mult.	0.2262	0.17719
Port related services			
SIC 412,	Per VPC Study	1.3662	1.42019
459,599,	Per Stats Can	-1.1437	-1.16448
799	Induced mult.	0.2225	0.2557

Employment induced multipliers are based on 1 direct full-time equivalent position.

Labour Income Multiplier Calculation:

Terminals			
SIC	Per VPC study	1.8652	2.01576
454,455	Per Stats Can	-1.54624	-1.59347
	Induced mult.	0.31896	0.42229

Port related transportation

SIC	Per VPC study	1.75418	1.87657
453, 456	Per Stats Can	-1.30134	-1.56559
	Induced mult.	0.45284	0.31098

Port related services

SIC 412,	Per VPC Study	1.73899	1.79625
459,599,	Per Stats Can	-1.29266	-1.30707
799	Induced mult.	0.44633	0.48918

Labour income induced multipliers are based on one dollar of direct labour income.

GDP Multiplier Calculation

GDP induced multipliers are based on a Labour Income to GDP ratio because no direct GDP figures are given in the VPC study. The ratio used to adjust the labour income multiplier is based on a ten year average from 1983 to 1992.

Ten year average of labour income to GDP, 1983 - 1992.

1983	316275 / 405717	= 0.78	1988	471325 / 603356	= 0.78
1984	350274 / 444735	= 0.79	1989	507600 / 651616	= 0.78
1985	374805 / 477988	= 0.78	1990	516437 / 667843	= 0.77
1886	390435 / 505666	= 0.77	1991	511831 / 674388	= 0.76
1987	427186 / 551336	= 0.77	1992	516996 / 687334	= 0.75

Average labour income to GDP ratio: 77.3%.

The GDP induced multiplier is found using the equation,

$$GDP_{(ind)i} = LY_{(ind)i} / .773$$

where $GDP_{(ind)i}$ is the GDP induced multiplier for sector i, $LY_{(ind)i}$ is the labour income induced multiplier for sector i, and .773 is the ten year average labour income to GDP ratio.

	B.C.	Canada
Terminals		
SIC 454,455	$\frac{0.31896}{0.773} = 0.41263$	$\frac{0.42229}{0.773} = 0.54630$
Port related transportation		
SIC 453, 456	$\frac{0.4528}{0.773} = 0.58582$	$\frac{0.31098}{0.773} = 0.40230$
Port related services		
SIC 412, 459,599,	$\frac{0.44633}{0.773} = 0.57740$	$\frac{0.48918}{0.733} = 0.66737$

The GDP induced multiplier is based on one dollar of direct GDP.

Appendix 4. Calculation of Port-Industry Impacts

Direct and indirect multipliers for B.C. are from the Statistics Canada Interprovincial Input-Output Table from 1984, and, for Canada, from the Statistics Canada National Input-Output Table from 1987. Induced multipliers were derived as shown in Appendix 1. Revenue, GDP, and labour income are given in dollars; employment is in full-time equivalent positions.

Port-industry sectors:

SIC 455: Service industries incidental to water transport - stevedoring, terminals, port authority, ship brokers, ship agents.
SIC 412: Highway and heavy construction - dredging, piers.
SIC 453: Railway transport industries - terminal rail operation.
SIC 454: Water transport industries - tugs and towing.
SIC 456: Truck transport industries - transfer trucking.
SIC 459: Other services incidental to transportation - freight forwarders.
SIC 599: Wholesale trade - ship chandlers.
SIC 779: Business services - customs brokers.

