METHODOLOGY FOR DETERMINING WASHINGTON STATE VALUE-ADDED OF FREIGHT MOVED IN WASHINGTON CORRIDORS

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METHODOLOGY FOR DETERMINING WASHINGTON STATE VALUE-ADDED OF FREIGHT MOVED IN WASHINGTON CORRIDORS

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16. ABSTRACT

Determining the marginal value of improved freight mobility along a corridor requires full information on tonnage, dollar value of freight movements and services used in moving these products and the value-added characteristics of those products. This report investigates whether a practical methodology, applicable in the real world, can estimate value-added components of freight moving on Washington's transportation system. Determining this value-added can be done with the methodology identified in this study though it was found that specific data availability varied heavily from commodity to commodity, from corridor to corridor and project to project. The general results, and restructive assumptions and data deficiencies necessary for statewide analysis, cast doubt on specific findings. Regional or highway segment analysis can be more precise, if the data are locally developed. The basic model, consisting of knowledge about traffic levels, commodity composition, commodity value and value added of the commodity can reveal the importance of a corridor or region of interest to the state's economy.

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EXECUTIVE SUMMARY

BACKGROUND AND METHOD OF ANALYSIS

The Issue

Efficient freight mobility is the result of successfully balancing the demand for transportation capacity and service with the quantity supplied of those services and capacities. Attaining this balance requires accurate assessment of transportation demands and the value of those demands in order to prioritize the provision of facilities and capacity to achieve efficient freight mobility. Basic knowledge of freight flows on state highways, county roads and city streets (hereinafter collectively called roadways), along with waterways and railways, is needed to generate basic information on the physical consumption of those roadways caused by the traffic using the infrastructure. Such information, often expressed in terms of tonnage on roadway segments or ton-miles on railways, can be used in the planning the physical maintenance, preservation or expansion of facilities. In fact, Washington State has adopted annual tonnage as the measure to identify its strategic freight corridors, primarily because the data can be readily generated or obtained for roadways, waterways and railways.

Determining the marginal or incremental value of improved freight mobility along a segment or corridor necessitates that more detailed information be used. Identification and prioritization of freight project or activities by total benefit to the state means planners have to move past physical tonnage to higher quality information. A fuller set of descriptors might include tonnage (as is currently used), dollar value of freight movements, dollar value of transportation services in moving these products, and the value-added characteristics of those products and commodities being moved. Of these, state value-added holds the promise of realistically reflecting public benefits to the state, although it must be acknowledged that freight value has proponents.

The value-added of freight requires information on whether it is a final product, input to another value-added activity and whether the value-added occurs within the state economy. Thus, the amount of value-added in a product movement varies depending on the extent of processing and transportation done within the state. These values vary significantly from commodity to commodity, product to product, industry to industry, and market to market, depending on forward and backward linkages. Markets in international trade may have less or more value-added potential than domestic markets. Location of the movement in a corridor, within the supply chain for a commodity, will also affect magnitude of the value-added. Are the products (inputs) used locally by other local industries or is there leakage outside of the state's economy as the product moves on?

Potential bias from alternative structures may occur since raw tonnage figures may bias corridor identification to routes with significant volumes of bulk commodities while value may bias corridor-identification and investment to routes with high-valued, but not high local value-added, goods moving through the state. As indicated above, Washington State value-added should highly correlate with moving freight of economic importance to the state. Any such estimates of value-added of moving freight include the value-added (wages, profits, rents, etc.) of the freight itself as well as the value-added (wages, profits, rents, etc.) of transporting the freight.

The Objectives

The general purpose of this research effort is to investigate whether a practical methodology, applicable in the real world of incomplete and often conflicting data, for estimating Washington State's value-added component of freight moving on Washington's transportation system (rail, truck, water) can be identified. Specific objectives are to:

- Develop a conceptual framework of freight flows within Washington State and relate freight tonnage, value and value-added measures to the framework.
- Identify data readily available in the state and federal arenas for freight tonnage, value and value-added, characterizing it as to source, structure, frequency, cost of generating and compiling, etc.
- Apply various methodologies for determining value-added to a limited set of case studies that represent international and domestic movements, transportation services provided, different freight modes, and various product/good categories.
- Identify the practical advantages and limitations of using a value-added measure compared to tonnage and value figures.
- Determine and recommend approaches to using freight value-added as a measure, if feasible to do so.

Method of Analysis

The conceptual model is one of focusing on the value-added of freight moving in a corridor or system segment. Such information provides an estimate of the economic activity or business benefit occurring in the state of Washington. The first step is to determine commodity composition and the relative tonnage of the different commodities moving in any corridor or region under examination, followed by a determination of the total market value of those commodities. The next critical step is to determine how much of that value was derived or "built within the state". Then, by multiplying the tonnage, the unit value as the relative value-added component, in the appropriate commodity distribution for the corridor, an assessment of the overall importance of that transportation segment to the economy can be made available to policy and decision makers in the state.

The focus of this analysis is the development of other descriptions, above tonnage and volume of the commodity, that detail the value-added to the state. This is analyzed by the use of transportation accounts as they are available. Transportation accounts (or payments/charges in the economy) are found within the input-output (I-O) accounting framework. These transportation accounts – particularly the direct requirements table – provide the basis for computing the value and value-added associated with transportation services by industry and commodity. These estimates are then put on a per-unit basis to derive value-added estimates per ton.

This analytical approach was applied to four case studies within the state of Washington. The resultant analyses reveal the type of data and information that are currently available, and the source of those data. Complete data series are found to be lacking in some degree in each of the value-added case study estimates. The case studies of Whatcom County border traffic, containers via Puget Sound ports, grain shipments on the Columbia-Snake River System and apple movements in Washington, were chosen to reflect bulk versus high value products, import versus domestic products, and differing modes of transportation.

FINDINGS

Data Availability

The amount of specific data available varies heavily from commodity to commodity, from corridor to corridor and project to project. Fairly complete data can be found for those movements via barge or rail modes of transportation. Less specific, but still detailed as to volume, are the data movements into and out of ports. The serious data deficiency is in the highway freight movement by truck, where little information on composition by commodity of the freight traffic exists. Only through the use of the extensive, and only at one point in time, database developed by the Eastern Washington Intermodal Transportation Study (EWITS) or the data generated by specific project surveys such as those around Blaine, Washington, can the critical composition by commodity be developed. In other instances, the data are mostly too aggregate or partial in coverage. Thus, any effort to determine value added by the transportation service would, in those cases, require new and extensive surveys. Current information does not exist.

Case Study: Whatcom County – Cross Border Trade with Canada

Information available for cross-border trade with Canada is specific with regards to commodity movements and mode of transportation. Data unavailable in this case are specific transportation coefficients (charges) for export and import movements of commodities. Information on the share of commodity movements by transportation modes was utilized. Subsequently, direct requirements coefficients from transportation accounts of Whatcom County I-O table value of commodities were applied to give an approximate estimate.

Whatcom County: Value of Trade, Value of Transportation Services, and Value-Added of Transportation Services from Cross-Border Trade, 2000

	Value of Trade ($000)	*Truck Transport Charge*	*Rail Transport Charge*	*Truck Value-Added*	*Rail Value-Added*
Imports from Canada	$9,456,420.9	$135,436,895	$1,568,317	$54,286,886	$941,504
Exports to Canada	$2,441,024.4	$36,014,955	$629,646	$14,435,799	$377,994
Total	$11,897,445.3	$171,451,851	$2,197,963	$68,722,685	$1,319,498

Shortcomings of using this methodology in Whatcom County are generally due to a lack of precise data. It was assumed that the general transportation coefficients obtained from the direct requirements table could be utilized in cross-border trade movements. How close these proxies are to the "true" transportation charges cannot be determined without an updated IO analysis of regional flows. Also assumed was that all of the associated transportation charges for cross-border trade movements are collected by transportation services residing in Whatcom County, an assumption that could result in overestimating the local value added.

Case Study: Apple Movements in Washington

Information available for apple movements in Washington is specific with regards to the fruit growing region and mode of transportation. The only data unavailable in this case were specific transportation coefficients for the movement of apples. Apples are grouped with all fruits within the IO framework. Thus, it was assumed that the transportation charges associated with the movement of apples is equivalent to all fruits—tree fruit, berries, and grapes. In this case study, we utilized the share of apple movement by transport mode from prior surveys. Then, transportation coefficients were applied to the value of apple production in the two district region for both truck and rail transport. These respective truck and rail transportation charges are equivalent to the value of output for truck transportation and rail transportation associated with the movement of apples in the six-county region. As value-added measures for truck and rail are derived from value of output, truck and rail value-added are estimated based on the model's share of truck and rail output value.

Yakima and Wenatchee Regions: Value of Production, Value of Transportation Services, and Value-Added of Transportation Services from Apple Movements, 2000

Apple region	*Value of production*	*Truck Transport charge*	*Rail Transport charge*	*Truck Value-Added*	*Rail Value-Added*
Yakima region	$216,720,000	$1,613,945	$12,082	$607,997	$7,155
Wenatchee region	$354,750,000	$2,641,875	$19,776	$995,233	$11,713
Total	$571,470,000	$4,255,821	$31,858	$1,603,230	$18,868

Some limitations potentially associated with the use of this methodology for apple movements do exist. First, all values—production, transport charges, and transport value-added—are only for the movement of apples within this six-county area. Given that apples are the region's dominant export, transportation services are utilized beyond the region. Estimation of the value of these transportation services for apples beyond the Yakima-Wenatchee region was not made in this analysis, again due to lack of precise data. Furthermore, no effort was made in estimating the value of transportation services associated with value-added apple production, that is, the movement of processed apple products (e.g., apple juice, sauce, chips, dried apples) from the region because such processing information was not currently available. Only transportation charges associated with the movement of raw apples was included in the analysis.

Case Study: Grain Shipments from Eastern Washington

Information available for grain shipments in Washington is again specific with regards to the agricultural districts and mode of transportation. Data unavailable in this case were the transportation coefficients for the movement of specific grains. In this case study, we approximated this by utilizing the share of grain shipments by transport mode from prior surveys. Then, we applied direct requirements coefficients from transportation accounts of Eastern Washington regional I-O table value of commodities. These transportation coefficients are applied to the value of apple production in the two district region for both truck and rail transport. These respective truck and rail transportation charges are equivalent to the value of output for truck transportation and rail transportation associated with grain shipments in the ten-county region. As value-added measures for truck and rail are derived from value of output, truck and rail value-added are estimated.

Eastern Washington: Value of Grain Shipments, Transportation Services, and Value-Added of Transportation Services by mode, 2000

Mode of transport	*Value of grain shipped by mode*	*Transport charges*	*Value-Added*
Railroad	$266,664,718	$1,232,719	$722,945
Truck	$3,207,308	$48,444	$19,102
Barge	$188,314,775	$97,045	$27,757

There are some limitations associated with the use of this methodology for grain shipments. First, all values—production, transport charges, and transport value-added—are only for grain shipments within this ten-county area. Given that grains are the region's dominant export, transportation services are utilized beyond the region, destined ultimately for final foreign markets. Estimation of the value of these transportation services for grain shipments beyond the East-central and Southeast region could not be made in this analysis because of lack of data.

Case Study: Containers via Puget Sound Ports

Container load terminals in Seattle and Tacoma are significant foci of international commerce. Information on the value of transportation services associated with the movement of containers at these port facilities does not result in a credible analysis for this case study for the following reasons. Transportation-specific information in the model direct requirements table, for instance, assumes production occurring within Washington State. Containers placed on ships at the Ports of Seattle and Tacoma ultimately destined for foreign export markets are filled with commodities and products produced throughout the state and beyond. Containers off-loaded from ships at the Ports of Seattle and Tacoma are ultimately destined for domestic markets, in-state and out-of-state. Additional information on the shares of transportation mode by commodity is unavailable.

A general finding is that the intermodal component of container throughput generates a portion of the direct economic activity in the following businesses, among some others (trucking, warehousing, etc.). The gross business income of these selected firms has increased from $1.9 billion in 1994 to $2.3 billion in 1999.

Gross Business Incomes of Intermodal-Related Businesses in Washington State

SIC	*Description*	*1994*	*1999*	*CAGR 94-99*
4011	Railroads, Line-haul Operating	$533,252,778	$660,950,000	4.4%
4412	Deep Sea Foreign Trans. Of Freight	$4,718,123	$1,542,811	-20.0%
4449	Water Transportation Of Freight, Nec	$54,495,402	$37,365,975	-7.3%
4491	Marine Cargo Handling	$617,717,630	$724,630,000	3.2%
4492	Towing And Tugboat Service	$258,946,637	$322,660,000	4.5%
4499	Water Transportation Services, Nec	$58,991,895	$85,815,786	7.8%
4731	Freight Transportation Arrangement	$430,276,292	$468,880,000	1.7%
4789	Transportation Services, Nec	$34,259,408	$17,356,956	-12.7%
	Subtotal	$1,992,658,165	$2,319,201,528	3.1%

Source: BST Associates, data from Washington State Department of Revenue

A preliminary estimate of the individual components of the intermodal economic activity was determined by using the following generalized approach:

Approximately $200 per container, including port charges, longshore labor and other port-related expenses (for equipment etc) are expended. At 1.75 TEUs per container, there are 512,000 full containers eastbound and 512,000 full/empty containers westbound or 1,024,000 containers in total generating a value added estimate of $204.8 million in 1999.

STUDY PURPOSE AND ORGANIZATION

PROBLEM STATEMENT

Efficient freight mobility is the result of successfully balancing the demand for transportation capacity and service with the quantity supplied of those services and capacities. Attaining this balance requires accurate assessment of transportation demands and the value of those demands in order to prioritize the provision of facilities and capacity to achieve efficient freight mobility. The need for prioritization arises particularly when funds are limited, because investments should be allocated to where the marginal returns of mobility are the highest. These economic truisms are as applicable to the public sector as they are to the private sector. However, public sector entities unlike their private sector counterparts, often experience difficulty in determining the benefits that result from public investments in freight-related infrastructure and activities.

Knowledge of traffic flows (needs) is required in several senses. Basic knowledge of freight flows on state highways, county roads and city streets (hereinafter collectively called roadways) along with waterways and railways is needed to generate basic information on the physical consumption of those roadways caused by the traffic using the infrastructure. Such information, often expressed in terms of tonnage on roadway segments or ton-miles on railways, can be used in the planning the physical maintenance, preservation or expansion of facilities. In fact, Washington State has adopted annual tonnage as the measure to identify its strategic freight corridors, primarily because the data can be readily generated or obtained for roadways, waterways and railways.

Determining the marginal or incremental value of improved freight mobility along a segment or corridor necessitates that more detailed information be used. Identification and prioritization of freight project or activities by total benefit to the state means planners have to move past physical tonnage to higher quality information. A fuller set of descriptors might include tonnage (as is currently used), dollar value of freight movements, dollar value of transportation services in moving these products, and the value-added characteristics of those products and commodities being moved. Of these, state value-added holds the promise of realistically reflecting public benefits to the state, although it must be acknowledged that freight value has proponents.

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The ports in the state of Washington create specific value as they aid, enhance and generate international trade, as well as aiding in some domestic movements, such as movements on the Columbia-Snake waterway. The availability of capacity in ports, above that needed for Washington production and consumption provides value and benefits to movements important in a national context. Similarly, some roadways where local production and consumption is low may well be providing value to products moving through the area via the local collector and distribution function. Benefits can be larger in scope and magnitude than just county or region production/consumption.

Potential bias from alternative structures may occur since raw tonnage figures may bias corridor identification to routes with significant volumes of bulk commodities while value may bias corridor-identification and investment to routes with high-valued, but not high local value-added, goods moving through the state. As indicated above, Washington State value-added should highly correlate with moving freight of economic importance to the state. Any such estimates of value-added of moving freight include the value-added (wages, profits, rents, etc.) of the freight itself as well as the value-added (wages, profits, rents, etc.) of transporting the freight.

PROJECT PURPOSE AND OBJECTIVES

The general purpose of this research effort is to investigate whether a practical methodology, applicable in the real world of incomplete and often conflicting data, for estimating Washington State's value-added component of freight moving on Washington's transportation system (rail, truck, water) can be identified. Underlying themes are to determine:

- Can it be done?
- How should it be done?
- How does it compare with alternate approaches (tonnage, value)?
- At what level (state, regional, local, corridor, project) is it useful?

Specific objectives are to:

- Develop a conceptual framework of freight flows within Washington State and relate freight tonnage, value and value-added measures to the framework.
- Identify data readily available in the state and federal arenas for freight tonnage, value and value-added, characterizing it as to source, structure, frequency, cost of generating and compiling, etc.
- Apply various methodologies for determining value-added to a limited set of case studies that represent international and domestic movements, transportation services provided, different freight modes, and various product/good categories.
- Identify the practical advantages and limitations of using a value-added measure compared to tonnage and value figures.
- Determine and recommend approaches to using freight value-added as a measure, if feasible to do so.

SOURCES AND CHARACTERISTICS OF FREIGHT DATA CURRENTLY AVAILABLE

The Transportation Research Board (TRB) Committee on Freight Transportation Data prepared a report in 2000 summarizing the current state of freight data[1]. Such reports offer a descriptive evaluation of the "condition" of the data necessary to determine value and value added of movements.

[1] Source: TRB Committee on Freight Transportation Data, Chairman: Paul Bingham, WEFA, Inc., Freight Transportation Data Report by Kathleen L. Hancock, University of Massachusetts at Amherst.

A variety of freight transportation data are currently available, from microscopic, local survey data to macroscopic, national commodity flow data and from hard-copy improvement plans to digital data sets stored on electronic media. Sources of data include individual shippers, forwarders, and carriers; private vendors and consultants; and public agencies. However, use and availability of this information are limited by several considerations:

- How can private companies provide information without compromising their competitive advantage?
- How do users identify the data needed to address their problems?
- How do users locate appropriate data?
- How do users decide whether the available data can be used to solve those problems?
- How can users link data sets?
- How do users acquire data that are not currently available or have not yet been collected?

Understanding these issues and the limitations of currently available data sets is the starting point to determine freight flows, values and value added. Several areas were identified in this study as requiring new data or the new packaging of existing data in order to achieve the above goals; these are outlined below.

Small Area Commodity Flow Data

The degree of detail required to record small area commodity flow is necessary if data are to be modeled and assigned to regional highway and railroad networks. Currently, federal agencies are unable to release information for public use unless it is aggregated into multi-county zones; state and local agencies often do not have the resources necessary for gathering such detailed information; thus, specific detailed data on commodity composition (related to value added determination) are not available.

Transborder Data

Under contract with the U.S. Bureau of the Census the U.S. government receives unpublished data on U.S. exports and imports, via rail, truck, water, and pipeline, with Canada and Mexico. Certain information, such as the Mexican state of destination for U.S. exports is coded and keyed by the U.S. Bureau of the Census. The U.S. Bureau of Transportation Statistics of the U.S. Department of Transportation (DOT) and the U.S. Army Corps of Engineers (water transportation) post public information files on their websites.

The major data element missing from information for U.S. exports and imports is weight, which is necessary to determine tonnage and value added. Obtaining weight data for surface modes of transportation will make it easier to compare the data across modes, corridors and commodities.