Port-Industry Economic Impact Calculations

GDP Calculations, B.C. ($)

SIC	Sales Revenue	Direct Mult.	Direct Impact	Indirect Mult.	Dir+Indir Impact	Induced Impact
455	88,150,347	0.45678	40,265,315	0.72117	63,571,385	16,614,677
412	31,498,405	0.45714	14,399,181	0.67291	21,195,592	8,314,087
453	12,100,000	0.58035	7,022,235	0.74338	8,994,898	4,113,766
454	69,442,479	0.45678	31,719,936	0.72117	50,079,833	13,088,597
456	30,428,379	0.44954	13,678,774	0.63105	22,242,841	8,013,299
459	10,198,125	0.54510	5,558,998	0.73099	7,454,727	3,209,765
599	12,010,000	0.73929	8,878,873	0.85772	10,301,217	5,126,661
779	4,927,749	0.62954	3,102,215	0.83041	4,092,052	1,791,219
Total	258,755,484					

Direct GDP impact	124,625,526
Indirect GDP impact	63,307,019
Direct + indirect GDP impact	187,932,546
Induced GDP impact	60,272,072
Total GDP impact	248,204,617

Employment Calculations, B.C.

SIC	Sales Revenue ($ '000's)	Direct Mult.	Direct Impact	Indirect Mult.	Dir+Indir Impact	Induced Impact
455	88,150	0.00852	268	0.01432	451	60
412	31,498	0.00894	108	0.01462	177	24
453	12,100	0.01134	787	0.01475	1,024	178
454	69,442	0.00852	259	0.01432	436	58
456	30,428	0.01399	143	0.01850	189	32
459	10,198	0.02439	293	0.02874	345	65
599	12,010	0.01827	90	0.02120	104	20
779	4,928	0.03333	164	0.03812	188	37

Direct employment impact	2,113
Indirect employment impact	801
Direct + indirect employment	2,914
Induced employment inpact	475
Total employment inpact	3,389

Labour Income Calculations, B.C. ($)

SIC	Sales Revenue	Direct Mult.	Direct Impact	Indirect Mult.	Dir+Indir Impact	Induced Impact
455	88,150,347	0.32545	28,688,530	0.50322	44,359,017	9,150,494
412	31,498,405	0.38461	12,114,602	0.54816	17,266,166	5,407,110
453	12,100,000	0.4443	5,376,030	0.55678	6,737,038	2,434,481
454	69,442,479	0.32545	22,600,055	0.50322	34,944,844	7,208,513
456	30,428,379	0.322	9,797,938	0.43454	13,222,348	4,436,898
459	10,198,125	0.52382	5,341,982	0.64117	6,538,732	2,384,287
599	12,010,000	0.61948	7,439,955	0.69594	8,358,239	3,320,675
779	4,927,749	0.45498	2,242,027	0.58099	2,862,973	1,000,684

Direct labour income impact	93,601,119
Indirect labour income impact	40,688,239
Direct + indirect impact	134,289,358
Induced labour income impact	35,343,143
Total labour income impact	169,632,500

GDP Calculations, Canada ($)

SIC	Sales Revenue	Direct Impact	Dir+Indir Mult.	Dir+Indir Impact	Induced Impact
455	88,150,347	40,265,315	1.64221	66,124,103	21,996,942
412	31,498,405	14,399,181	1.80601	26,005,065	9,609,581
453	12,100,000	7,022,235	1.56237	10,971,329	2,825,045
454	69,442,479	31,719,936	1.64221	52,090,795	17,328,601
456	30,428,379	13,678,774	1.69090	23,129,438	5,502,971
459	10,198,125	5,558,998	2.01726	11,213,944	3,709,908
599	12,010,000	8,878,873	1.32387	11,754,473	5,925,493
779	4,927,749	3,102,215	1.23279	3,824,380	2,070,325

Direct GDP impact	124,625,526
Indirect GDP impact	80,488,002
Direct + indirect impact	205,113,529
Induced GDP impact	68,968,867
Total GDP impact	274,082,396

Employment Calculations, Canada

SIC	Sales Revenue ($,000.'s)	Direct Impact	Dir+Indir Mult.	Dir+Indir Impact	Induced Impact
455	88,150	268	1.65590	444	86
402	31,498	108	1.61499	175	28
453	12,100	787	1.46276	1,152	140
454	69,442	259	1.65590	429	83
456	30,428	143	1.56115	223	25
459	10,198	293	1.80868	530	75
599	12,010	90	1.32679	119	23
779	4,928	164	1.16448	191	42