Currently, the Railroad Carload Waybill Sample required by the U.S. Surface Transportation Board does not retrieve data from most shipments that terminate in Canada (that is, on Canadian railroads). Few shipments from Mexico to the United States are recorded, and U.S. exports to Mexico are indicated as terminating at U.S. border points.

With the growth of inter-country freight traffic under the North American Free Trade Agreement (NAFTA), a NAFTA waybill sample would allow recording of complete movements along the United States, Canada and Mexico; such a waybill sample does not currently exist.

Small Railroad Data

Precise information about how many freight railroads operate in the United States is difficult to obtain. The American Association of Railroads conducted a survey of operating railroads in 1997 and received responses from 507 local and 34 regional railroads in addition to the Class I railroads. Information about parameters such as major commodities hauled and origin and destination also would be useful to the goals of this study.

Intercity Trucking Data

In addition to existing shipper-based surveys such as the Commodity Flow Survey (CFS), a carrier-based survey similar to that used for domestic water transportation would provide better routing information about origin, destination, value, hazardous materials designation, and weight. In contrast, shipper-based surveys are better linked to industrial activity. Again, such a carrier-based survey does not exist.

Regional and Local Truck Trips

Data on truck trips from warehouses to retailers are needed to measure local traffic and value added. The total number of trips to convenience stores, grocery stores, gas stations, and similar facilities might not vary greatly among cities with comparable populations. This pattern will reduce survey requirements; further, it would allow more precise determination of commodity and traffic movements.

Time Dimension of Freight Data

Time recognition and tracking information could provide measures of our transportation system's productivity related to the value of the product carried. Issues such as just-in-time and next-day delivery as well as time- sensitive commodities (fresh food) also must include temporal considerations in logistics and planning activities which affect the value, and even value added, as a result.

For many uses of freight data, linking data sets together could provide the requisite information to address such value issues. However, this task is difficult to achieve because of limitations caused by several kinds of inconsistencies:

- In the terms, phrases, codes, acronyms, and collection tools between and across modes (locations, commodities, vessel and vehicle types, and facilities);
- In geographic codes and references across databases; and
- Between U.S. military, commercial, and public uses and time frames of the transportation infrastructure and the data collected to support evaluation and planning for those uses.

Freight Data Collection

Current efforts to collect surface freight data consist primarily of surveys, whereas water transportation data are submitted by domestic carriers and by foreign shippers and carriers for each movement. CFS data are submitted by shippers in response to a survey from the U.S. Bureau of the Census. Rail waybills are submitted by rail carriers in response to a survey from the U.S. Surface Transportation Board. Local agencies and private consultants request information via surveys sent to local shippers, carriers, and forwarders. The burden is on the companies to provide freight data.

The potential for unobtrusive freight data-collection methods is very high, especially given the expansion of advance technologies such as electronic data interchange (EDI), intelligent transportation systems for commercial vehicle operation (ITS-CVO), global positioning systems (GPSs), web site data retrieval and assembly, and automated freight-handling activities. Development and use of these technologies could, in the future, provide several benefits to the research for the data necessary for this study, such as:

- Less paperwork for survey-laded companies (e.g., shippers, carriers, consignees).
- Reduced burden from public and agency data collection requirements, while still maintaining the necessary data.
- Improved completeness, quality, and timeliness of data and statistics for decision making.
- Consistent information about hazardous materials, making it possible to link hazard codes and commodity codes.

Freight Data Dissemination

Traditionally, freight data have been disseminated as hard copies of reports and tables, on magnetic tape and related media, and, more recently, over the Internet. As the Internet has become widely accessible to the public via the World Wide Web, it has become the preferred mode for providing users with data, either directly (as downloadable files) or indirectly (by informing users of data available for purchase).

For this study, the biggest limitation of information dissemination via the Internet was determining which data are available. One possible way to minimize this limitation is to establish processes across federal and state agencies to maximize the distribution of data and products. Such procedures would cover the assessment of distribution media and the creation of supporting interagency and international teams to establish and implement standardized terms, codes, access protocols, and sharing protocols. At the current time, such procedures were not available for this study effort.

In summary, improving our understanding of how to utilize freight transportation data, in whatever form it is available, in examining value added will involve the use of data and statistics from all available sources (see references). This in turn will ultimately rely on improvements in the completeness, quality, and timeliness of the data; in their collection, processing, and distribution; in ways to minimize the associated costs; and in assigning confidence limits on publicly distributed transportation data and statistics. Such data parameters will be necessary to provide the detailed commodity/corridor/value information critical in determining value added.

METHODOLOGY AND APPROACH

CONCEPTUAL MODEL

How important is transportation to the state's economy? What is the value of transportation within various sub-state regions, such as counties or transportation corridors? What is the value of product movements within the state? What freight project or activity offers greater potential economic benefits to the state? These queries are currently addressed with information on physical units, namely tonnage, vehicle counts, or some combination (e.g., ton-miles). These measures, however, do not adequately answer these questions. After the data has been collected and analyzed, we still do not know the value of product movements within sub-state regions or how to prioritize freight mobility projects based on economic benefit measures. The principal problem stated at the outset of this study was determining the marginal or incremental value of freight movements along a transportation segment or corridor. Existing data on tonnage, vehicle counts, and dollar value of freight movements have historically been utilized to assess the magnitude of flows on transportation corridors.

The process, or model, to determine value added to Washington State of a movement in a corridor or region of interest is quite straightforward. The basic information needed is an estimate of the tonnage being moved through that corridor or region. As suggested earlier, these data are often the most readily available. But the next step is critical, determining the commodity/product profile or composition of the traffic. Then, the value of that total investment can be determined by adding per unit/ton estimates of value, by commodity, to the analysis. Finally, the commodity characteristics critical to determining value added, e.g. manufacturing/growing in state, processing in state, transportation in state, etc, can be added to the value/value commodity profile picture to offer estimates of the value added to the state's economy of a particular movement. Thus, traffic + commodity + value + value added can reveal the importance of a corridor or region of interest to the state's economy.

A working set of hypotheses could be that a) bulk commodities, though high in volume, are low in value for the state, versus b) bulk commodities may be high in value added because they are produced, processed, marketed and transported within the state compared to imported computer who, while high in value, create little economic value for the state.

DATA AND MODEL STRUCTURE APPLICATION

Data do exist on the value of freight transportation services for the state and sub-state regions. These transportation services are generally presented by mode of transportation, such as railroad, motor freight, water transportation, and air transportation. Information on employment, wages & salaries and number of establishments can be obtained on a county basis for each transportation service sector. Unfortunately, information on transportation services is not collected on a sub-state segment or corridor basis. The review of previous data sources suggests costs of obtaining such information are simply prohibitive.

The focus of this conceptual model is the development of other descriptors for freight transportation corridors in Washington State. These descriptors are value-based and are found with varying degrees of success within the set of transportation accounts with sub-state regional specificity.

On a national basis, transportation accounts provide a systematic and consistent framework and data set for conducting analytical studies of transportation in the economy, both from an industry and commodity basis. These transportation accounts cover all activities related to the use of vehicles (such as trucks, aircraft, boats, trains) and related structures (including highways, airports, port facilities) for the movement of goods and passengers. In this study, we are most concerned about freight mobility, the efficient multi-modal movement of goods. Source: U.S. Transportation Satellite Accounts for 1996 Bingsong Fang, Xiaoli Han, Sumiye Okubo, and Ann M. Lawson. Survey of Current Business, May 2000.

Transportation accounts are found within the input-output (I-O) accounting framework. These I-O accounts provide detailed estimates of intermediate purchases by industries, including transportation industries. They also provide an analytical framework with detailed linkages among and between industries and final demand. Such a framework facilitates various estimates of the interdependencies between transportation and the rest of the economy. Transportation accounts use the following input-output accounting conventions:

- Overall industry and commodity classification system and the special definitions;
- Total value-added (or gross domestic product) by all industries is the same in transportation accounts; and
- All transactions are valued in producers' prices, the valuations of purchases for final use remain unchanged. Transportation costs—costs to move commodities from producers to purchases—are the same.

The latest national transportation accounts (1996) consists of six groups of for-hire transportation industries from the I-O accounts and a single group for in-house transportation.

- Railroads and related services; and passenger ground transportation (railroads, including AMTRAK; switching and terminal companies; private local and suburban transportation; intercity, rural and other bus services, including charter and school buses; bus terminal and service facilities; and taxicabs);
- Motor freight transportation and warehousing (including trucking and courier services, except air; public warehousing and storage; and trucking terminal facilities);
- Water transportation (including deep sea and other water transportation of freight, water transportation of passengers; services incidental to water transportation, including marinas and other services);
- Air transportation (including domestic and international passenger and freight transportation; and airport terminal services).
- Pipelines, freight forwarders, and related services (including refined petroleum pipelines; other pipelines, including crude petroleum and natural gas; arrangement of freight and passenger transportation, including freight forwarding; and miscellaneous services incidental to transportation).
- State and local government passenger transit.
- In-house transportation (including private trucking and bus operations in all non-transportation industries.

The for-hire transportation activities are consistent with published input-output accounts. In addition, the transportation accounts estimate the own-use transportation services (truck or bus) provided internally by non-transportation industries, particularly agriculture, construction, wholesale and retail trade, and services. Own-account transportation cover such activities as transporting groceries from a company's warehouse operations to its retail outlets by the company's truck fleet and local delivery services provided by small retailers.

Transportation accounts data are presented in four tables—make (production) table, use (consumption) table, direct requirements table, and industry-by-commodity total requirements table. An I-O make table shows the value in producers' prices of each commodity produced by each industry. An I-O use table shows the values, again in producers' prices, of transportation and all other intermediate and value-added inputs consumed by industries of final users. In the direct requirements table, each cell shows the direct requirement per dollar output of the industry for the commodity. These cells are also referred to as the "direct requirements coefficients." The sum of an industry's direct requirement coefficients for intermediate inputs and value-added categories is equal to one. The final table, industry-by-commodity total requirements, shows the total requirements coefficients for each industry's output that is directly and indirectly required to deliver a dollar's worth of goods and services to consumers and other final users. Each column shows the commodity delivered to final users, whereas each row shows the demand for an industry's output in response to a dollar increase in the final demand for a commodity.

These transportation accounts—particularly the direct requirements table—provide the basis for computing the value and value-added associated with transportation services by industry and commodity. On an aggregate basis for each commodity and industry, the associated transportation costs (margins) can be calculated for each transportation mode/sector. In turn, the amount of value-added associated with each of these transportation services can then be calculated. Thus, this technique, when combined with tonnage and value parameters, can offer valid estimates of value added to the state.

LIMITATIONS

There are some definite limitations in the most recent transportation accounts jointly released by the US Department of Transportation, Bureau of Transportation Statistics and the US Department of Commerce, Bureau of Economic Analysis, as identified in the review for this study. These limitations are grouped under transportation cost specificity and geographic specificity.

With respect to transportation cost specificity, not included in these transportation accounts are detailed data on the transportation margin (or cost) embodied within each cell of the direct requirements table. At present, the direct requirements for transportation by each industry is an aggregate cost value; that is, the transportation margin is a summation of transportation expenses associated with moving intermediate inputs to the industry as well as the transportation expenses of moving the various commodities to final users. In other words, no distinction between inputs and output is made within the transportation margin. Sectoral (industry and commodity) information is readily available, but this vector of transportation costs associated with each industry's inputs and output has not been available for years and most likely will not be provided in the future.

The transportation accounts make no distinction regarding origin and destination of products/commodities. The transportation accounts assume that the outlay for transportation services applies to those domestic industries. This becomes a significant issue in sub-national and sub-state regions where pass-thru trade and handling of exports and imports plays a more prominent role, especially, as will be seen later, in the handling of the imports and exports from Washington ports.

The other major limitation of these transportation accounts is they are only national in geographic scope. As such, national transportation accounts have limited applicability for individual states and sub-state regions. Geographic detail required for the analysis could be obtained from state and sub-state specific transportation accounts.

As in the national I-O accounts, the transportation accounts are imbedded within each of the available state and sub-state input-output tables. Unfortunately, the Washington State and derived Eastern Washington and Puget Sound tables are dated (Chase et. al, 1993; Chase and Pascall, 1996; and Chase, 1996). Given the required geographic specificity, the input-output modeling program available is Impact Analysis for Planning (IMPLAN) (MIG, Inc., 2000). IMPLAN, originally developed by the USDA Forest Service in 1979, consists of national-level technology matrices and estimates of regional data for institutional demand and transfers, value-added, industry output, and employment for each county in each state.

Unlike the national transportation accounts, no distinction is made between for-hire and own-account transportation services in the IMPLAN models. Although the IMPLAN modeling program offers geographic specificity down to the county-level, the value and value-added of transportation services at the transportation segment or corridor level (i.e., sub-county level) can only be measured with varying degrees of confidence.

DOLLAR VALUE OF TRANSPORTATION SERVICES

Similar to the national input-output accounts, the IMPLAN model provides a number of input-output accounting tables, including direct requirements. The direct requirements table presents data on industry use of intermediate and value-added inputs as a percentage of the industry output. The direct requirements table is derived from the transactions table by dividing each industry's intermediate and value-added inputs by that industry's total output. Each column shows, for the industry named at the head of the column, the input coefficients for the intermediate inputs and for the value-added components that an industry directly requires to produce a dollar's worth of output for that industry. For each industry column, all input coefficients for intermediate inputs and value-added components sum up to 1.0. Here, our particular focus for this study is on transportation charges per dollar value of commodity production and movement. Transportation charges here only include for-hire transportation services. Own-account transportation services, split-out on the national transportation accounts, are not as such in the IMPLAN accounts. For-hire freight transportation services include the following sectors:

Railroad transportation (SIC 40), including line-haul operating and railroad switching and terminal establishments.

Motor freight transportation and warehousing (SIC 42), including local trucking, "over-the-road" trucking, public warehousing and storage, and terminal facilities.

Water transportation (SIC 44), including deep sea foreign and domestic transportation of freight, and services incidental to water transport.

Air transportation (SIC 45), including air courier services, air cargo, and airport terminal services.

Pipelines, except natural gas (SIC 46), including crude and refined petroleum pipelines.

Transportation services (SIC 47), including arrangement of transportation of freight and cargo, rental of railroad cars, and miscellaneous services incidental to freight transportation.

In general, the approach is to determine the cost of transportation by commodity by tracing back to the direct requirements matrix for transportation by mode for each major product grouping that is being moved from production source to market. The direct requirements matrix unbundles the various inputs associated with production of a dollar of commodity output. As stated earlier, transportation services within the direct requirements table will include the transportation charge (per dollar of commodity output) associated with the movement of all inputs and output for that commodity. Although the focus of this exercise is product movements to market, there are substantial movements of inputs for the on-site commodity production.

Generally, the steps in applying this approach are as follows:

a. Obtain direct requirements—focus on transportation charges by mode for each industry sector.

b. Apply this coefficient to the value of product movements to determine the value of transportation service by mode for each industry sector. This value will be a summation of costs associated with transport of inputs and product outputs for the industry.

c. Value of transportation service by mode is equivalent to output for that transportation sector for the movement of that particular commodity or industry.

VALUE ADDED OF TRANSPORTATION SERVICES

IMPLAN provides value-added coefficients for each industry in its direct requirements table. In order to obtain these value-added measures of transportation services, value-added coefficients are applied to the amount of each transportation sector output associated with commodity/industry movement.

SUMMARY

The conceptual model is one of focusing on the value-added of freight moving in a corridor or system segment. Such information provides an estimate of the economic activity or business benefit occurring in the state of Washington. Again, the first steps are to determine commodity composition and the relative tonnage of the different commodities moving in any corridor under examination, followed by a determination of the total market value of those commodities. The next critical step is to determine how much of that value was derived or "built within the state". Then, multiplying the tonnage, the unit value and the relative value-added component, in the appropriate commodity distribution for the corridor, an assessment of the overall importance of that transportation segment to the economy can be made available to policy and decision makers in the state. The success of such an effort is dependent on the availability of data at each juncture in this conceptual model.

CASE STUDIES

Determining a methodology to identify value added of movements is dependent on both data availability and value added estimates. The following case studies reveal the general type of data and information that are currently available (some useful to this study and others not), and the source of those data. The final section will apply the I-O methodology to those data. The case studies in the state of Washington were chosen to examine bulk versus high value percent products, import traffic versus domestic products and differing modes of transportation in the state.

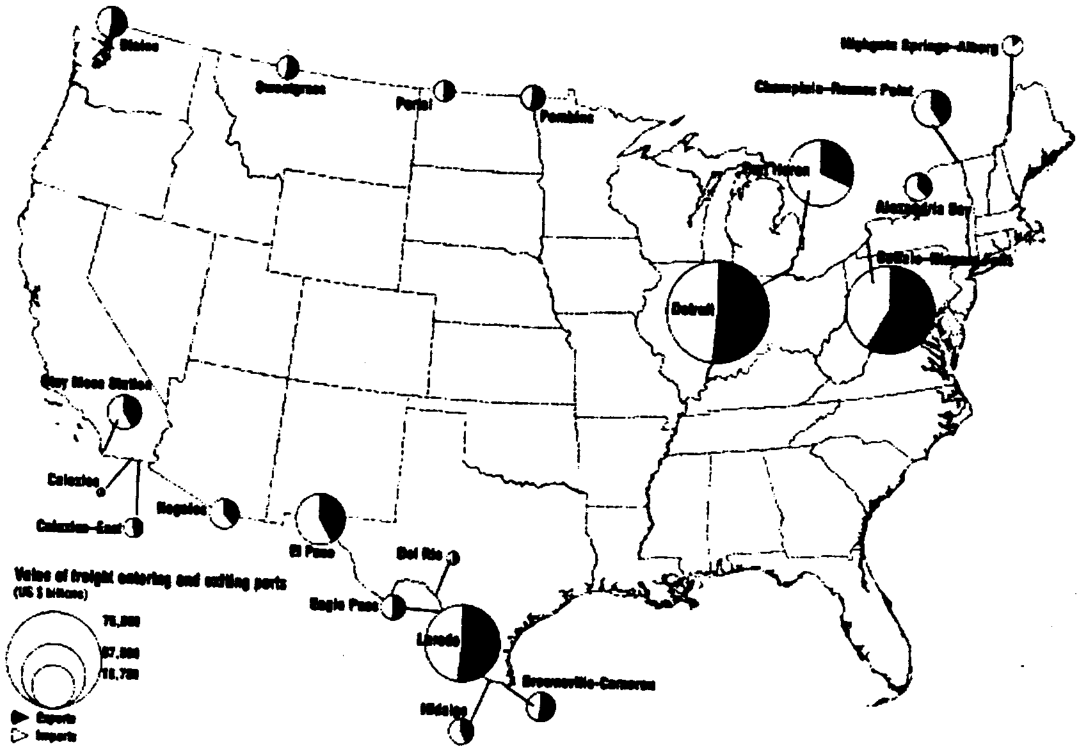
CASE STUDY: WHATCOM COUNTY BORDER TRAFFIC

This section evaluates the flow of trade across the border in Whatcom County at three border crossings (Pacific Highway at Blaine, Sumas and Lynden).

Relative Size

Blaine was the fifth largest border crossing along the U.S./Canadian border in 1998, as reported by the U.S. Surface Transportation Board. Only Detroit, Buffalo, Port Huron and Champlain-Rouses Point, all of which are in the east, handled more freight (Figure 1). Blaine is by far the largest border crossing in the west, with the Sweetgrass crossing in Montana and Pembina crossing in North Dakota approximately half as large. The U.S. Customs Department reported that Blaine was the fourth busiest commercial truck crossing on the U.S. Canadian Border in 1999.

Figure 1 U.S. Border Crossings



NOTES: Data include transshipments between the United States and Mexico. Trade levels reflect the mode of transportation as a shipment entered or exited a U.S. Customs port. Alaska is not shown as its border land ports do not fit the criteria for inclusion in this figure.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, Transborder Surface Freight Data, 1996.

Direction of Trade by Mode

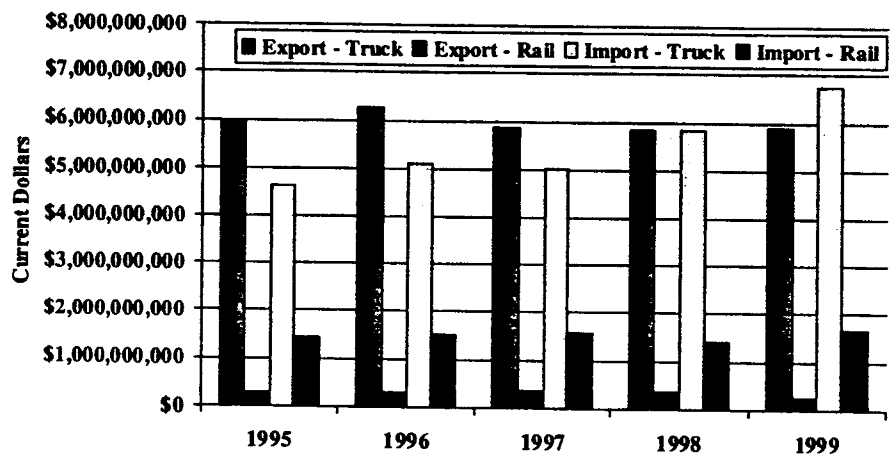
The total value of trade crossing the border via the Seattle Customs District[2] increased from $12.3 billion in 1995 to $14.6 billion in 1999, or at 4.3% per year (approximately 2.0% per year after adjusting for inflation). Most (90%+) of this traffic crosses the border in Whatcom County.

However, exports declined slightly (-0.4%) while imports gained steadily (8.6%), reflecting the difficult economic conditions in B.C. and particularly the relatively low value of the Canadian dollar (Figure 2). As the value of the Canadian dollar declines, the

[2] This includes Blaine, Sumas, Lynden, Oroville and Frontier, but the great majority of this traffic moves through the Whatcom County border crossings.

value of U.S. exports to Canada is also expected to decline and the value of U.S. imports expected to increase.

Figure 2 Value of Traffic Crossing Canadian Border via Seattle Custom District



Most of the trade with Canada through the Seattle Customs District occurs by truck (87%), with only 13% moving by rail. By value, there is more than six times the amount of import rail traffic as compared with export rail traffic. Truck traffic is more evenly distributed across imports and exports. WSDOT is currently studying the opportunities of diverting trucks to rail along the I-5 corridor, in order to reduce truck traffic in the congested areas of the corridor (Everett-Seattle-Tacoma and Vancouver-Portland).

Import Trade

There is significant diversity in the origin of Canadian imports moving thorough the Seattle Customs District - most are from British Columbia but some are also from Ontario, Manitoba, and Alberta. More than 90% of the imports moved by road into the Seattle Customs District from Canada are generated in British Columbia. The majority of overland imports moving into the Seattle Customs District by road are destined for the three West Coast states but there are substantial imports that move to other inland states (e.g. primarily Texas, Illinois, Idaho). Washington state alone accounts for approximately 43% of these imports by road (including imports from British Columbia, Ontario and Manitoba) but many are headed to transload or distribution facilities and are destined for other states. The top ten province of origin and state of destination pairs are provided in Table 1.

Table 1 Imports by Road and by Destination through Seattle Customs District (Current $)

Rank	*Prov*	*State*	*1995*	*1999*	*Share*	*Growth*
1	BC	Washington	1,607,502,830	2,051,029,511	30.3%	6.3%
2	BC	California	519,216,038	909,447,265	13.4%	15.0%
3	Ont	Washington	50,928,902	600,957,839	8.9%	85.3%
4	BC	Oregon	388,608,214	554,944,014	8.2%	9.3%
5	Man	Washington	84,788,021	243,961,205	3.6%	30.2%
6	BC	Texas	109,818,405	187,401,847	2.8%	14.3%
7	Ont	California	9,108,185	120,931,459	1.8%	90.9%
8	BC	Illinois	61,414,146	114,874,753	1.7%	16.9%
9	BC	Idaho	64,798,077	88,022,129	1.3%	8.0%
10	Ont	Oregon	9,510,987	87,374,695	1.3%	74.1%
		Other	1,695,316,628	1,805,535,997	26.7%	1.6%
		Total	4,601,010,433	6,764,480,714	100.0%	10.11%

Source: BST Associates using data from the U.S. Surface Transportation Board

The origins and destination for rail imports into the Seattle Customs District are even more diverse than those moving by road (Table 2). Trade between British Columbia. and the three West Coast states accounts for slightly more than one-quarter of this trade. Alberta generates a substantial amount of rail-borne imports (in terms of value) and inland states receive a substantial amount of imports. Most of these movements are not transloaded and provide less of an opportunity for this corridor unless an overweight corridor or some other cost competitive advantage can be designed to attract the cargo to the local corridor.

Approximately 59% of the imports from Canada through the Seattle Customs District are wood and related products (including lumber, wood chips and related products). Other key products include:

- Paper And Paperboard (7.5% of total),
- Lime And Cement (5.5% of total),
- Pulp and Scrap (8.5% of total),
- Beverages, Spirits And Vinegar (1.2% of total), and,
- Fertilizers (1.8% of total)

Table 2 Imports by Rail and by Destination through Seattle Customs District ($)

Rank	*Prov*	*State*	*1995*	*1999*	*Share*	*Growth*
1	BC	Washington	150,287,801	182,898,708	10.9%	5.0%
2	BC	California	214,857,952	168,450,390	10.1%	-5.9%
3	Alb	Washington	93,784,983	124,848,678	7.5%	7.4%
4	BC	Oregon	105,980,171	111,988,720	6.7%	1.4%
5	Alb	California	86,913,034	108,427,121	6.5%	5.7%
6	BC	Texas	68,521,568	88,403,323	5.3%	6.6%
7	Alb	Oregon	40,978,569	60,181,573	3.6%	10.1%
8	BC	Arizona	34,359,797	58,746,023	3.5%	14.4%
9	BC	Minnesota	56,665,281	49,489,380	3.0%	-3.3%
10	BC	Colorado	25,191,918	47,153,255	2.8%	16.9%
		Other	582,300,746	673,495,988	40.2%	3.7%
		Total	1,459,841,820	1,674,083,159	100.0%	3.5%

Source: BST Associates using data from the U.S. Surface Transportation Board

Export Trade

The I-5 corridor is strongly represented in trade with Canada. Washington, Oregon and California accounted for approximately 54% of exports to Canada through the Seattle Customs District by value. Other states (notably Illinois, Texas, Pennsylvania and Ohio) account for the remaining 46% of exports. (See Table 3). The value of exports moving by rail is very low when compared with the value moving by truck, for cargo shipped through the Seattle Customs District from the U.S. to Canada. Road transport accounted for 96% of these exports, with rail accounting for the remaining 4%. Approximately 90% of the U.S. exports that move by road through the Seattle Customs District to Canada cross the border in Whatcom County (i.e., Blaine, Lynden and Sumas account for 84.9%, 5% and 0.3% of these exports, respectively, in terms of value)[3]. Approximately 93% of the U.S. exports that move by rail through the Seattle Customs District to Canada cross the border in Whatcom County (i.e., Blaine and Sumas account for 81.0% and 12.3% of these exports, respectively, in terms of value).

Table 3 Origin of Exports to Canada by State and Mode (Value)

Origin	*Road*	*% Road*	*Rail*	*% Rail*	*Total*	*% Rail*
Other	1,968,524,893	33.4%	132,828,176	50.7%	2,101,353,069	34.2%
Washington	1,478,910,269	25.1%	14,587,628	5.6%	1,493,497,897	24.3%
California	1,274,114,647	21.6%	19,259,789	7.3%	1,293,374,436	21.0%
Oregon	499,470,198	8.5%	15,408,612	5.9%	514,878,810	8.4%
Illinois	241,896,306	4.1%	40,942,045	15.6%	282,838,351	4.6%
Texas	164,740,186	2.8%	14,979,986	5.7%	179,720,172	2.9%
Pennsylvania	147,726,462	2.5%	14,823,056	5.7%	162,549,518	2.6%
Ohio	113,068,684	1.9%	9,378,010	3.6%	122,446,694	2.0%
Total	5,888,451,645	100.0%	262,207,302	100.0%	6,150,658,947	100.0%

Source: BST Associates using data from the U.S. Surface Transportation Board

[3] The remaining exports move through the crossings in Oroville and Boundary.

The commodity group that accounts for the largest share of exports by road from the United States to British Columbia, through all Customs Districts, is wood and articles of wood, which accounts for nearly 70% of all exports in 1999 (Table 4). Coniferous wood moldings account for the largest share of this category (15.1%). Engineered lumber is the next largest commodity (14.2% of exports by volume).

Other important commodity groups include:

- mineral fuels (6.6% of total), consisting primarily of primarily jet fuel, petroleum coke and unleaded gasoline 16.5%.
- paper and paperboard (3.8% of total) consisting mainly of kraft linerboard,
- inorganic chemicals (3.8% of total),
- iron and steel (2.3% of total), and,
- other (11.4% of total).

Most of these commodities move by road (92.0%). However, a larger share of inorganic chemicals (32.8%) and lime and cement (48.9%) move by rail.

Table 4 Major Export Commodities (estimated metric tons)

Commodity	*Road*	*% of Total*	*Rail*	*% of Total*	*Total*	*% of Total*
Wood and Articles of Wood	7,099,507	96.4%	266,033	3.6%	7,365,540	69.2%
Mineral Fuels	629,123	89.8%	71,513	10.2%	700,636	6.6%
Paper and Paperboard	368,670	90.9%	36,696	9.1%	405,366	3.8%
Inorganic Chemicals	268,189	67.2%	131,095	32.8%	399,284	3.8%
Iron and Steel	203,217	84.8%	36,290	15.2%	239,507	2.3%
Lime and Cement	162,476	51.1%	155,333	48.9%	317,809	3.0%
Other	1,064,638	87.7%	149,138	12.3%	1,213,776	11.4%
Total	9,795,820	92.0%	846,098	8.0%	10,641,918	100.0%

Source: BST Associates using data from the U.S. Surface Transportation Board

Truck Traffic Movements

The following section reviews the relative importance of border generated traffic as a percentage of all Whatcom County truck traffic.

Truck Traffic

The number of trucks coming from Canada to the U.S. via Whatcom County border crossings has increased at 7.9% per year between 1991 and 2000 (Table 5). Trucks at the Blaine crossing increased 7.8%, Sumas 8.8% and Lynden at 7.2%. Blaine accounts for 75% of the truck traffic, Sumas 18% and Lynden 7% of the total in 2000.

Table 5 Southbound Truck Traffic

Year	*PacHwy*	*Lynden*	*Sumas*	*Total*
1991	262,662	27,509	57,838	348,009
1992	278,307	19,785	62,343	360,435
1993	287,838	21,629	78,550	388,017
1994	328,153	22,104	84,059	434,316
1995	368,835	19,842	94,412	483,089
1996	402,090	27,889	94,008	523,987
1997	463,074	32,938	89,863	585,875
1998	539,306	37,206	93,915	670,427
1999	491,885	44,877	117,974	654,736
2000	516,829	51,330	123,420	691,579
CAGR 91-00	7.8%	7.2%	8.8%	7.9%

Source: Whatcom Council of Governments using data from US Customs

The number of trucks going from the U.S. into Canada via Whatcom County border crossings has increased at 9.2% per year between 1991 and 2000 (Table 6). Trucks at the Blaine crossing increased 10.2%, Sumas 6.7% and Lynden at 5.3%. However, exports from the US have been more sluggish since 1995, as a result of the decrease in the Canadian exchange rate. Blaine accounts for 79% of the truck traffic, Sumas 10% and Lynden 11% of the total in 2000.

Table 6 Northbound Truck Traffic

Year	*PacHwy*	*Lynden*	*Sumas*	*Total*
1991	206,425	43,664	35,156	285,245
1992	193,007	38,782	42,152	273,941
1993	313,306	37,152	36,075	386,533
1994	348,045	37,971	47,842	433,858
1995	396,807	35,958	65,206	497,971
1996	391,637	37,227	70,664	499,528
1997	394,979	44,595	63,919	503,493
1998	393,449	56,576	60,210	510,235
1999	428,878	62,184	64,558	555,620
2000	495,166	69,316	63,093	627,575
CAGR 91-00	10.2%	5.3%	6.7%	9.2%

Source: Whatcom Council of Governments using data from Canadian Customs

The number of trucks on I-5 at Lakeway Drive averages 7,520 per day in 1999 (Table 7). This includes:

- 2,820 single-axle trucks, which mainly serve local Whatcom County business traffic, and,
- 4,700 double or triple axle configurations, which originate at major manufacturers, distributors and retail outlets in Whatcom County and also include most of the Canadian border traffic.

The border traffic averaged 3,329 trucks per day in 1999 from all three crossings (2,523 trucks per day at the Pacific Highway, 293 at Lynden/Aldergrove, and 500 at Sumas/Huntingdon[4]). Lakeway Drive is located far enough south that it captures the border traffic from all three crossings.

Border traffic accounts for a very large portion of truck traffic in Whatcom County:

[4] Includes traffic counts in both directions.

- approximately 44% of all truck traffic in Whatcom County at Lakeway Drive, and,

- approximately 88% of the double and triple rig traffic at Lakeway Drive [5].

Table 7 Truck Traffic in Whatcom County (Average Daily Truck Traffic in 1999)

Location	*Single*	*Double*	*Triple*	*Total*
		Number of Axles		
I-5				
Before Ramp to Lakeway Drive	2,820	3,290	1,410	7,520
After Ramp to SR 542	2,160	3,780	1,620	7,560
After Ramp to SR 539	2,100	2,940	840	5,880
Pacific Highway Truck Border Crossings				2,548
SR-542 Mount Baker Highway				
After Junction with SR 9	270	108	54	432
SR-539 Guide Meridian				
After Junction with Kelly Road (Bellingham)	1,190	340	170	1,700
After Junction with Front Street (Lynden)	550	440	330	1,320
Lynden/Aldergrove Truck Border Crossings				315
SR-543 Blaine Truck Border Route				
After Junction with Boblett Street	1,600	1,100	400	3,100
Sumas/Huntingdon Truck Border Crossings				466

Source: BST Associates using data from Washington State Department of Transportation, US Customs and Stats Canada

[5] Assumes that most border truck traffic is transported in double and triple rig configurations. Some border traffic is immediately transloaded to U.S. trucks and/or the BNSF railroad. However, most passes directly through onto I-5 and passes by Lakeway Drive.

Suitability of Data for Value-Added Analysis

The above data provide a rich picture of the overall movements. There are three types of movements that are of special interest in this value-added study because they could, and probably do, generate different value-added characteristics:

- First, some products moving through the Whatcom County borders originate in Washington State. For these exports from Washington State, it is possible to evaluate the full impact of the production by commodity type (matching SIC codes).
- Second, some imports are destined for Washington State. For imports, the relationship is less clear but it may be possible to do a more detailed impact estimate.
- Third, pass through cargoes (northbound or southbound) may create handling charges or related freight economic activity charges for Washington State.

The following table describes related data from surveys by Census to give a broader perspective on this movement. Data are also available from all-modes data for imports moving from Canada into the Seattle Customs District. These data offer a sense of the transportation and port services provided and the magnitude of those changes. Such data are utilized later in the value added determination.

Table 8 Estimate of Transportation Charges in Trade With Canada (Million Current $)

Receipts	***1996***	***1997***	***1998***	***1999***
Freight & Port Services Total	2,394	2,414	2,317	2,479
Freight Total	1,816	1,905	1,856	1,967
Freight Ocean	32	54	59	52
Freight Air	59	69	71	76
Freight Other	1,725	1,782	1,726	1,839
Port Services Total	578	509	461	512
Port Services Ocean	60	68	38	63
Port Services Air	358	287	263	282
Port Services Other	160	154	160	167
Payments	***1996***	***1997***	***1998***	***1999***
Freight & Port Services Total	2,790	3,037	2,910	3,224
Freight Total	2,249	2,415	2,285	2,510
Freight Ocean	112	131	97	101
Freight Air	60	80	56	62
Freight Other	2,077	2,204	2,132	2,347
Port Services Total	541	622	625	714
Port Services Ocean	131	165	158	170
Port Services Air	328	373	381	446
Port Services Other	82	84	86	98

Source: Survey of Current Business – Report on US International Services, US Bureau of Census

Table 9 Selected Washington County Transportation Sector Characteristics

Transportation Sector	*Industry Output ($ millions)*	*Employment*	*Employee Compensation ($ millions)*	*Proprietor Income ($ millions)*	*Other Property Indirect Income ($ millions)*	*Total Business Tax ($ millions)*	*Value Added ($ millions)*
Railroads	10.878	61	4.318	0.000	1.917	0.295	6.530
Local, Interurban Transit	6.155	198	2.760	0.432	0.424	0.075	3.691
Motor Freight Transport	127.998	1,206	31.674	7.504	10.188	1.940	51.305
Water Transportation	35.306	155	8.604	0.254	3.082	0.944	12.885
Air Transportation	31.741	310	11.523	0.528	3.412	1.541	17.004
Pipe Lines, Ex. Natural Gas	1.862	3	0.219	0.000	0.847	0.130	1.196
Arrangement of Pass Transport	6.790	137	2.660	0.269	1.233	0.153	4.315
Transportation Services	17.082	300	8.038	0.780	1.192	0.101	10.111

Source: Survey of Current Business – Report on US International Services, US Bureau of Census