Direct employment impact	2,113
Indirect employment impact	1,150
Direct + indirect employment	3,264
Induced employment impact	501
Total employment impact	3,764

Labour Income Calculations, Canada ($)

SIC	Sales Revenue	Direct Impact	Indirect Mult.	Dir+Indir Impact	Induced Impact
455	88,150,347	28,688,530	1.59347	45,714,312	12,114,879
412	31,498,405	12,114,602	1.69954	20,589,250	5,926,221
453	12,100,000	5,376,030	1.50716	8,102,537	1,671,838
454	69,442,479	22,600,055	1.59347	36,012,509	9,543,777
456	30,428,379	9,797,938	1.62403	15,912,145	3,046,963
459	10,198,125	5,341,982	1.79973	9,614,125	2,613,191
599	12,010,000	7,439,955	1.28062	9,527,755	3,639,477
779	4,927,749	2,242,027	1.17423	2,632,656	1,096,755

Direct labour income impact	93,601,119
Indirect labour income impact	54,504,171
Direct plus indirect impact	148,105,290
Induced labour income impact	39,653,101
Total labour income impact	187,758,391

Appendix 5: Calculation of Cargo Values and Associated Impacts

1. International Exports.

Commodity	Foreign Outbound Tonnage	$ Value Per Tonne	Total $ Value
FOREST PRODUCTS			
Lumber	775,847	*	115,626,230
Wood Chips	79,055	132	10,435,260
Pulp	193,209	650	125,585,850
Paper	28,825	550	15,853,750
Plywood	36,626	*	24,173,160
Shingles	1,069	1,800	1,924,200
Other wood products	5,307	522	2,770,254
TOTAL FOREST PRODUCTS	1,119,938		296,368,704
CEMENT PRODUCTS & MATERIALS			
Cement	103,487	75	7,761,525
GENERAL CARGO **Food Products**			
Lentils	35,428	463	16,403,164
Canary Seed	1,921	303	582,063
Pink Beans	1,008	59	59,472
Sugar	1,154	620	715,480
Yellow/Green Peas	2,073	300	621,900
Seafood	2,187	5,990	13,100,130
Barley	66	130	8,580
Beans	315	598	188,370
Cherries	171	2,855	488,205
Canned Berries	184	3,000	552,000
Alfalfa Cubes	76	140	10,640
Yellow/Brown Mustard	100	1,368	136,800
Oats	46	152	6,992
Rapeseed/Flaxseed	310	283	87,730
Canned Asparagus	873	3,588	3,132,324
French Fries	39	726	28,314
Other	81	1,286	104,161
TOTAL FOOD PRODUCTS	46,032		36,226,325
OTHER GENERAL CARGO			
Rock Salt	106,239	28	2,974,692
Crushed Bath	695	242	168,190
Small Arms/Ammunition	20	* *	7,244

*,** Please see notes at the end of the appendix.