Table 10 Whatcom County Modal Distribution by Commodity, Example of Commodities

Commodity/Product	*Percentage of Movements*						
	Total Transport	*Rail*	*Motor Freight*	*Water Transport*	*Air Transport*	*Pipeline*	*Freight Trans Srvs*
Dairy Farm Products	0.03267	0.00615	0.02452	0.00122	0.00002	0.00000	0.00076
Poultry and Eggs	0.02637	0.00406	0.01997	0.00168	0.00009	0.00001	0.00057
Ranch Fed Cattle	0.02737	0.00411	0.02045	0.00097	0.00002	0.00000	0.00183
Range Fed Cattle	0.01994	0.00299	0.01490	0.00070	0.00001	0.00000	0.00133
Cattle Feedlots	0.02682	0.00403	0.02003	0.00095	0.00002	0.00000	0.00179
Sheep, Lambs and Goats	0.02614	0.00392	0.01952	0.00092	0.00002	0.00000	0.00175
Hogs, Pigs and Swine	0.02595	0.00390	0.01938	0.00092	0.00002	0.00000	0.00173
Miscellaneous Livestock	0.03117	0.00392	0.01933	0.00166	0.00129		0.00496
Food Grains	0.02407	0.00260	0.01673	0.00420	0.00006	0.00006	0.00042
Feed Grains	0.02117	0.00146	0.01665	0.00254	0.00016	0.00002	0.00033
Hay and Pasture	0.02257	0.00156	0.01776	0.00271	0.00017	0.00002	0.00035
Fruits	0.01761	0.00070	0.01423	0.00162	0.00073	0.00003	0.00030
Tree Nuts	0.01519	0.00057	0.01324	0.00075	0.00039		0.00023
Vegetables	0.01620	0.00034	0.01432	0.00081	0.00047	0.00001	0.00025
Forest Products	0.01326	0.00047	0.01065	0.00124	0.00064		0.00026
Greenhouse and Nursery Products	0.01401	0.00006	0.00911	0.00084	0.00348	0.00002	0.00050
Forestry Products	0.00313	0.00018	0.00154		0.00124		0.00017
Commercial Fishing	0.00893	0.00008	0.00075	0.00769	0.00031	0.00000	0.00010
Agricultural, Forestry, Fishery Services	0.01441	0.00108	0.00956	0.00065	0.00262		0.00049
Landscape and Horticultural Services	0.00873	0.00006	0.00386	0.00010	0.00420	0.00001	0.00051
Gold Ores	0.00837	0.00061	0.00643	0.00037	0.00073	0.00001	0.00021
Metal Mining Services	0.00363	0.00026	0.00279	0.00016	0.00032	0.00000	0.00009
Dimension Stone	0.01533	0.00053	0.01293	0.00062	0.00091	0.00002	0.00032
Sand and Gravel	0.00924	0.00123	0.00635	0.00051	0.00088		0.00027
New Residential Structures	0.01998	0.00079	0.01709	0.00105	0.00068	0.00000	0.00037
New Industrial and Commercial Buildings	0.01194	0.00029	0.01059	0.00022	0.00061	0.00000	0.00023
New Utility Structures	0.00849	0.00015	0.00770	0.00014	0.00036	0.00000	0.00016
New Highways and Streets	0.03513	0.00076	0.02941	0.00378	0.00062	0.00000	0.00056
New Mineral Extraction Facilities	0.00038	0.00006	0.00022	0.00006	0.00004	0.00000	0.00001
New Government Facilities	0.00853	0.00015	0.00774	0.00014	0.00036	0.00000	0.00016
Maintenance and Repair, Residential	0.01656	0.00068	0.01385	0.00105	0.00067	0.00000	0.00032
Maintenance and Repair Other Facilities	0.01127	0.00038	0.00961	0.00069	0.00039	0.00000	0.00020
Maintenance and Repair Oil and Gas Wells	0.06350	0.00384	0.05228	0.00143	0.00446		0.00149
Meat Packing Plants	0.01024	0.00007	0.00866	0.00123	0.00013		0.00014
Sausages and Other Prepared Meats	0.01884	0.00042	0.01578	0.00014	0.00205		0.00047
Cheese, Natural and Processed	0.00896	0.00023	0.00636	0.00013	0.00193		0.00031
Condensed and Evaporated Milk	0.01065	0.00078	0.00692	0.00034	0.00222		0.00039
Fluid Milk	0.00920	0.00039	0.00613	0.00012	0.00221		0.00035
Pickles, Sauces, and Salad Dressings	0.04368	0.00188	0.03719	0.00089	0.00278		0.00095
Frozen Fruits, Juices and Vegetables	0.06277	0.00136	0.05488	0.00207	0.00323		0.00122

CASE STUDY: CONTAINERS VIA PUGET SOUND PORTS

Import and export movements of containers is a growing activity in the state. This section describes containers moving through Puget Sound Ports by rail (e.g., intermodal containers).

All Containers

On the West Coast of North America, the major container ports consist of Long Beach, Los Angeles, Oakland, Seattle, Tacoma, Vancouver, B.C., and Portland. As shown in Table 11, container traffic through these ports increased at 7.5% per year between 1990 and 2000. However, the rate of growth varied significantly between ports. The southern tier (Los Angeles, Long Beach, Oakland and San Francisco) averaged annual growth of 8.6%. The northern tier (Los Angeles, Long Beach, Oakland and San Francisco) has average annual growth of 5.3% during the past decade.

Table 11 West Coast Container Statistics (1,000s of TEUs[6])

Year	*Seattle*	*Tacoma*	*Portland*	*Vancouver BC*	*Oakland*	*San Francisco*	*Long Beach*	*Los Angeles*	*West Coast*
1990	1,171	938	163	323	1,124	140	1,598	2,117	7,573
1991	1,155	1,021	176	384	1,189	224	1,768	2,039	7,954
1992	1,151	1,054	217	441	1,291	188	1,829	2,289	8,462
1993	1,159	1,075	239	434	1,245	119	2,079	2,319	8,429
1994	1,414	1,028	318	494	1,423	66	2,574	2,519	9,891
1995	1,479	1,092	330	495	1,550	33	2,844	2,555	10,667
1996	1,474	1,073	302	617	1,480	6	3,067	2,683	10,702
1997	1,476	1,159	295	724	1,464	18	3,505	2,960	11,601
1998	1,544	1,156	259	840	1,575	18	4,098	3,378	12,869
1999	1,490	1,271	293	1,070	1,664	40	4,408	3,829	14,065
2000	1,488	1,380	291	1,200	1,777	60	4,601	4,879	15,676
AAGR 90-00	2.4%	3.9%	6.0%	14.0%	4.7%	-8.1%	11.2%	8.7%	7.5%

Source: BST Associates, data from individual ports

[6] A TEU is a twenty-foot long equivalent container. It serves as the main indicator for container comparisons in the maritime industry.

Seattle and Tacoma have been rather sluggish during this period, with growth of 2.4% and 3.9% respectively. Tacoma appears poised for more rapid growth than Seattle in the near future.

Vancouver BC has grown the most rapidly of all west coast ports at 14% per year between 1990 and 2000, reaching 1.2 million TEUs in 2000. Much of the growth has occurred from regaining Canadian in-transit cargoes (which previously moved through the Ports of Seattle and Tacoma) and containerization of breakbulk forest and agricultural exports. In addition, improvements to the route infrastructure, levels of service and pricing by the transcontinental railroads (Canadian National and Canadian Pacific) have helped Vancouver to attract more U.S. originating and destined cargo.

While Portland grew rapidly during the past decade, its throughput volumes were down slightly in 2000. They will likely decline further, as Evergreen has decided to stop calling at the Port. Evergreen accounted for 20% to 30% of the Port's business.

In absolute terms, the Ports of Long Beach and Los Angeles are the largest and have been growing rapidly, at 11.2% and 8.7% respectively. Los Angeles regained the title of largest container port in North America in 2000 from the Port of Long Beach. Oakland has also been growing relatively rapidly, with an average rate of 4.7%. It surpassed the 1.7 million TEU mark in 2000.

Full Containers

Table 12 identifies the number of full containers in international trades. Overall, the number of full containers has grown 2.7% per year, according to PIERs data. Imports have grown at 4.0% while exports have languished at 1.1% per year. As a result, imports have increased from 53% to 59% of all full international containers.

Table 12 Full Containers in International Trade

Year	*Imports*	*Percent*	*Export*	*Percent*	*Total*
1990	632,124	52.9%	562,829	47.1%	1,194,953
1991	672,773	53.7%	579,061	46.3%	1,251,834
1992	708,691	55.4%	570,872	44.6%	1,279,564
1993	722,184	55.8%	572,551	44.2%	1,294,735
1994	783,420	54.2%	660,981	45.8%	1,444,400
1995	776,136	51.8%	720,980	48.2%	1,497,116
1996	673,822	47.6%	742,931	52.4%	1,416,753
1997	741,266	50.3%	733,883	49.7%	1,475,150
1998	826,645	57.0%	623,261	43.0%	1,449,905
1999	899,723	59.1%	622,282	40.9%	1,522,006
CAGR 90-99	4.0%		1.1%		2.7%

Source: PIERS

Intermodal Activity

From an industry cost-efficiency standpoint, containers are typically moved to and from load centers. Load centers can include more than one port if they are geographically close to one another. For example, Los Angeles/Long Beach (LA/LB) ports are considered a single load center, as are Tacoma/Seattle, New York/New Jersey, Charleston/Savannah, among others.

In 1999, the top 10 North America load centers ranked by total TEU and rail intermodal TEU show LA/LB first, New York/New Jersey ranked second and Seattle/Tacoma ranked third.

According to data provided by the Ports of Seattle and Tacoma, approximately 59% of full international containers move by rail intermodal. Approximately 70% of imports move intermodally and 43% of exports.

As a percentage of full intermodal containers, imports account for 70% and exports, the remaining 30% (Table 13). This means that 355,477 full containers return from their inland destination either empty (approximately 178,000 TEUs) or filled with domestic cargo that is unloaded in the Puget Sound area (also approximately 178,000 TEUs).

What is apparent is that the data on commodities/products moved in the containers is not readily available. Such data may be dependent on individual primary surveys.

Table 13 Puget Sound Intermodal Container Activity in 1999 (TEUs)

		Intermodal		
Direction	*Total Full TEUs*	*Intermodal TEUs*	*% of Fulls*	*% of Intermodal*
Imports	899,723	625,625	69.5%	69.8%
Exports	622,282	270,148	43.4%	30.2%
Total	1,522,006	895,772	58.9%	100.0%

Source: BST Associates, data from individual ports

CASE STUDY: GRAIN SHIPMENTS ON THE COLUMBIA-SNAKE RIVER SYSTEM

This section evaluates the movement of grains, principally wheat, in the Columbia-Snake River corridor. It examines the feasibility of determining the value-added of this movement by presenting the results of a data search on production levels, destinations, modal shares, and value/value-added of the commodity. Data availability and data needs to determine value-added underlie and are emphasized in the discussion.

Grain Flows In The United States

The volume of grain moved on the Columbia-Snake River system is dependant on the quantity moved into the domestic and international markets, the relative competitive position among the modes, and the resultant modal splits. Aggregate data on the national modal splits for grain are available from Eriksen, et al. al. This analysis updates a 1992 study of grain movements by transportation mode by explaining data from 1978-95.

Modal utilization is highly dependent on the type of commodity being carried. Wheat producers rely on the mode most effectively available, rail versus water. As a result, the volume of grain moved, rather than water or truck tonnages, affects railroad tonnages more. Total grain tonnages increased strongly from 1978-95, reaching a peak of 380.3 million tons in 1995, an increase of 57% over 1978 (Table 14). However, grain exports decreased from 49% to 35% over that period; it is such movements that are most amenable to water transportation.

Table 14 Tonnages of U.S. grains transported by type of crop and type of movement, 1978-95 (1,000s of Tons)

Year	*Corn*	*Wheat*	*Soybeans*	*Sorghum*	*Barley & Rye*	*Oats*	*All Grains*
1978	102,198	61,471	53,879	13,281	7,165	3,813	241,807
1979	122,470	59,213	56,408	13,391	7,878	4,419	263,779
1980	142,869	62,725	59,452	11,808	8,493	4,158	289,505
1981	114,028	72,829	56,889	10,611	8,314	3,479	266,150
1982	116,188	70,701	61,177	13,276	7,914	2,170	271,426
1983	122,200	72,655	58,767	13,037	10,461	3,605	280,725
1984	125,854	79,725	52,732	17,837	11,116	3,930	291,194
1985	133,187	58,697	52,050	18,908	10,245	3,893	276,980
1986	124,368	60,078	58,339	17,153	12,177	4,142	276,257
1987	165,230	67,694	61,503	16,715	12,406	3,946	327,494
1988	177,003	75,698	56,318	22,054	11,304	3,789	346,165
1989	165,066	67,977	50,213	20,912	9,451	2,950	316,568
1990	171,990	65,123	53,849	19,961	10,517	3,451	324,890
1991	172,122	72,283	57,038	15,734	10,272	3,759	331,208
1992	176,473	68,392	62,049	17,019	9,288	3,117	336,337
1993	190,562	71,875	62,454	17,727	8,791	3,513	354,922
1994	167,348	72,999	61,855	17,738	10,884	3,385	334,208
1995	217,515	64,583	70,492	15,118	9,394	3,223	380,325
Exports:							
1978	55,162	37,584	22,822	2,680	716	206	119,170
1979	65,233	36,799	23,027	6,524	862	49	132,494
1980	69,492	39,407	24,006	8,813	1,798	107	143,623
1981	60,347	48,409	24,064	8,818	2,350	140	144,128
1982	53,780	44,954	28,081	6,630	1,522	42	135,009
1983	52,391	42,401	25,027	5,821	1,703	23	127,366
1984	53,947	46,566	21,476	7,487	2,187	16	131,679
1985	48,559	27,342	18,617	7,333	779	13	102,643
1986	29,795	27,152	23,566	4,559	1,803	34	86,909
1987	44,993	33,772	23,427	5,496	3,344	17	111,049
1988	51,211	44,640	19,674	7,140	2,405	14	125,084
1989	62,213	40,237	16,582	9,212	1,984	13	130,241
1990	57,450	27,445	16,933	7,456	2,386	11	111,681
1991	48,683	34,072	19,324	6,530	1,671	9	110,289
1992	47,349	38,647	21,820	8,326	2,047	79	118,268
1993	44,288	44,395	21,410	6,645	1,663	81	118,482
1994	39,198	33,647	25,096	6,362	1,706	16	106,024
1995	65,200	35,515	24,760	6,103	1,368	18	132,964

Table 14 Tonnages of U.S. grains transported by type of crop and type of movement, 1978-95 (1,000s of Tons) Continued

Domestic:							
1978	47,036	23,887	31,057	10,601	6,449	3,607	122,637
1979	57,237	22,414	33,381	6,867	7,016	4,370	131,285
1980	73,377	23,318	35,446	2,995	6,695	4,051	145,882
1981	53,681	24,420	32,825	1,793	5,964	3,339	122,022
1982	62,408	25,747	33,096	6,646	6,392	2,128	136,417
1983	69,809	30,254	33,740	7,216	8,758	3,582	153,359
1984	71,907	33,159	31,256	10,350	8,929	3,914	159,515
1985	84,628	31,355	33,433	11,575	9,466	3,880	174,337
1986	94,573	32,926	34,773	12,594	10,347	4,108	189,348
1987	120,237	33,922	38,076	11,219	9,062	3,929	216,445
1988	125,792	31,058	36,644	14,914	8,899	3,775	221,081
1989	102,853	27,740	33,631	11,700	7,467	2,937	186,327
1990	114,540	37,678	36,916	12,505	8,131	3,440	213,209
1991	123,439	38,211	37,714	9,204	8,601	3,750	220,920
1992	129,124	29,745	40,229	8,693	7,241	3,038	218,069
1993	146,274	27,480	41,043	11,082	7,128	3,432	236,439
1994	128,150	39,352	36,759	11,376	9,178	3,369	228,184
1995	152,315	29,068	45,732	9,015	8,026	3,205	247,361

Source: Eriksen, et. al.

Substantial shifts in modal share took place from 1978 to 1995 (Eriksen, et. al.). By the early 1990's truck had become the predominant mode of grain transportation (Table 15). These gains came at the loss of barge, which dropped from an average of 25% over 1978-1992 to 20% during the period 1991-1995. Barge export share increased slightly, from 45.7% in 1984 to 54.7% in 1994, compared to a decrease from 4.1% in 1984 to 2.5% in 1995 for domestic grain traffic. Again, it is clearly evident that water transportation of grain is heavily dependant on export volumes.

Table 15 Tonnages and modal shares for all U.S. grains, 1978-95

Year & Type of Movement	Mode of Transport					
	Rail		Barge		Truck	
	1,000 Tons	Percent	1,000 Tons	Percent	1,000 Tons	Percent
1978	117,087	48.4	50,814	21.0	73,905	30.6
1979	127,177	48.2	52,207	19.8	84,396	32.0
1980	143,402	49.5	60,495	20.9	85,608	29.6
1981	127,581	47.9	65,504	24.6	73,065	27.5
1982	121,188	44.6	71,855	26.5	78,383	28.9
1983	130,457	46.5	69,078	24.6	81,191	28.9
1984	124,984	42.9	66,808	22.9	99,401	34.1
1985	105,086	38.0	57,806	20.9	113,823	41.1
1986	115,094	41.7	51,835	18.8	109,327	39.6
1987	139,667	42.7	62,447	19.1	125,151	38.2
1988	151,145	43.7	62,753	18.1	132,268	38.2
1989	143,893	45.5	67,313	21.3	105,362	33.3
1990	134,999	41.5	72,001	22.1	118,074	36.3
1991	126,245	38.1	70,168	21.2	134,795	40.7
1992	135,681	40.3	76,162	22.6	124,494	37.0
1993	134,717	38.0	68,563	19.3	151,642	42.7
1994	124,489	37.2	64,968	19.4	144,751	43.3
1995	152,033	40.0	73,725	19.4	154,570	40.6
Exports:						
1984	58,247	44.2	60,194	45.7	13,238	10.1
1985	40,466	39.4	51,554	50.2	10,623	10.3
1986	34,892	40.1	45,108	51.9	6,908	7.9
1987	46,175	41.6	56,990	51.3	7,883	7.1
1988	56,204	44.0	58,480	46.8	10,400	8.3
1989	51,882	39.8	62,745	48.2	15,614	12.0
1990	62,501	47.4	62,501	47.4	6,880	5.2
1991	63,477	47.6	63,477	47.6	6,269	4.7
1992	68,424	46.9	68,424	46.9	9,017	6.2
1993	43,119	36.4	60,595	51.1	14,768	12.5
1994	27,722	26.1	57,966	54.7	20,336	19.2
1995	50,616	38.1	67,631	50.9	14,719	11.1

Table 15 Tonnages and modal shares for all U.S. grains, 1978-95 Continued

Domestic:						
1984	66,737	41.8	6,614	4.1	86,163	54.0
1985	64,620	37.1	6,252	3.6	103,200	59.3
1986	80,202	42.4	6,726	3.6	102,419	54.1
1987	93,492	43.2	5,457	2.5	117,268	54.2
1988	94,941	42.9	4,273	1.9	121,868	55.1
1989	92,011	49.4	4,568	2.5	89,748	48.2
1990	72,498	37.5	9,500	4.9	111,194	57.6
1991	62,768	31.7	6,690	3.4	128,526	64.9
1992	67,257	35.3	7,738	4.1	115,477	60.6
1993	91,598	38.7	7,968	3.4	136,873	57.9
1994	96,767	42.4	7,002	3.1	124,416	54.5
1995	101,417	41.0	6,094	2.5	139,851	56.5

Source: Eriksen et. al.

Wheat is the second largest crop, after corn, transported in the United States. As Eriksen et. al. found, most wheat transportation is concentrated in the Great Plains states, where no direct access to water transportation exists. Only the Columbia-Snake River system (white wheat in the Pacific Northwest) and the Mississippi River (soft red winter wheat in Corn Belt and Mississippi River Valley areas) have competitive access to barge transportation.