Tote Bags	40	* *	14,488
Poly Liners	70	3407	238,490
Total other	107,064		3,403,104
TOTAL GENERAL CARGO	153,096		39,629,429
CHEMICALS AND FERTILIZERS			
Sodium Chlorate	80	432	34,560
Potasium Chloride	58	122	7,076
Magnese oxide	36	719	25,884
Calcium Hydrochlorite	150	1,799	269,850
Amonium Nitrate	138	191	26,358
Sodium Benzoate	40	1,130	45,200
Black Carbon	6.3	787	4,958
Sulphur Fertilizer	55	196	10,780
Copolymer	136	1,910	259,760
Resins	1,699	3,169	5,384,131
Dowlex	2,346	5,000	11,730,000
Pentaerythritol	74	1,535	113,590
Benzaldehyde	39	2,645	103,155
Other	565	1,510	853,367
TOTAL CHEMICALS	5,422		18,868,669
MINERAL PRODUCTS			
Fused Magnesia	1,681	3,965	6,665,165
Ferro-nickel	79	1,025	80,975
Zinc	2,936	1,562	4,586,032
Lignum pitch	110	549	60,390
Bentonite (Clay)	18	486	8,748
Molybdenite Concentrate	41	5,750	235,750
TOTAL NON-FERROUS MINERALS	4,865		11,637,060
Steel (Scrap)	70,184	50	3,509,200
HEAVY EQUIP/MACHINERY	1,137		
Agricultural equipment	432	1500	648,000
Heavy equipment parts	188	500	94,000
Mining equipment and parts	93	500	46,500
Agricultural implements	44	370	16,280
Other	380	370	140,600
(includes electric motors, auto body equipment, machine parts, hydraulic equip.,etc)			
TOTAL HVY EQUIP/MACHINERY	1,137		945,380
TOTAL INT'L ASSOC VALUE	1,459,266		378,719,967

2. Domestic Outbound.

Commodity	Domestic Outbound Tonnage	Value Per Tonne	Total Value
FOREST PRODUCTS			
Wood Chips	3,841,580	40	153,663,200
Sawdust	213,765	6	1,182,120
Hogfuel	377,710	5	1,888,550
Logs	2,157,240	292	629,914,080
Pulp	22,500	650	14,625,000
TOTAL FOREST PRODUCTS	6,612,795		801,272,950
CEMENT PRODUCTS & MATERIALS			
Cement	218,957	*	10,419,000
Aggregate	286,700	6	1,720,200
Gravel			
TOTAL CEMENT PRODUCTS	505,657		12,139,200
SINGLE PRODUCTS			
Steel	134,600	50	6,730,000
General Cargo	291,313	* *	105,455,306
Machinery	300	* *	108,600
TOTAL SINGLE PRODUCTS	426,213		112,293,906
TOTAL DMSTC OUTBOUND	7,544,665		925,706,056

TOTAL INTERNATIONAL AND DOMESTIC OUTBOUND TONNAGE AND VALUE

Tonnage	$ Value
9,003,931	1,304,426,024

3. International Imports.

Commodity	Foreign Inbound Tonnage	Value Per Tonne	Total Value
Automobiles (in units)	308,391	*	3,566,085,530
NON-FERROUS METALS			
Copper/Brass	28	*	95,031
Other	523	4,500	2,353,500

TOTAL NON-FERROUS	551		2,448,531
STEEL PRODUCTS			
plate	38,878	464	18,039,392
beam	11,141	1,385	15,430,285
pipe	34,059	1,540	52,450,860
coil	79,707	403	32,121,921
wire rod	64,833	1,230	79,744,590
billets	7,581	340	2,577,540
other	3,101	894	2,771,260
TOTAL STEEL PRODUCTS	239,300		203,135,848
Wood Products	3,242	265	857,929
Heavy Equipment	4,197	*	19,810,467
GENERAL CARGO			
Soft Drinks	25	*	13,350
Mineral Water	45	*	16,470
MSG	92	1,438	132,296
Coffee	621	2,000	1,242,000
Pasta	348	1,517	527,916
Olive Prods	566	2,556	1,446,696
Tomato Prods	522	775	404,550
Corned Beef	86	3,891	334,626
Lentil Seeds	40	700	28,000
Wine/Liquor	3187	*	6,085,347
Canned Mandarin	135	1,295	174,825
Calcium silcone	59	1,364	80,476
Rock Salt	69,771	28	1,953,588
Gypsum	50,000	25	1,250,000
Silica Sand	60,000	15	900,000
Liquid Asphalt	5,900	300	1,770,000
Ceramic tiles	7,078	*	5,745,924
Red Clay Vases	525	* *	660,089
Decorative Stones	1,462	8	11,696
Rubber Hose	15	4,241	65,311
Auto tires	134	* *	857,600
Wheels	60	* *	58,440
Porcelin Insul	121	* *	117,665
Furniture	1,958	* *	2,465,244
Other	47,642	* *	53,095,436
TOTAL GENERAL CARGO	242,958		26,342,109
TOTAL INT'L INBOUND	806,073		3,853,770,006