Table 16 indicates the tonnages and modal shares for U.S. wheat from 1978-1995. Barge displays a relatively flat trend in both tonnages and modal shares. During 1978-1995 barge carried 19% of wheat traffic, peaking in 1981 at 16.9 million tons or 23.2% of wheat movements. The export wheat movements again show a reliance on barge, reaching 31.6% in 1995. As is shown later in this report, the Columbia-Snake River system movements of white wheat are significantly higher compared to rail.

Table 16 Tonnages and modal shares for U.S. wheat, 1978-95

Year & Type of Movement	*Mode of Transport*					
	Rail		*Barge*		*Truck*	
	1,000 Tons	*Percent*	*1,000 Tons*	*Percent*	*1,000 Tons*	*Percent*
1978	44,449	72.3	10,248	16.7	6,773	11.0
1979	45,661	77.1	10,222	17.3	3,331	5.6
1980	49,631	79.1	12,876	20.5	218	0.3
1981	50,432	69.2	16,889	23.2	5,508	7.6
1982	52,590	74.4	16,330	23.1	1,781	2.5
1983	51,500	70.9	13,867	19.1	7,289	10.0
1984	49,507	62.1	15,992	20.1	14,226	17.8
1985	36,904	62.9	9,796	16.7	11,997	20.4
1986	39,578	65.9	9,465	15.8	11,035	18.4
1987	45,339	67.0	10,081	14.9	12,274	18.1
1988	54,788	72.4	13,706	18.1	7,204	9.5
1989	42,435	62.4	15,434	22.7	10,109	14.9
1990	38,101	58.5	12,472	19.2	14,550	22.3
1991	40,587	56.2	13,688	18.9	18,007	24.9
1992	44,165	64.6	14,964	21.9	9,263	13.5
1993	46,581	64.8	12,516	17.4	12,778	17.8
1994	40,336	55.3	12,620	17.3	20,043	27.5
1995	42,692	66.1	12,153	18.8	9,738	15.1
Exports:						
1984	28,429	61.1	14,168	30.4	3,969	8.5
1985	16,402	60.0	8,081	29.6	2,859	10.5
1986	16,050	59.1	8,043	29.6	3,059	11.3
1987	21,472	63.6	9,218	27.3	3,082	9.1
1988	28,600	64.1	12,888	28.9	3,151	7.1
1989	20,776	51.6	14,553	36.2	4,907	12.2
1990	15,937	58.1	11,260	41.0	248	0.9
1991	19,088	56.0	12,234	35.9	2,750	8.1
1992	19,805	51.2	13,831	35.8	5,011	13.0
1993	24,639	55.5	11,589	26.1	8,167	18.4
1994	14,883	44.2	11,932	35.5	6,832	20.3
1995	20,470	57.6	11,221	31.6	3,824	10.8

Table 16 Tonnages and modal shares for U.S. wheat, 1978-95 Continued

Domestic:						
1984	21,078	63.6	1,824	5.5	10,257	30.9
1985	20,502	65.4	1,715	5.5	9,138	29.1
1986	23,528	71.5	1,423	4.3	7,976	24.2
1987	23,867	70.4	863	2.5	9,192	27.1
1988	26,188	84.3	818	2.6	4,053	13.0
1989	21,659	78.1	880	3.2	5,201	18.7
1990	22,164	58.8	1,212	3.2	14,302	38.0
1991	21,499	56.3	1,454	3.8	15,257	39.9
1992	24,359	81.9	1,133	3.8	4,252	14.3
1993	21,942	79.8	927	3.4	4,611	16.8
1994	25,453	64.7	688	1.7	13,211	33.6
1995	22,222	76.4	932	3.2	5,914	20.3

Source: Eriksen et. al.

Grain Flows in the State of Washington

An intimate picture of the grain movements within and out of, Washington is available from the data sets of the Eastern Washington Intermodal Transportation Study (EWITS) by Washington State University. EWITS was a six-year study funded jointly by the Federal Government and the Washington State Department of Transportation as part of the Intermodal Surface Transportation Efficiency Act of 1991. A specific component of the 40-report EWITS work was a detailed study on the movement of wheat and barley to and from commercial elevators in the 16 counties of eastern Washington for the three-year period ending June 30, 1993. Unfortunately, no follow up studies have been produced, although a current updating study is now being done by the Department of Agricultural and Resource Economics at Washington State University under the Strategic Freight Transportation Analysis (SFTA) project.

The total volume moved per year during this study was 125,400,000 bushels of grain. The following percentage splits can be applied to that base movement. The destination of wheat shipments is predominately to Columbia River ocean elevators located between Portland, Oregon and Kalama, Washington (Table 17). Almost 80% of the wheat, with the bulk rail users shipping over 88%, moves to those elevators. Transshipments were mainly smaller elevators moving grain to multiple car loading facilities.

Table 17 Wheat Shipments by Destination

Destination	Percent			
	All	***Upcountry***	***Bulk Rail User***	***Bulk Rail Non-User***
Columbia River Ocean Elevators	79.5	73.2	88.4	78.6
Puget Sound Elevators	2.1	2.7	7.6	0.1
Transshipment to Other Houses	12.3	16.1	0.8	14.7
In-State Flour Mills	0.9	1.1	0.3	0.9
Vancouver, WA	0.3	0.4	0.9	0.1
Feedlots	-[1]	-	-	-
Other	4.8	6.3	2.0	5.3

[1]An omission means that no grain was shipped to that particular destination.

Columbia River ocean elevators were the destination for about 61% of barley (Table 18). Feedlots were the next highest destination with 16.9%; Vancouver mills received 10.2%.

Table 18 Barley Shipments by Destination

Destination	Percent			
	All	***Upcountry***	***Bulk Rail User***	***Bulk Rail Non-User***
Columbia River Ocean Elevators	60.9	51.7	36.4	86.9
Puget Sound Elevators	1.9	2.5	9.7	-[1]
Transshipment to Other Houses	4.5	5.9	-	2.2
In-State Flour Mills	-	-	-	-
Vancouver, WA	10.2	11.4	14.2	4.0
Feedlots	16.9	21.4	38.2	4.4
Other	4.6	6.0	1.4	2.1

[1]An omission means that no grain was shipped to that particular destination.

Truck-barge moved 61.3% of the wheat (Table 19). Since much of the transshipped grain ultimately goes via rail, about 33.9% actually moves by the 25/26-car mode. At elevators that do not ship wheat by bulk rail, over 80% of their wheat is shipped via truck-barge. Elevators with 25/26 car facilities ship 83% of this wheat by rail.

Table 19 Modes Used to Ship Wheat

	Percent			
Transportation Mode	***All***	***Upcountry***	***Bulk Rail User***	***Bulk Rail Non-User***
Truck to Other Houses[1]	12.5	16.3	0.3	14.6
Truck to Final Market	2.0	2.6	0.8	2.2
Truck-Barge	61.3	49.5	15.5	80.1
Single-Car Rail	0.9	1.2	-[2]	1.1
3-Car Rail	1.7	2.2	0.9	1.8
25/26-Car Rail	21.4	27.9	82.6	-
Other	0.1	0.2	-	0.1

[1]Most of this grain eventually moves as a 25/26-car rail shipment with the exception of grain in Garfield County, which ends up as a truck-barge shipment.
[2]An omission means that mode was not utilized to ship wheat.

Local markets such as dairies, cattle feeders and breweries play a much more important role in barley marketing than is true for wheat. As a result the modal mix for barley shipments is very different from that of wheat shipments (Table 20). Truck-barge is still the leading mode for barley shipments with 44.8%, with truck to final market and truck to other houses having 19.6% and 14.5%, respectively. Rail shipments were 20.6%, split evenly between 25/26 car and 3 car shipments.

Table 20 Modes Used to Ship Barley

	Percent			
Transportation Mode	***All***	***Upcountry***	***Bulk Rail User***	***Bulk Rail Non-User***
Truck to Other Houses[1]	14.5	19.1	4.3	5.6
Truck to Final Market	19.6	25.8	28.4	6.9
Truck-Barge	44.8	29.9	15.7	83.4
Single-Car Rail	1.1	1.4	1.4	0.4
3-Car Rail	9.6	10.2	15.1	3.4
25/26-Car Rail	9.9	13.0	35.0	-[1]
Other	0.2	0.3	-	0.1

[1]An omission means that mode was not utilized to ship barley.

Of use in determining the value-added of a commodity is how do storing and handling the grain generate value. The EWITS data show the storage rates were 2.04 cents per bushel per month, ranging from a low of no charge (but with a substantial handling rate) to 4.5 cents (Table 21). Over 85% of the elevators charged between 1.5 and 2.5 cents per bushel per month; almost half charged in the 1.5 to 2.0 cent range. Barley storage rates followed a similar distribution, with an average rate of 2.45 cents per bushel per month. Storage rates at upcountry elevators were lower than at river elevators, especially for wheat.

Table 21 Wheat and Barley Storage Rates

Rates (c/bu/mo)	***Wheat Number of Sites***	***Barley Number of Sites***
[0]	3	2
(0, 0.5]	9	8
(0.5, 1]	0	0
(1, 1.5]	15	7
(1.5, 2]	120	82
(2, 2.5]	103	93
(2.5, 4.5] (wheat only)	10	-
(2.5, 20.4] (barley only)	-	25
Total Sites Reporting	260	217

Handling charges for wheat and barley ranged from a low of no charge to a high of 18 cents per bushel (Table 22). Over 90% of reporting elevators had wheat handling rates in the 7 to 10 cent range, with over 40% reporting handling rates in the 7 to 8 cent range, generating an overall average of 8.23 cents per bushel. About 74% of the reporting elevators had barley-handling rates in the 7 to 10 cent range, with a similar average of 8.24. River elevator rates were slightly lower than handling rates at upcountry elevators.

Table 22 Wheat and Barley Handling Rates

Rates (c/bu)	*Wheat Number of Sites*	*Barley Number of Sites*
[0]	6	9
(0, 1]	0	0
(1, 2]	2	0
(2, 3]	0	0
(3, 4]	0	0
(4, 5]	2	0
(5, 6]	12	26
(6, 7]	11	4
(7, 8]	94	40
(8, 9]	34	53
(9, 10]	78	68
(10, 11]	4	2
(11, 12]	9	10
(12, 13]	0	0
(13, 14]	4	3
(14, 18]	4	2
Total Sites Reporting	260	217

Another important component of value-added is the cost of the transportation itself. A comparison and average experience by truck-barge versus bulk rail shipper is shown in Table 23. Bulk rail rates are lower than truck-barge rates for all counties except for those counties that did not use bulk rail. The average weighted rate for truck-barge is

38 cents per bushel and 34 cents for rail. Thus movements on the Columbia-Snake River system are experiencing a transportation-induced value-added of about 38 cents.

Table 23 Wheat Truck-Barge and 25/26-Car Rail Rates by County

County	Cents per Bushel	
	Truck-Barge[1]	25/26-Car Rail
Adams	33.47	28.21
Benton	29.93	-[2]
Chelan	47.10	32.20
Columbia	28.64	25.18
Douglas	47.10	34.41
Franklin	29.90	27.70
Garfield	28.81	25.70
Grant	40.23	32.51
Kittitas	-	-
Lincoln	41.51	33.83
Okanogan	47.10	39.20
Spokane	42.18	28.36
Stevens	46.36	-
Walla Walla	28.59	24.36
Whitman	33.74	25.85
Yakima	35.60	25.70

[1]Includes handling
[2]The omission of a rate means elevators in that county did not use the corresponding transportation mode.

Data, which are over 8 years old, as is this EWITS study, can be corroborated or updated by examining the modal splits by mode from various sources. The lower Columbia port dry bulks arrivals (note: this includes more than just grain) are available in forecasts of the 1999 Marine Cargo forecast (Columbus Group, et. al.). Columbus group et. al. found that two-thirds of the wheat and barley is received by export terminals by rail and one-third by barge (Table 24). They found that overtime no substantial changes were expected. Growth rates for the modal tonnage were forecasted to be 1.7% for both rail and barge, and 1.8% for truck.

Table 24 Lower Columbia Port Dry Bulks (1,000s of Metric Tons, % by Mode)

	Metric Tons (1,000s)					% by Mode			
Year	***Rail***	***Truck***	***Barge/Raft***	***Plant***	***Total***	***Rail***	***Truck***	***Barge/Raft***	***Plant***
1992	9,219	1255	3,904	500	14,878	62.0%	8.4%	26.2%	3.4%
1993	8,760	1186	4,335	442	14,723	59.5%	8.1%	29.4%	3.0%
1994	7,231	1175	4,720	489	13,614	53.1%	8.6%	34.7%	3.6%
1995	12,885	960	4,295	578	18,718	68.8%	5.1%	22.9%	3.1%
1996	9,980	668	4,369	406	15,423	64.7%	4.3%	28.3%	2.6%
1997	10,266	604	4,253	315	15,438	66.5%	3.9%	27.5%	2.0%
Forecast									
1998	8,711	615	4,187	328	13,840	62.9%	4.4%	30.3%	2.4%
1999	9,510	626	4,935	339	15,410	61.7%	4.1%	32.0%	2.2%
2000	9,711	637	4,856	351	15,555	62.4%	4.1%	31.2%	2.3%
2001	9,813	649	4,760	362	15,585	63.0%	4.2%	30.5%	2.3%
2002	10,263	661	5,116	363	16,402	62.6%	4.0%	31.2%	2.2%
2003	10,609	673	5,227	363	16,873	62.9%	4.0%	31.0%	2.2%
2004	10,861	686	5,332	364	17,242	63.0%	4.0%	30.9%	2.1%
2005	11,101	699	5,438	364	17,602	63.1%	4.0%	30.9%	2.1%
2010	12,222	766	5,719	366	19,072	64.1%	4.0%	30.0%	1.9%
2015	13,525	841	6,014	368	20,749	65.2%	4.1%	29.0%	1.8%
2020	14,987	916	6,325	370	22,598	66.3%	4.1%	28.0%	1.6%
Average Annual Growth Rate									
92-97	2.2%	-13.6%	1.7%	-8.8%	0.7%				
95-00	-5.5%	-7.9%	2.5%	-9.5%	-3.6%				
00-05	2.7%	1.9%	2.3%	0.7%	2.5%				
05-10	1.9%	1.8%	1.0%	0.1%	1.6%				
10-15	2.0%	1.9%	1.0%	0.1%	1.7%				
15-20	2.1%	1.7%	1.0%	0.1%	1.7%				
97-20	1.7%	1.8%	1.7%	0.7%	1.7%				

Source: 1999 Marine Cargo forecast (Columbus Group, et. al.)

A report based on unpublished data (Casavant) provides a broader longitudinal look at the volume and modal splits. These data, reported in EWITS, were developed by a comprehensive survey of all exporting firms merchandising grain through tidewater elevators. The sources of the grain are heavily eastern Washington and central United States.

Total grain receipts into the Columbia River elevators, the focus of this case study, are shown in Table 25. Modal shares are shown in Table 26. A fairly noticeable decrease and then recovery in total volumes of exports is evident, starting from 493 million bushels in 1980-81, decreasing to a low of 311 million bushels in 1985-86 to a record high of nearly 578 million bushels in 1995-96. This was followed by a decrease of 19% to 470 million in 1996-97 and 5% to 446 million bushels in 1997-98. Total receipts increased by 4.2%, to 464 million bushels in 1998-99 and then decreased slightly more than 10% to 417 million bushels in the 1999-2000 season. Ancillary data (Casavant) indicate the share of grain delivered to Columbia River exporters has increased during the past seasons while the share for Willamette River exporters has declined, reflecting the relative activity and capacity of the exporting grain terminals.

Table 25 Receipts of Grain Transported by Mode, in 1,000 Bushels, 1980-81 to 1999-00

Crop Year	*Rail*	*Barge*	*Truck*	*Total*
80-81	247,686	217,687	28,024	493,397
81-82	227,475	205,089	28,681	461,245
82-83	203,748	170,254	26,054	400,056
83-84	229,029	171,542	17,234	417,985
84-85	215,575	169,235	20,123	404,933
85-86	178,411	116,722	15,819	310,952
86-87	233,612	140,075	15,720	389,407
87-88	274,825	199,855	17,032	491,712
88-89	247,441	198,185	14,707	460,333
89-90	226,714	165,197	11,798	403,709
90-91	254,514	179,528	10,505	444,547
91-92	251,942	162,067	8,406	422,415
92-93	267,143	155,888	10,456	433,487
93-94	317,299	185,589	9,353	512,241
94-95	315,989	176,540	9,282	501,811
95-96	343,136	227,163	7,564	577,863
96-97	258,778	203,353	8,055	470,186
97-98	243,499	196,252	5,995	445,746
98-99	228,684	232,478	3,477	464,639
99-00	242,299	171,475	2,791	416,565

Table 26 Percent of Grain Transported by Mode, 1980-81 to 1999-00

Crop Year	Rail	Barge	Truck
80-81	50.2	44.1	5.7
81-82	49.3	44.5	6.2
82-83	50.9	42.6	6.5
83-84	54.9	41.1	4.0
84-85	53.2	41.8	5.0
85-86	57.4	37.5	5.1
86-87	60.0	36.0	4.0
87-88	55.9	40.6	3.5
88-89	53.8	43.0	3.2
89-90	56.2	40.9	2.9
90-91	57.2	40.4	2.4
91-92	59.6	38.4	2.0
92-93	61.6	36.0	2.4
93-94	61.9	36.0	2.4
94-95	62.9	35.2	1.9
95-96	59.4	39.3	1.3
96-97	55.0	43.3	1.7
97-98	54.7	44.0	1.3
98-99	49.2	50.0	0.8
99-00	58.2	41.1	0.7

Barge shipments show a general increase in volume since the 1985-86 and 1986-87 years. The number of bushels barged decreased from 218 million bushels in 1980-81 to 117 bushels in 1985-86. Barge transportation increased by 99% during the next 13 seasons and peaked at a record 232 million bushels during the 1998-99 season. In contrast to this trend, barge shipments reduced by 26% to 171 million bushels during the 1999-00 period.

Barge receipts have also experienced a fairly steady increase in modal share, with a more pronounced resurgence during the 1996-99 seasons (Table 26). Barge share had decreased from 44% in 1980-81 to a record low of 35% in 1994-95. However, in the 1995-96 crop years 39% of the grain was received by barge, an increase of 28% in volume over the previous year. In the following three seasons, barge share increased to

43.2%, 44% and 50% of total receipts, respectively. Barge shipments were reduced to 41.1% of the total delivered grain during the 1999-00 crop year.