4. Domestic Inbound.

Commodity	Domestic Inbound Tonnage	Value Per Tonne	Total Value
Logs	5,707,497	115	656,362,155
Shakes	12,020	1,350	16,227,000
Lumber	7,700	149	1,147,300
Paper	181,546	550	99,850,300
Pulp	83,066	650	53,992,900
Chips	519,485	40	20,779,400
Aggregate	1,618,601	7	11,330,207
Liquids	7,501	105	787,605
Limestone	1,162,567	*	4,500,000
Gypsum	191,893	25	4,797,325
Coal	10,100	50	505,000
Steel	4,100	894	3,664,033
General Cargo	365,954	* *	13,685,277
Fish	28,758	1,850	53,202,300
TOTAL DMSTC INBOUND	9,900,788		940,830,802
TOTAL DOMESTIC AND INTERNATIONAL INBOUND CARGO	10,706,861		4,794,600,808

5. Summary

TOTAL INBOUND TONNAGE AND VALUE

	Tonnes	$ Value
Domestic	9,900,788	940,830,802
International	806,073	3,853,770,006
Total	10,706,861	4,794,600,808

TOTAL OUTBOUND TONNAGE AND VALUE

Domestic	7,544,665	925,706,056
International	1,459,266	378,719,967
Total	9,003,931	1,304,426,024

TOTAL INBOUND AND OUTBOUND TONNAGE AND VALUE

Domestic	17,445,453	1,866,536,858
International	2,265,340	4,232,489,973
Total	19,710,793	6,099,026,831

6. Port-Associated economic impact by industry sector, Exports.

GDP Calculation, Canada

Industry Sector/SIC	Sector Value ($)	Direct GDP Mult	Direct GDP Impact ($)	Indirect GDP Mult	Total D & I GDP Impact ($)
Wood industries					
SIC 251	287,489,814	0.3682	105,865,249	0.846	243,227,883
SIC 252	24,173,160	0.3747	9,057,441	0.819	19,797,818
Paper & allied products, SIC 271					
Pulp	140,210,850	0.4505	63,163,586	0.8458	118,588,935
Paper	15,853,750	0.4299	6,816,161	0.8295	13,150,369
Logging industry					
SIC 041	629,914,080	0.4092	257,786,038	0.839	528,497,913
Non-metallic industries					
SIC 354 cement	18,180,525	0.4907	8,921,365	0.8334	15,151,104
Quarry & sand pit					
SIC 082	1,720,200	0.5743	987,962	0.8441	1,451,986
Other prods. industries					
SIC 591	10,645,880	0.6779	7,216,949	0.8975	9,554,358
Machin/equip manufacturing					
SIC 319 ag.equip.	648,000	0.3779	244,892	0.6383	413,625
SIC 319 mfg. eqp.	46,500	0.3779	18,890	0.6383	29,681
SIC 319 oth.eqp.	343,200	0.4062	129,702	0.6701	229,975
SIC 311 Ag prods	16,280	0.3426	5,578	0.579	9,426
Chemical products					
SIC 371 organic	1,070,112	0.2319	248,127	0.6962	745,012
SIC 371 inorgan.	17,798,557	0.3619	6,441,832	0.7563	13,460,515
Primary metal industries					
SIC 295	11,637,060	0.2881	3,353,102	0.7502	8,730,355
Misc non-met mines					
SIC 062 rock salt	2,974,692	0.6101	1,814,919	0.8566	2,548,240
Agricultural products.					
SIC 101-14 food	36,226,325	0.4233	15,333,517	0.7712	27,937,850
Other Products	105,477,038	0.4233	44,645,332	0.7712	81,344,155
TOTAL EXPORT GDP IMPACT	1,304,426,024		532,050,643		1,084,869,201