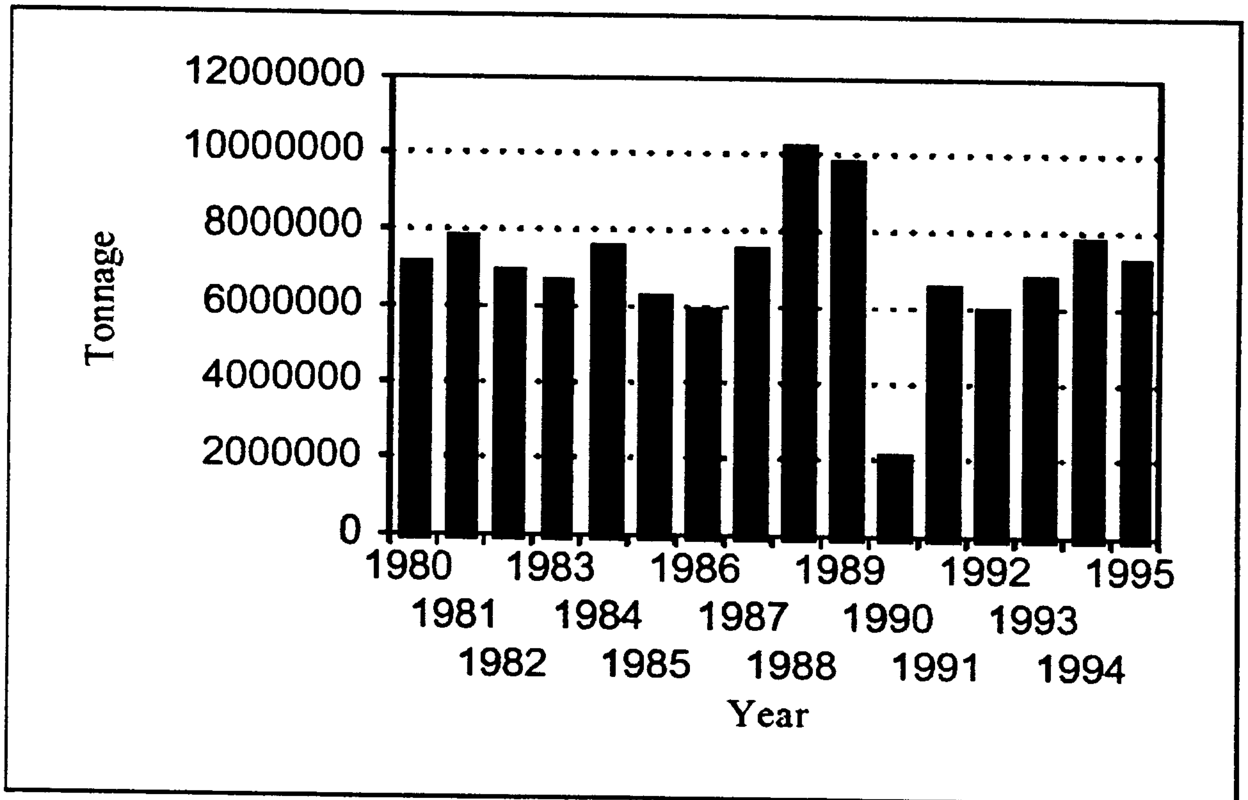
It is apparent that rail volumes closely follow total volumes. Thus, truck-barge movements could be considered to be a mover of traffic that is residual after rail capacity is utilized. Rail car shortages, a continual concern for capacity, are obviously not as important in low volume years as in the past season. In times of high grain volumes, the critical role played by barge transportation is evident.

Waterborne Commerce on the Columbia-Snake River System

A detailed analysis of all commodities moving on the Columbia-Snake River system is also available in the monthly Lock Tonnage Reports collected by the U.S. Army Corps of Engineers. Although sometimes characterized as imprecise data, this series is often used in the region and provides useful information on grain movement in the corridor.

It is quickly evident that the function of the river system in upriver movements is one of distribution, while it serves an assembly function in its downward direction (Lee and Casavant). Fuels and fertilizer travel upriver to the Tri-Cities area; forest and agricultural products are collected in the Snake River pools and moved to mainly international markets downriver. The average tonnage per year, between 1980 and 1995, traveling downriver was approximately 8 million tons (Figure 3). Several peaks in 1988 and 1989 are evident. Grains, in particular wheat, make up the majority of the total tons barged downriver (Table 27). Of the 112 million tons barged downriver between 1980 and 1995, 71% was grain. Grain movements, while fairly steady annually does show some seasonality (Figure 4). The source of these movements can also be examined by dam pool (Figure 5). Grains tend to accumulate throughout the Snake River pools. Wheat is continuously added to barges at Lower Granite, Little Goose, Lower Monumental, Ice Harbor and McNary before the tonnage levels off and the wheat continues on to Bonneville. Some grain is added onto or taken off along the way, but not in significant quantities. The overall distribution of commodity movements, especially wheat, is summarized in Figure 6.

Figure 3 Total Annual Tonnage Barged Down River, 1980 to 1995



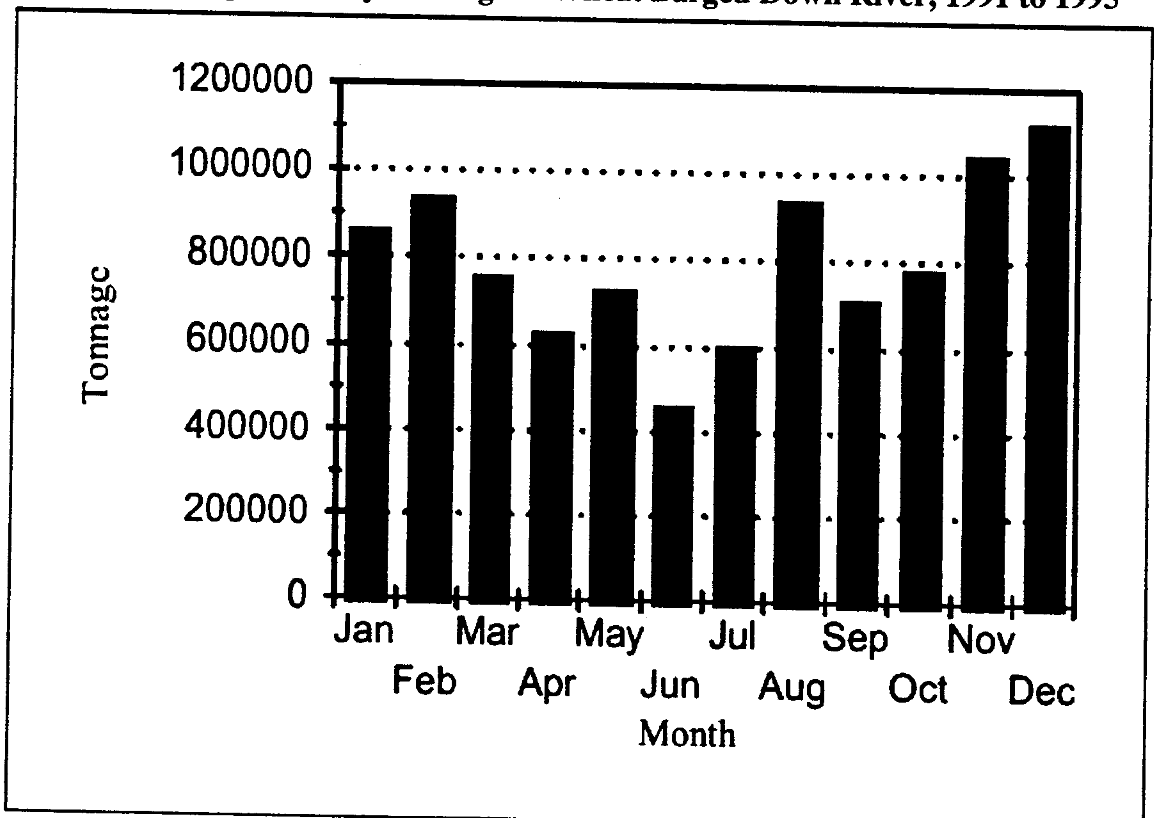
Source: US Army Corps of Engineers Lock Tonnage Reports

Table 27 Tonnage of Each Commodity Group Barged Down River, 1980 to 1995, Percent

Commodity Group	*Percent of Total Tonnage Barged Downriver Between 1980 and 1995*
Gasoline, Jet Fuel, and Kerosene	< 1
Distillate, Residual, and Other Fuels	< 1
Petroleum Pitches, Asphalt, and Naphtha	< 1
Fertilizer (Nitrogenous, Potassic, Phosphoric)	< 1
Forest Products (Lumber, Logs, Wood Chips)	9
Grain (Wheat, Corn, Rye, Barley, Rice, Sorghum and Oats)	71
Commodity Unknown	18

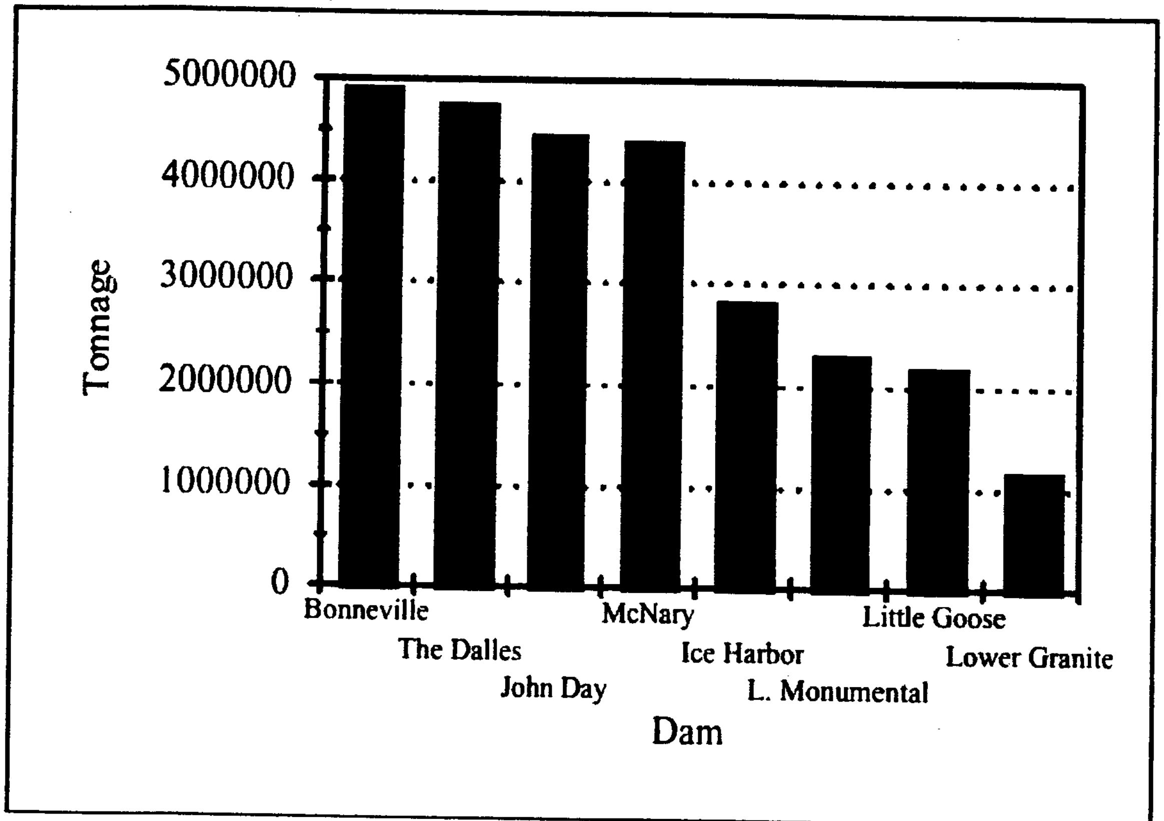
Source: US Army Corps of Engineers Lock Tonnage Reports

Figure 4 Average Monthly Tonnage of Wheat Barged Down River, 1991 to 1995



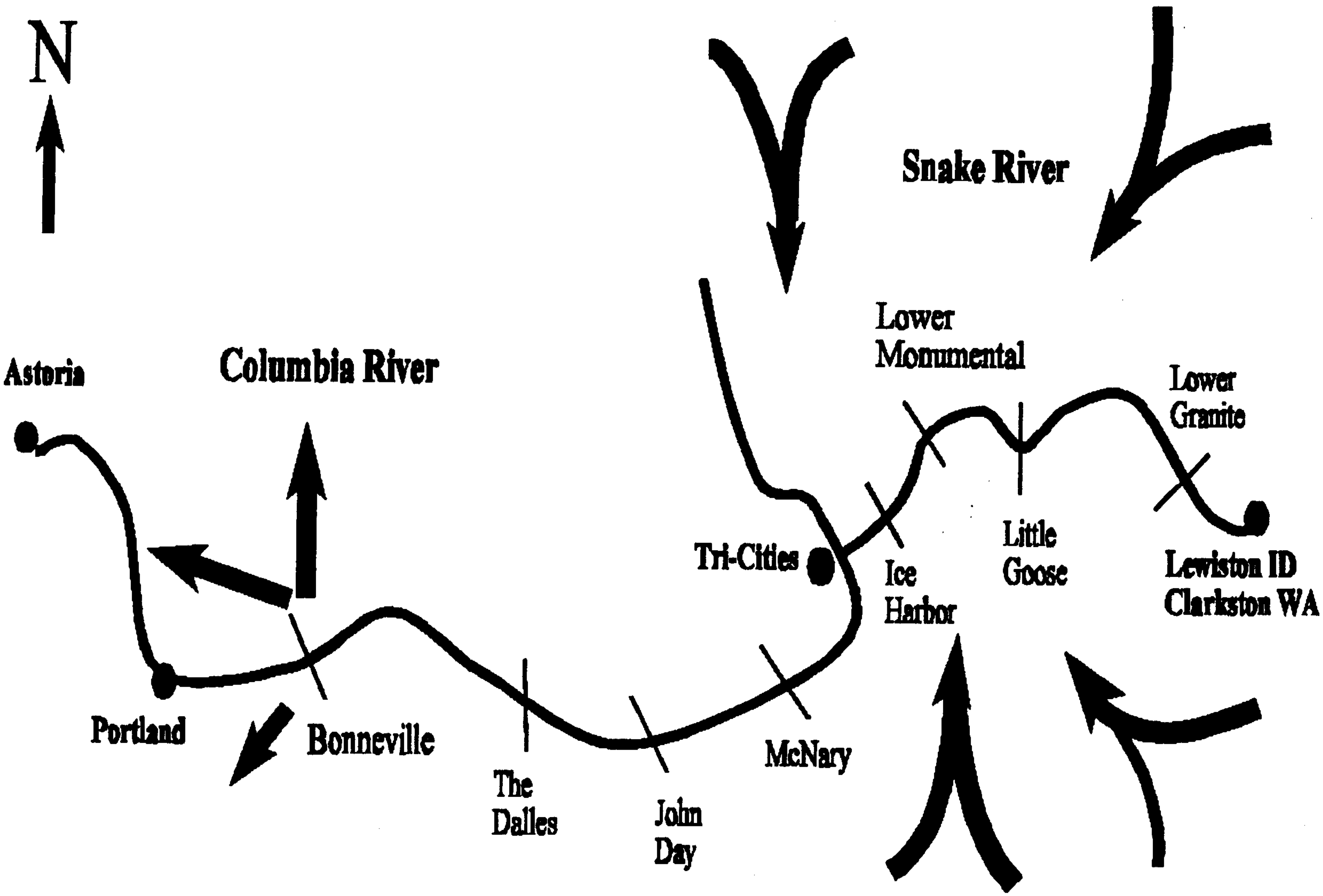
Source: US Army Corps of Engineers Lock Tonnage Reports

Figure 5 Average Down Bound Movement of Wheat Through Columbia and Snake River Dams, 1991 to 1995



Source: US Army Corps of Engineers Lock Tonnage Reports

Figure 6 Direction and Magnitude of Down Bound Commodity Movements



Value-Added Determination Data

It is evident that multiple levels and foci of data are available for grain movements on the Columbia-Snake River system. Value of the commodity, the second layer of examination, depends on the point in supply chain being examined. The price at the terminal elevator is publicly quoted and available. The price (value) of the commodity in the country is that terminal price minus the cost of transportation and handling. An average terminal price in recent years is $3.50 per bushel as compared to $3.10 at the country elevator. Thus, the value of the grain in a corridor can be determined by multiplying $3.10 times the average annual volume.

CASE STUDY: APPLE MOVEMENTS IN WASHINGTON

Apple production usually ranks in the top four of commodities produced in the state and is often the top commodity in value of production (Washington Agricultural Statistics Service). This commodity has received the attention of statistical accumulators, regulators and researchers over many years. Several point estimates in time are available but, as evidenced below, little time series information is normally produced and available.

Production of Apples

Washington Agricultural Statistics Services publishes an annual report, which includes production and value of major Washington Agricultural Crops (as an example, see Table 28 for 1993 figures, the first year that apples passed wheat as the largest value of production in the state). More specific information of a situational nature is available from the Yakima Valley Growers-Shippers Association. Estimates of fresh crop volumes, by variety and district, with current inventory and shipments are produced monthly (Table 29). These production data are supplemented by market analyses and export shipment data (Table 30), which provide general understanding of the aggregate flow of the apple shipments.