Employment Calculation, Canada

Industry Sector/SIC	Sector Value ($ '000.'s)	Direct Emply Mult	Direct Employment Impact	Indirect Emply Mult	Total D + I Employment Impact
Wood industries					
SIC 251	287,490	0.0071	2,053	0.0163	4,700
SIC 252	24,173	0.0102	246	0.019	460
Paper & allied products, SIC 271					
Pulp	140,211	0.0036	502	0.0107	1,502
Paper	15,854	0.0055	87	0.0121	192
Logging industry					
SIC 041	629,914	0.008	5,046	0.0157	9,883
Non-metallic Industries					
SIC 354 cement	18,181	0.0088	160	0.0148	269
Quarry & sand pit					
SIC 082	1,720	0.0065	11	0.0119	20
Other prods. industries					
SIC 591	10,646	0.0129	138	0.0172	183
Machin/equip manufacturing					
SIC 319 ag.equip.	648	0.009	6	0.0143	9
SIC 319 mfg. eqp.	47	0.009	0	0.0143	1
SIC 319 oth.eqp.	343	0.0094	3	0.0148	5
SIC 311 ag prods	16	0.0189	0	0.026	0
Chemical products					
SIC 371 organic	1,070	0.0024	3	0.0083	9
SIC 371 inorgan.	17,799	0.0059	105	0.0116	207
Primary metal industries					
SIC 295	11,637	0.004	47	0.0109	126
Misc non-met mines					
SIC 062 rock salt	2,975	0.0094	28	0.0137	41
Agricultural products.					
SIC 101-14 food	36,226	0.0082	296	0.0145	524
Other Products	105,477	0.0082	862	0.0145	1,525
TOTAL EXPORT EMPL IMPACT	1,304,426		9,593		19,657

Labour Income calculation, Canada

Industry Sector/SIC	Sector Value ($)	Direct Income Mult	Direct Labour Income Impact ($)	Indirect Income Mult	Total D +I Labour Y Impact ($)
Wood industries					
SIC 251	287,489,814	0.2574	73,994,128	2.1544	159,409,251
SIC 252	24,173,160	0.2808	6,788,549	1.9981	13,563,927
Paper & allied products, SIC 271					
Pulp	140,210,850	0.1566	21,955,617	2.4948	54,775,532
Paper	15,853,750	0.2275	3,607,362	1.9614	7,075,553
Logging industry					
SIC 041	629,914,080	0.2886	181,818,400	1.8337	333,407,673
Non-metallic Industries					
SIC 354, cement	18,180,525	0.3065	5,572,513	1.6231	9,044,968
Quarry & sand pit					
SIC 082	1,720,200	0.2527	434,712	1.6553	719,574
Other prods. industustries					
SIC 591	10,645,880	0.4958	5,278,334	1.2806	6,759,540
Machin/equip manufacturing					
SIC 319 ag.equip.	648,000	0.2707	175,414	1.6363	287,033
SIC 319 mfg. eqp.	46,500	0.2707	12,588	1.6363	20,597
SIC 319 oth.eqp.	343,200	0.2864	92,904	1.6071	149,306
SIC 311 ag prods	16,280	0.3426	5,578	1.6897	9,426
Chemical products					
SIC 371 organic	1,070,112	0.1114	119,253	2.8863	344,204
SIC 371 inorgan.	17,798,557	0.1861	3,312,489	2.0329	6,734,026
Primary metal industries					
SIC 295	11,637,060	0.1564	1,819,803	2.409	4,383,816
Misc non-met mines					
SIC 062,rock salt	2,974,692	0.3041	904,574	1.456	1,317,078
Agricultural products.					
SIC 101-14 food	36,226,325	0.2622	9,497,093	1.8972	18,017,838
Other Products	105,477,038	0.2622	27,651,333	1.8972	52,459,953
TOTAL EXPORT LBR Y IMPACT	1,304,426,024		343,040,645		668,479,295

7. Domestic inbound economic impacts, B.C.

Domestic inbound cargoes arrive from destinations within B.C. Thus, they are assessed for their backward linkages to the B.C. economy. Direct and indirect impacts are calculated using Statistics Canada Interprovincial multipiers from 1984.