Table 28 Production and Value of Major Washington Agricultural Crops, 1993

	Production (1,000) Tons	*Value of Production ($1,000)*
Wheat	5,327	572,026
Potatoes	4,425	469,050
Hay	2,835	282,150
Apples	2,500	698,000
Corn for Silage	1,040	27,040
Corn for Grain	912	47,120
Sweet Corn	587	47,697
Barley	520	46,230
Pears	383	93,771
Grapes	292	89,929
Onions	250	83,250
Carrots	180	23,409
Dry Edible Peas	118	16,464
Green Peas	93	22,115
Sweet Cherries	80	94,036
Lentils	58	19,589
Asparagus	45	55,790
Hops	29	101,220
Peaches	24	10,145
Raspberries	22	28,126
Apricots	8	6,280
Strawberries	6	5,946
Total for Selected Commodities	19,734	2,839,383

Source: Washington Agricultural Statistics Service, Washington Agricultural Statistics 1993-1994

Table 29 Fresh Crop Estimate with current inventory and shipments to date in 1,000 boxcars

	Yakima District				*Wenatchee District*				*State*			
	Est. fresh on hand	*Ship to date*	*Indic crop*	*Gain/ (loss)*	*Est. fresh on hand*	*Ship to date*	*Indic crop*	*Gain/ (loss)*	*Est. fresh on hand*	*Ship to date*	*Indic crop*	*Gain/ (loss)*
Red Del	19,368	8,842	28,210	(16)	12,393	4,791	17,184	322	31,761	13,633	45,394	306
Gold Del	5,221	2,370	7,591	(131)	6,244	1,645	7,889	115	11,465	4,015	15,480	(16)
Granny	3,767	1,464	5,231	63	2,618	1,009	3,627	(59)	6,385	2,473	8,858	4
Fuji	4,890	2,240	7,130	253	4,067	1,479	5,546	354	8,957	3,719	12,676	607
Gala	2,631	2,824	5,455	244	2,019	1,845	3,864	(159)	4,650	4,669	9,319	85
Braeburn	1,270	513	1,783	(47)	678	222	900	10	1,948	735	2,683	(37)
Jonagold	476	402	878	32	100	125	225	(12)	576	527	1,103	20
Cameo	158	19	177	3	417	77	494	(25)	575	96	671	(22)
Pink Lady	432	29	461	(12)	150	24	174	13	582	53	635	1
Other	409	828	1,237	(96)	150	371	521	(3)	559	1,199	1,758	(99)
All Varieties	38,622	19,531	58,153	293	28,836	11,588	40,424	556	67,458	31,119	98,577	849

Source: Washington Agricultural Statistics Service, Washington Agricultural Statistics 1993-1994

Table 30 Yakima–Wenatchee Apple Export Report

		First Half of January		Season To Date		Percent Chg
		00-01	99-00	00-01	99-00	99-00
CANADA & MEXICO	CANADA	233,226	129,950	1,458,720	985,130	48.1%
	MEXICO	793,534	336,777	1,769,942	666,109	165.7%
	TOTAL	1,026,760	466,727	3,228,662	1,651,239	95.5%
CARIBBEAN, SOUTH, & CENTRAL AMERICA	VENEZUELA	108,392	61,421	591,735	541,953	9.2%
	COLOMBIA	41,602	52,956	185,954	191,605	-2.9%
	COSTA RICA	3,753	5,408	215,229	165,987	29.7%
	TRINIDAD–TOBAGO	3,946	2,674	41,274	14,421	186.2%
	ARGENTINA	0	0	18,032	10,290	75.2%
	EL SALVADOR	1,176	6,472	168,532	129,515	30.1%
	PERU	1,029	0	5,488	3,856	42.3%
	NETHERLAND ANTILLES	0	0	80	1,029	-92.2%
	DOMINICAN REPUBLIC	2,305	1,381	259,783	149,054	74.3%
	ECUADOR	12,244	0	40,255	4,128	875.2%
	GUATEMALA	6,558	5,045	197,488	112,617	75.4%
	HONDURAS	3,349	0	102,406	59,792	71.3%
	PANAMA	2,773	0	71,679	35,014	104.7%
	BRAZIL	0	0	29,831	8,148	266.1%
	CHILE	2,058	2,058	7,203	6,174	16.7%
	NICARAGUA	1,739	0	23,653	9,422	151.0%
	OTHER	4,248	924	20,669	20,558	0.5%
	TOTAL	195,172	138,339	1,979,291	1,463,563	35.2%
MIDDLE EAST & AFRICA	SAUDI ARABIA	102,984	59,698	697,831	620,573	12.4%
	DUBAI	59,921	29,546	378,385	138,518	173.2%
	BAHRAIN	0	1,029	35,535	7,404	379.9%
	KUWAIT	3,087	7,151	43,596	45,364	-3.9%
	EGYPT	43,781	28,196	189,231	443,112	-57.3%
	ISRAEL	1,029	0	37,289	0	----
	AFRICA	0	0	0	0	----
	INDIA	13,518	0	27,189	0	----
	OTHER	4,621	5,208	9,990	16,611	-39.9%
	TOTAL	228,941	130,828	1,419,046	1,271,582	11.6%
ASIA & SOUTH PACIFIC	SINGAPORE	25,725	17,308	93,697	98,630	-5.0%
	MALAYSIA	31,110	38,261	153,182	137,381	11.5%
	THAILAND	24,156	41,686	216,389	174,892	23.7%
	TAIWAN	380,007	484,981	2,547,198	2,074,542	22.8%
	HONG KONG	170,236	145,856	780,012	486,047	60.5%
	CHINA	0	0	2,058	0	----
	JAPAN	2,794	0	7,316	12,327	-40.7%
	INDONESIA	92,505	31,342	685,045	542,586	26.3%
	PHILIPPINES	11,375	6,021	124,892	160,238	-22.1%
	VIETNAM	3,489	17,556	70,769	40,033	76.8%
	RUSSIA	539	0	18,393	20,325	-9.5%
	NEW ZEALAND	0	0	1,176	4,067	-71.1%
	BANGLADESH	24,077	0	51,195	5,145	895.0%
	SRI LANKA	0	0	10,615	0	----
	OTHER	0	3,530	18,423	22,805	-19.2%
	TOTAL	766,013	786,541	4,780,360	3,779,018	26.5%

Table 30 Yakima–Wenatchee Apple Export Report Continued

	UNITED KINGDOM	34,632	21,601	222,073	135,700	63.6%
	IRELAND	0	0	1,029	0	----
	NORWAY	2,072	0	16,534	9,841	68.0%
	FINLAND	0	0	43,511	48,414	-10.1%
	SWEDEN	7,203	0	10,313	8,769	17.6%
	NETHERLANDS	6,302	1,050	10,715	3,108	244.8%
	GERMANY	0	293	393	3,351	-88.3%
EUROPE	FRANCE	0	0	12	0	----
	BELGIUM	0	0	0	0	----
	ICELAND	3,969	1,641	15,990	28,597	-44.1%
	SPAIN	0	0	0	0	----
	PORTUGAL	0	0	0	0	----
	GREECE	1,029	0	1,029	0	----
	OTHER	0	1,029	0	7,203	-100.0%
	TOTAL	55,207	25,614	321,599	244,983	31.3%
	GRAND TOTAL	**2,272,093**	**1,548,049**	**11,728,958**	**8,410,385**	**39.5%**

Source: Yakima Valley Grain Growers – Shippers Association

Location of Production

The geographic centers of fruit (including apples) within eastern Washington can be determined from the U.S. Census of Agriculture data (Table 31). These data show that Yakima County farms have the highest level of fruit production, followed by Chelan and Okanogan counties.

Table 31 County Profile of Fruit Sales, 1990

County	*Fruits*	*County*	*Fruits*
Yakima	314.6	Whitman	D
Grant	103.0	Spokane	1.0
Franklin	30.4	Klickitat	4.3
Benton	70.1	Stevens	0.3
Chelan	150.7	Lincoln	D
Okanogan	117.4	Pend Oreille	D
Douglas	81.8	Ferry	D
Adams	5.6	Columbia	D
Walla Walla	15.5	Asotin	D
Kittitas	12.5		

Source: US Census of Agriculture, 1992
D=Unable to disclose due to confidentiality

More specific information on production location is available from the EWITS survey done in 1994, but not duplicated since then (Gillis, et. al.). The average tons shipped annually, by county location, are presented in Table 32. Survey respondents reported shipping a total of two million tons of apple product in a typical year, ranging from 300,000 tons down to only 7 tons, with an average of about 48,000 tons. County averages ranged from 36,588 to 45,190 tons. Apple respondents generally indicated that the amount shipped out of a facility was equal to the amount shipped into the facility. Comparison of elements in Table 32 indicates that about 5 percent shrinkage (culls, losses) occurs during packaging of the raw commodity.

Table 32 Average Volume of Product Shipped by Typical Facilities

Respondent Location	*Average Tons Shipped Annually by a Typical Facility*
Yakima County	45,190
Chelan County	56,575
Okanogan County	36,588
Other Apple Respondents	46,735
All Apple Respondents	**47,667**

Source: EWITS Fruit, Vegetable and Hay Survey, 1994

Table 33 Average Volume of Raw Commodity Received by Typical Facilities

Respondent Location	*Average Tons/Year Received by a Typical Facility*
Yakima County	46,604
Chelan County	58,200
Okanogan County	45,088
Other Apple Respondents	52,567
All Apple Respondents	**50,356**

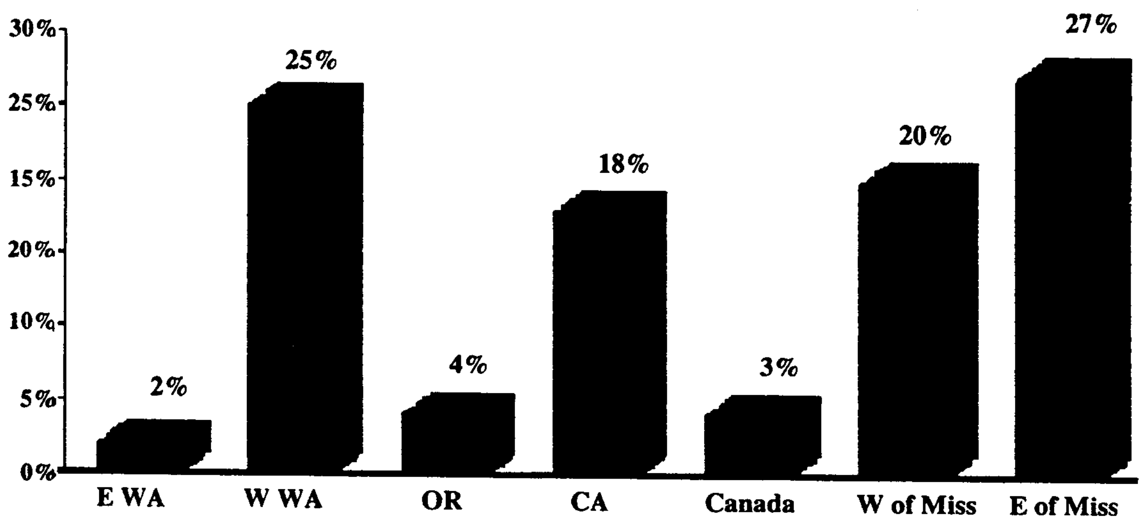
Source: EWITS Fruit, Vegetable and Hay Survey, 1994

Destination of Shipments

Respondents in this EWITS study were asked to estimate the percentage of a product shipped from each facility to different geographical regions in a typical year. In the apple industry, the final products are primarily packed fresh apples, apple juice or applesauce. On average, 27% of apple product was transported to states east of the Mississippi, 25% was transported to western Washington including the ocean ports, 20% to states west of the Mississippi (not including California, Oregon or Washington) and 18% to California (Figure 7).

Figure 7 Apple Industry: Major Destinations of Product

Averages Weighted by Tonnage for Apple Respondents

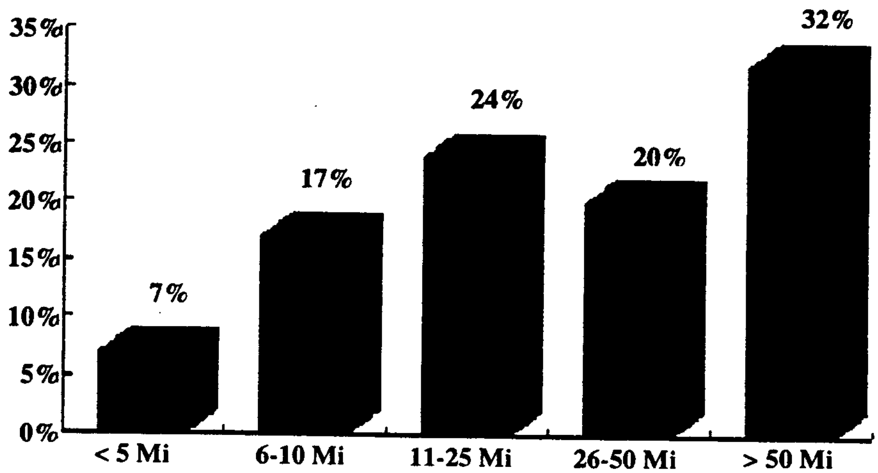


Note: W of Miss = states west of Mississippi River except CA, OR, WA
Source: EWITS Fruit, Vegetable and Hay Survey, 1994

These out shipments are the result of the raw commodity receipts by these facilities. Figure 8 details the typical percentage of raw commodity received by mileage range. Thirty two percent of the raw commodity travels more than 50 miles to the respondent's facilities, 20% travels between 26 and 50 miles, 24% travels 11 to 25 miles, 17% travels 6 to 10 miles and 7% travels less than 5 miles. This distribution would allow, as needed, determination of the ton-miles on the highways generated by apple raw product movement.

Figure 8 Apple Industry: Source of Raw Commodity

Averages Weighted by Tonnage for Apple Respondents

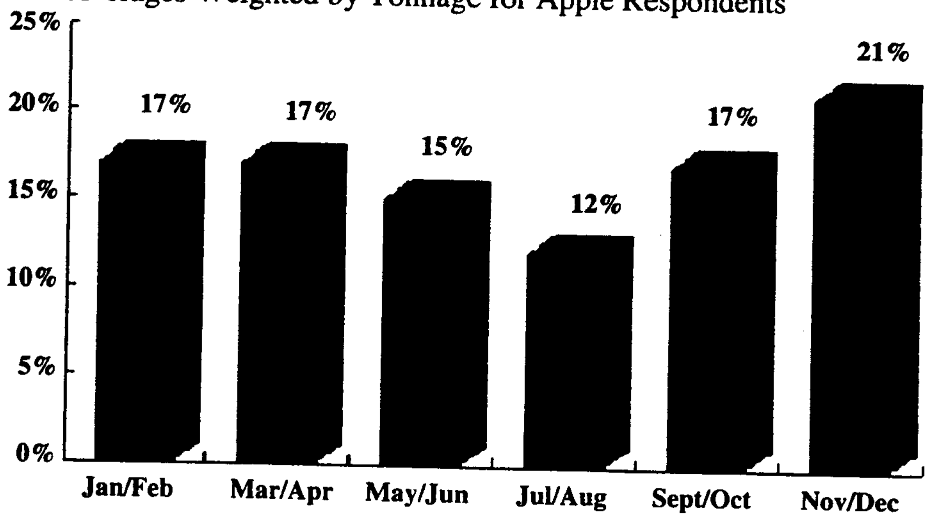


Source: EWITS Fruit, Vegetable and Hay Survey, 1994

Movements on highways vary depending on the time of the year. The EWITS analysis does reveal the timing of both the product shipments (Figure 9) and the raw commodity receipts into the facilities (Figure 10). The product shipments are quite stable over the year, ranging from 12% in July/August (the pre-harvest period) to 21% in November/December (the holiday season). Raw commodity receipts are much more concentrated than product flows since they are generated by crop harvests as well as movements from packers to processors. The facilities participating in this study typically receive 60% of their raw apple commodity in September/October. Between 12 and 14% is received by the apple facilities in the shoulder months of July/August and November/December. Five percent or less of the raw product is received in the other six months. The shipments in the first six months of the year are primarily between warehouse facilities and processors.

Figure 9 Apple Industry: Timing of Product Shipments

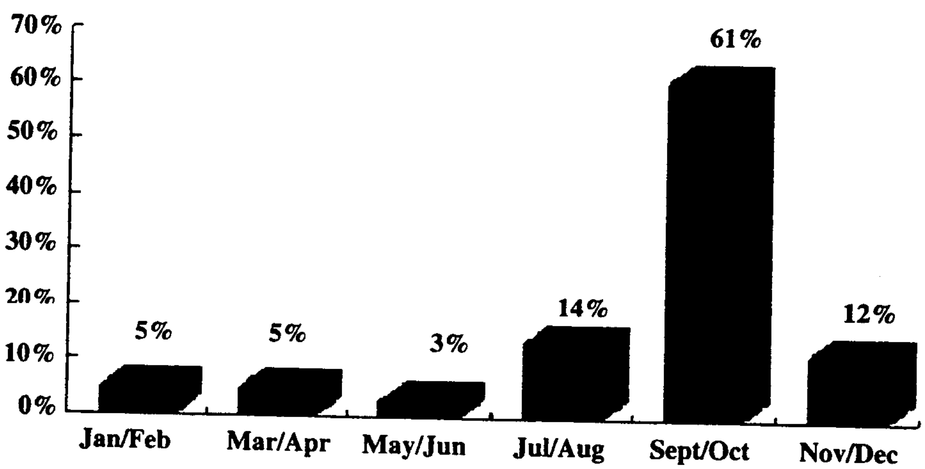
Averages Weighted by Tonnage for Apple Respondents



Source: EWITS Fruit, Vegetable and Hay Survey, 1994

Figure 10 Apple Industry: Timing of Raw Commodity Receipts

Averages Weighted by Tonnage for Apple Respondents



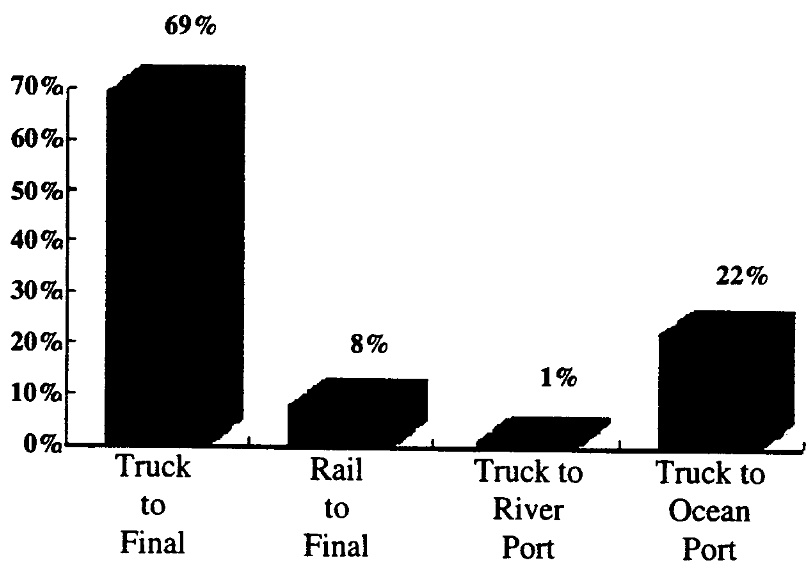
Source: EWITS Fruit, Vegetable and Hay Survey, 1994

Modes of Transport and Major Routes

The importance of trucking and highway transportation for apple shipments is very evident (Figures 11 and 12). Approximately 70% of the product shipped moves to final destination via truck. Rail only moves 8% of the product volume. The entire raw commodity arrives at the packing and processing facilities by truck.