GDP Calculation, B.C.

Cargo	Value ($)	Dir GDP Mult	Direct GDP Impact ($)	Ind GDP Mult	Total D+I GDP Impact ($)
Forest Products					
Logs	656,362,155	0.3591	235,699,650	0.70271	461,232,250
Sawmill prods.	38,153,700	0.30581	11,667,783	0.73482	28,036,102
Pulp	53,992,900	0.20953	11,313,132	0.68822	37,158,994
Paper	99,850,300	0.24173	24,136,813	0.70461	70,355,520
Aggregate/Gravel	11,330,207	0.28904	3,274,883	0.68061	7,711,452
Gypsum	4,797,325	0.28904	1,386,619	0.68061	3,265,107
Limestone	4,500,000	0.28904	1,300,680	0.68061	3,062,745
Coal	505,000	0.47586	240,309	0.67278	339,754
Steel	3,664,033	0.30529	1,118,593	0.47552	1,742,321
Fish	53,202,300	0.39761	21,153,767	0.63649	33,862,732
General Cargo/ Liquids	14,472,882	0.30716	4,445,490	0.66894	9,681,538
Total	940,830,802		315,737,719		656,448,515

Employment Calculation, B.C.

Cargo	Value ($)	Dir Empl Mult	Direct Empl Impact	Ind Empl Mult	Total D+I Empl Impact
Forest Products					
Logs	656,362	0.00745	4,890	0.01457	9,563
Sawmill prods.	38,154	0.00804	307	0.01734	662
Pulp	53,993	0.00493	266	0.01163	628
Paper	99,850	0.00589	588	0.01141	1,139

Aggregate/Gravel	11,330,207	0.01265	143	0.01865	211
Gypsum	4,797	0.01265	61	0.01865	89
Limestone	4,500	0.01265	57	0.01865	84
Coal	505	0.01167	6	0.01585	8
Steel	3,664	0.00517	19	0.00856	31
Fish	53202.3	0.00946	503	0.01411	751
General Cargo/ Liquids	14,473	0.0079	114	0.01503	218
Total	940,831		6,949		13,384

Labour Income Calculation, B.C.

Cargo	Value ($)	Dir LY Mult	Direct Labour Y Impact ($)	Ind LY Mult	Total D+I LY Impact ($)
Forest Products					
Logs	656,362,155	0.3076	201,896,999	0.52777	346,408,255
Sawmill prods.	38,153,700	0.30581	11,667,783	0.61175	23,340,526
Pulp	53,992,900	0.20953	11,313,132	0.42518	22,956,701
Paper	99,850,300	0.24173	24,136,813	0.41153	41,091,394
Aggregate/Gravel	11,330,207	0.28904	3,274,883	0.4405	4,990,956
Gypsum	4,797,325	0.28904	1,386,619	0.4405	2,113,222
Limestone	4,500,000	0.28904	1,300,680	0.4405	1,982,250
Coal	505,000	0.31885	161,019	0.44252	223,473
Steel	3,664,033	0.23199	850,019	0.35372	1,296,042
Fish	53,202,300	0.31576	16,799,158	0.46066	24,507,959
General Cargo/ Liquids	14,472,882	0.27585	3,992,312	0.45489	6,583,505
Total	940,830,802		276,779,418		475,492,282

8. Port-associated sectors:
SIC 327: Shipbuiding and repair industry.
SIC 965: Theatre,sports,and recreational services-marinas and moorage

GDP Calculations, Canada

SIC	Sales Revenue	Direct Mult.	Direct Impact	Dir+Indir Mult.	Dir+Indir Impact
327	31,855,780	0.4905	15,625,260	2.17608	34,001,816
965	1,969,125	0.58629	1,154,478	1.36809	1,579,430

Direct sales revenue	33,824,905
Direct GDP impact	16,779,738
Indirect GDP impact	18,801,508
Direct + indirect GDP impact	35,581,246

Employment Calculations, Canada

SIC	Sales Revenue ($ '000's)	Direct Mult.	Direct Impact	Indirect Mult.	Dir+Indir Impact
327	31,856	0.01836	585	0.02455	782
965	1,969	0.01389	27	0.01889	37

Direct employment impact	612
Indirect employment impact	207
Direct + indirect employment	819

Labour Income Calculations, Canada

SIC	Sales Revenue	Direct Mult.	Direct Impact	Indirect Mult.	Dir+indir Impact
327	31,855,780	0.48057	15,308,932	1.53236	23,458,795
965	1,969,125	0.43869	863,835	1.31107	1,132,549

Direct labour income impact	16,172,768
Indirect labour income impact	8,418,576
Direct plus indirect impact	24,591,344

GDP Calculations, B.C.

SIC	Sales Revenue	Direct Mult.	Direct Impact	Indirect Mult.	Dir + indir Impact
327	31,855,780	0.4905	15,625,260	0.58857	18,749,356
965	1,969,125	0.58629	1,154,478	0.77108	1,518,353
Direct sales revenue			33,824,905		
Direct GDP impact			16,779,738		
Indirect GDP impact			3,487,971		
Direct plus indirect GDP			20,267,709		

Employment Calculations, B.C.

SIC	Sales Revenue ($,000.'s)	Direct Mult.	Direct Impact	Indirect Mult.	Dir+Indir Impact
327	31,856	0.01153	367	0.01403	447
965	1,969	0.02719	54	0.03225	64
Direct employment Impact			421		
Indirect employment Impact			90		
Direct + indirect employment			511		

Labour Income Calculations, B.C.

SIC	Sales Revenue	Direct Mult.	Direct Impact	Indirect Mult.	Dir + Indir Impacts
327	31,855,780	0.48057	15,308,932	0.55139	17,564,959
965	1,969,125	0.43869	863,835	0.55106	1,085,106
Direct labour income impact			16,172,768		
Indirect labour income impact			2,477,297		
Direct plus indirect impact			18,650,065		

* The category includes more than one product and price. The total value is based on the sum of each product's total value. For example, export lumber products include spruce, fir, and pine of different grades and sizes. Price information was obtained from the B.C.Council of Forest Industries (COFI), and the mills located along the Fraser River. Mill prices were used with the quantity of products associated with the particular mill. The remainder of the lumber tonnages were valued using the COFI spruce/fir/pine average price.

A second example is the automotive sector. Automobile imports include cars and trucks. To determine a total value, the automobiles had to be disaggregated into country of origin and automobile make. Values from the Statistics Canada Commodity Imports by Country could then be used to determine a contry of origin value, and consequently and total Fraser Port automobile import value.

Fraser River Harbour Commission provided statistics showing the quantity of automotive imports by country of origin. The quantity of different makes, however, had to be estimated using data from the Commodity Imports by Country publication. For example, a percentage of total automobiles entering Canada in the less than or equal to 1000CC displacement gas engine category was calculated for Japan. The quantity of automobiles entering Fraser Port from Japan was then multiplied by that percentage to provide a Fraser Port quantity of 1000CC automobiles. A per unit landed price for 1000CC automobiles was calculated for Japan and applied to the quantity, thus producing a total value for Japanese 1000CC automobiles entering Canada via Fraser Port. Values were calculated in this manner for eight automobile sectors representing over 90% of total automobiles entering Canada and for each country shipping automobiles via Fraser Port.

** The commodity values are based on average prices of similar commodities.