Figure 11 Apple Industry: Modes Utilized to Ship Products

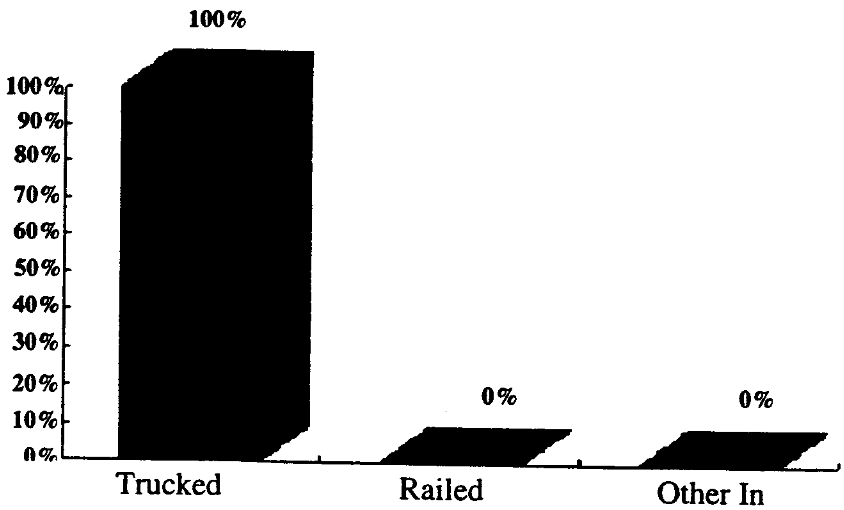
Averages Weighted by Tonnage for Apple Respondents



Source: EWITS Fruit, Vegetable and Hay Survey, 1994

Figure 12 Apple Industry: Modes Utilized to Receive Commodities

Averages Weighted by Tonnage for Apple Respondents

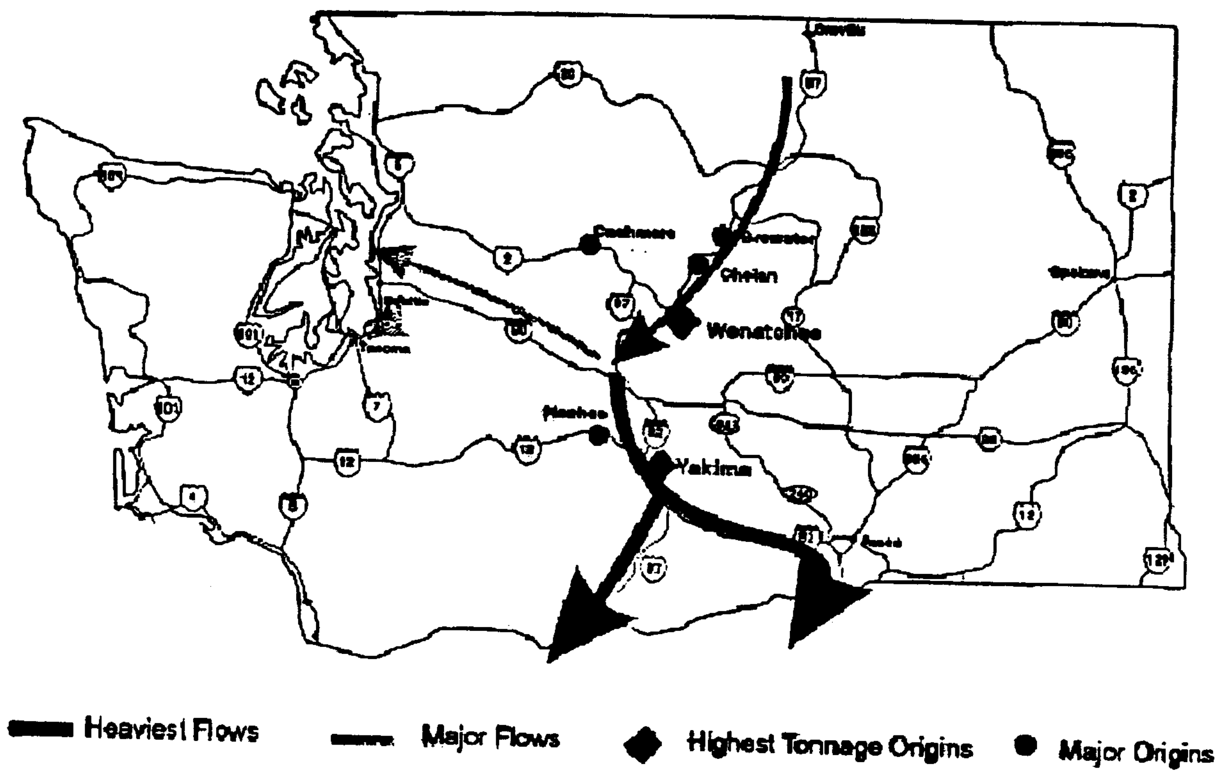


Source: EWITS Fruit, Vegetable and Hay Survey, 1994

Specific information on the major routes used by apple shippers was not available from the fruit shipper survey but is available from the EWITS Origin and Destination Study. The EWITS Origin and Destination Study involved personal interviews of over 28,000 truck drivers to collect information on origin, destination and routes of freight cargo on Washington highways. The data were collected during each of the four seasons over the course of one-year, beginning summer of 1993 and ending spring of 1994 (Gillis et. al., November, 1995). The patterns of apple shipments on eastern Washington highway are shown generally in Figure 13. According to truck driver interviews, the major origins are Wenatchee and Yakima, with significant tonnage originating from the small communities in the Wenatchee and Yakima areas. On the average throughout the year, nearly 3,000 tons of apples per day originate from communities located in Yakima

County. An additional 2,100 tons of apples per day leave communities located in Chelan, Douglas and Okanogan counties.

Figure 13 Major Apple Movements on E. WA Highways



Source: EWITS Origin and Destination Study, 1994

Routes most widely utilized by apple shippers are southbound on US 97 and I-82 to reach produce markets in other states. Approximately 4,000 tons of apples per day are shipped south from eastern Washington locations via these routes. An additional 1,000 tons per day are transported to western Washington retail outlets, distribution centers and ocean ports each day. A combination of I-82, US 97 and I-90 are the primary routes utilized in reaching western Washington markets.

To illustrate the data used to construct the flow of commodities, Tables 35, 36 and 37 are presented. The specific origins of the apple shipments are presented by season.

Quickly evident are the major areas of Wenatchee and Yakima, as noted earlier. Table 35 shows the destinations for an example season, summer. Evident again are shipments to Seattle/Tacoma for export. Finally, the tonnage utilizing each highway in the state of Washington could be developed from Table 36. This table documents the number of shipments passing over each route on the way to the market. This information, when combined with the average product price and processed fresh shipment volumes, from Washington Agricultural Statistics, can be used to determine volume and value of transportation on each highway. However, these data suffer from being over 8 years old, even though they are the best currently available.

Table 34 Origin of Apple Transportation

Cargo City	*Cargo State*	*Spring 94*	*Summer 93*	*Fall 93*	*Winter 94*
Abbotsford	WI			2	
Aberdeen	WA			12	
Aldergrove	BC			1	
Anacortes	WA			3	
Arlington	WA			2	
Auburn	WA	1	1	4	
Bellevue	WA			2	
Bellingham	WA			2	
Bingen	WA				2
Bremerton	WA			1	
Brewster	WA	15	9		15
Burlington	WA			1	
Cashmere	WA	6	3		6
Castle Rock	WA			1	
Centralia	WA			4	
Chehalis	WA		1	4	
Chelan	WA	12	11		15
Chewelah	WA		1		
Coos Bay	OR	1			
Dryden	WA				1
Edmonds	WA			1	
Edmonton	AB			1	
Enumclaw	WA			2	
Everett	WA			1	

Table 34 Origin of Apple Transportation Continued

Federal Way	WA			3	
Fife	WA			2	
Hood River	OR	1			2
Hoquiam	WA			3	
Kaukauna	WI	1			
Kelowna	BC	2			2
Kent	WA			18	
Kirkland	WA			1	
Lacey	WA			1	
Langley	WA			1	
Lynnwood	WA			1	
Malott	WA		1		1
Manson	WA	3			1
Monitor	WA		1		
Monroe	WA			1	
Montesano	WA			1	
Morton	WA			2	
Mossyrock	WA			1	
Mukilteo	WA		1		
New Westminster	BC			1	
Oakville	WA			1	
Odell	OR	1			
Okanogan	WA		1		
Oliver	BC	2			
Olympia	WA			2	
Omak	WA				1
Orondo	WA	2			
Oroville	WA	2	1		1
Ostrander	OH			1	
Othello	WA	1	1		
Packwood	WA			1	
Pasco	WA	3	1		
Pateros	WA	2			
Payette	ID				1
Peshastin	WA				1
Port Angeles	WA			1	
Port Townsend	WA			1	
Portland	OR	2			1
Prescott	WA	1			
Prosser	WA	4			1
Puyallup	WA			1	
Quincy	WA	1			2
Randle	WA			1	
Rochester	WA			1	

Table 34 Origin of Apple Transportation Continued

Rock Island	WA	1			
Royal City	WA	1			
Salt Lake City	UT			1	
Seattle	WA	4	4	30	
Selah	WA	5	8		2
Shelton	WA	1		1	
Spokane	WA	1	1		1
Steilacoom	WA			1	
Summerland	CA				1
Sumner	WA			2	
Sunnyside	WA	1	1		1
Tacoma	WA			19	
Tieton	WA	1	1		
Toledo	WA			1	
Tonasket	WA	1		1	4
Toppenish	WA		2		1
Toutle	WA			2	
Trenton	NJ	1			
Tukwila	WA			2	
Tumwater	WA			1	
Underwood	WA				1
Union Gap	WA	1			
Vancouver	BC			4	
Wallowa	OR	1			
Wapato	WA	2			3
Wenatchee	WA	44	18		54
White River	VT			1	
Winfield	KS	3			1
Woodburn	OR				1
Yakima	WA	31	1	2	55
Zillah	WA		1		

Source: EWITS Origin and Destination Study, 1994

Table 35 Destination of Apple Transportation

Cargo City	*Cargo State*	*Summer*
Edmonton	AB	2
Little Rock	AR	1
Vancouver	BC	2
Douglas	BC	1
Unknown (Toronto)	CA	1
Tracy	CA	3
Sebastopol	CA	2
San Francisco	CA	2
Sacramento	CA	2
Roseville	CA	1
Mission Hills	CA	2
Los Angeles	CA	5
Unknown	CO	1
Denver	CO	2
Orlando	FL	1
Miami	FL	1
Savannah	GA	1
Atlanta	GA	1
Chicago	IL	1
Indianapolis	IN	1
Louisville	KY	1
Methuen	MA	1
Winnipeg	MB	2
Baltimore	MD	1
Lansing	MI	1
Grand Rapids	MI	1
St Louis	MO	1
Edison	MO	1
Greenwood	MS	1
Unknown	MX	1
Mt Airy	NC	1
Unknown	NE	1
Rochester	NY	1
New York City	NY	1
Buffalo	NY	1
Toledo	OH	1
Columbus	OH	1
Cincinnati	OH	1
Portland	OR	2
Philadelphia	PA	1
Derry	PA	1
Montreal	PQ	1

Table 35 Destination of Apple Transportation Continued

Cargo City	*Cargo State*	*Summer*
San Antonio	TX	2
McAllen	TX	4
Laredo	TX	1
Houston	TX	2
Dallas	TX	1
Salt Lake City	UT	2
Norfolk	VA	1
Yakima	WA	5
Wenatchee	WA	1
Tacoma	WA	5
Spokane	WA	3
Selah	WA	1
Seattle	WA	8
Fife	WA	1
Charleston	WV	2

Source: EWITS Origin and Destination Study, 1994

Table 36 Highways for Transportation of Apples

Route	*Spring*	*Summer*	*Fall*	*Winter*
US 97	113	36	1	134
US 395	21	13	0	23
I 5	36	14	149	7
I 82	61	17	0	116
I 90	67	17	1	87
US 2	24	4	2	6
US 12	5	1	8	9

Source: EWITS Origin and Destination Study, 1994

APPLICATION OF VALUE ADDED METHODOLOGY – CASE STUDIES

The above case study discussion reveals the significant variation in the amount of data that are available and the diversified sources of those data. This section applies the I-O method to those data to evaluate the degree of success in the search for value added estimates in each case study.

WHATCOM COUNTY—CROSS-BORDER TRADE WITH CANADA

Information available for cross-border trade with Canada is specific with regards to commodity movements and mode of transportation. Data unavailable in this case are specific transportation coefficients for export and import movements of commodities. Information on the share of commodity movements by transportation modes was utilized. Subsequently, we applied direct requirements coefficients from transportation accounts of the Whatcom County I-O table value of commodities. These coefficients are used as proxies for the value of cross-border trade via truck and rail (or truck and rail transport charges) with Canada. After these coefficients are applied to each set of commodities, we sum across all transportation charges for each mode and obtain the total truck and rail transportation charge for moving imports from Canada and exports to Canada (Table 37). These respective truck and rail transportation charges are equivalent to the value of output for truck transportation and rail transportation in Whatcom County. As value-added measures for truck and rail are derived from value of output, truck and rail value-added are estimated based on the IMPLAN model's share of truck and rail output value.

It is evident that this approach would allow, as data became available, tracking of the changes in trade and commodity cooperation over time.

Table 37 Whatcom County: Value of Trade, Value of Transportation Services, and Value-Added of Transportation Services from Cross-Border Trade, 2000

	Value of Trade ($000)	*Truck Transport Charge*	*Rail Transport Charge*	*Truck Value-Added*	*Rail Value-Added*
Imports from Canada	$9,456,420.9	$135,436,895	$1,568,317	$54,286,886	$941,504
Exports to Canada	$2,441,024.4	$36,014,955	$629,646	$14,435,799	$377,994
Total	$11,897,445.3	$171,451,851	$2,197,963	$68,722,685	$1,319,498

Shortcomings of using this methodology in Whatcom County can be grouped under the lack of precision category. It is assumed that the transportation coefficients obtained from the direct requirements table can be utilized in cross-border trade movements. How close these proxies are to the "true" transportation charges can not be determined. Also assumed is that all of the associated transportation charges for cross-border trade movements are collected by transportation services resident in Whatcom County. Again, these first-approximations are probably not realistic given that most Washington State exports do not originate in Whatcom County and the final destination for imports from Canada are not in Whatcom County. But, no further data are currently available to fill these holes or to allow these assumptions to be relaxed.

APPLE MOVEMENTS IN WASHINGTON

As detailed above, information available for apple movements in Washington is specific, on an ongoing basis, with regards to the fruit growing region and mode of transportation. Data unavailable in this case are specific transportation coefficients for the movement of apples. Apples are grouped with all fruits within the IMPLAN sector plan. Thus, it is assumed that the transportation charges associated with the movement of apples is equivalent to all fruits—tree fruit, berries, and grapes. In this case study, we utilize the share of apple movement by transport mode from prior surveys (EWITS, etc.). Then, we applied direct requirements coefficients from transportation accounts of Yakima-Wenatchee regional I-O table value of commodities. Here, the Yakima-Wenatchee region is composed of the two fruit growing districts of Yakima Valley and Wenatchee as defined by the Washington Agriculture Statistical Service. These districts are composed of the following counties: Yakima Valley (Benton, Kittitas, and Yakima); and Wenatchee (Chelan, Douglas, Okanogan). Direct transportation coefficients are obtained from this multi-county regional table for truck and rail transport. Then transportation coefficients are applied to the value of apple production in the two district region for both truck and rail transport (Table 38). These respective truck and rail transportation charges are equivalent to the value of output for truck transportation and rail transportation associated with the movement of apples in the six-county region. As value-added measures for truck and rail are derived from value of output, truck and rail value-added are estimated based on the IMPLAN model's share of truck and rail output value. As desired, a similar analysis could be conducted on a corridor or origin-destination basis.

Table 38 Yakima and Wenatchee Regions: Value of Production, Value of Transportation Services, and Value-Added of Transportation Services from Apple Movements, 2000

Apple region	*Value of production*	*Truck transport charge*	*Rail transport charge*	*Truck Value-added*	*Rail Value-added*
Yakima region	$216,720,000	$1,613,945	$12,082	$607,997	$7,155
Wenatchee region	$354,750,000	$2,641,875	$19,776	$995,233	$11,713
Total	$571,470,000	$4,255,821	$31,858	$1,603,230	$18,868

There are obvious limitations associated with the use of this methodology for apple movements. First, all values—production, transport charges, and transport value-added—are only for the movement of apples within this six-county area. Given that apples are the region's dominant export, transportation services are utilized beyond the region. Estimation of the value of these transportation services for apples beyond the Yakima-Wenatchee region was not made in this analysis. Furthermore, no effort was made in estimating the value of transportation services associated with value-added apple production, that is, the movement of processed apple products (e.g., apple juice, sauce, chips, dried apples) from the region. Only transportation charges associated with the movement of raw apples was included in the analysis. If data on volume, value, and destination are made available, similar analysis on processes apples could be produced.

GRAIN SHIPMENTS FROM EASTERN WASHINGTON

Information available for grain shipments in Washington is again specific with regards to the production areas and mode of transportation. Data unavailable in this case is transportation coefficients for the movement of specific grains. Wheat, barley, and oats are grouped with all grains within the IMPLAN sector plan. Thus, it is assumed that the transportation charges associated with the movement of wheat or barley or oats is equivalent to all grains. In this case study, we utilize the share of grain shipments by transport mode from prior surveys, most of which, unfortunately, are not time series data. Then, we applied direct requirements coefficients from transportation accounts of Eastern Washington regional I-O table value of commodities. Here, the Eastern Washington region is composed of the two agricultural districts of East Central and Southeast as defined by the Washington Agriculture Statistical Service. These districts are composed of the following counties: East-Central (Adams, Douglas, Franklin, Grant, and Lincoln); and Southeast (Asotin, Columbia, Garfield, Walla Walla, and Whitman). Direct transportation coefficients are obtained from this multi-county regional table for truck and rail transport. These transportation coefficients are applied to the value of apple production in the two district region for both truck and rail transport (Table 39). These respective truck and rail transportation charges are equivalent to the value of output for truck transportation and rail transportation associated with grain shipments in the ten-county region. As value-added measures for truck and rail are derived from value of output, truck and rail value-added are estimated based on the IMPLAN model's share of truck and rail output value.

Table 39 Eastern Washington: Value of Grain Shipments, Transportation Services, and Value-Added of Transportation Services by mode, 2000

Mode of transport	*Value of grain shipped by mode*	*Transport charges*	*Value-Added*
Railroad	$266,664,718	$1,232,719	$722,945
Truck	$3,207,308	$48,444	$19,102
Barge	$188,314,775	$97,045	$27,757

There are limitations associated with the use of this methodology for grain shipments. First, all values—production, transport charges, and transport value-added—are only for grain shipments within this ten-county area. Given that grain are the region's dominant export, transportation services are utilized beyond the region, destined ultimately for final foreign markets. Estimation of the value of these transportation services for grain shipments beyond the East-central and Southeast region could not be made in this analysis. Furthermore, no data existed for estimating the multi-mode shares of grain shipments in each county. Prior survey data indicates that a multiple number of transport modes is used for shipping most bushels of grain produced in Washington. Finally, the value of transportation services associated with grain produced outside Washington (e.g., Oregon, Idaho, Montana) are not estimated, and as such, not included in the analysis. Only transportation charges associated with grain shipments originated in Washington were included in the analysis.

CONTAINERS VIA PUGET SOUND PORTS

Container load terminals in Seattle and Tacoma are significant foci of international commerce. Information on the value of transportation services associated with the movement of containers at these port facilities does not result in a complete analysis for this case study. Transportation-specific information in the IMPLAN direct requirements table, for instance, assumes production occurring within Washington State. Containers placed on ships at the Ports of Seattle and Tacoma ultimately destined for foreign export markets are filled with commodities and products produced throughout the state and beyond. Containers off-loaded from ships at the Ports of Seattle and Tacoma are ultimately destined for domestic markets, in-state and out-of-state. Additional information on the shares of transportation mode by commodity is unavailable.

A general finding is that the intermodal component of container throughput generates a portion, though unknown, of the direct economic activity in the following businesses, among some others (trucking, warehousing, etc.). The gross business income of these selected firms has increased from $1.9 billion in 1994 to $2.3 billion in 1999.

Table 40 Gross Business Incomes of Intermodal-Related Businesses in Washington State

SIC	***Description***	***1994***	***1999***	***CAGR 94-99***
4011	Railroads, Line-haul Operating	$533,252,778	$660,950,000	4.4%
4412	Deep Sea Foreign Trans. Of Freight	$4,718,123	$1,542,811	-20.0%
4449	Water Transportation Of Freight, Nec	$54,495,402	$37,365,975	-7.3%
4491	Marine Cargo Handling	$617,717,630	$724,630,000	3.2%
4492	Towing And Tugboat Service	$258,946,637	$322,660,000	4.5%
4499	Water Transportation Services, Nec	$58,991,895	$85,815,786	7.8%
4731	Freight Transportation Arrangement	$430,276,292	$468,880,000	1.7%
4789	Transportation Services, Nec	$34,259,408	$17,356,956	-12.7%
	sub-total	$1,992,658,165	$2,319,201,528	3.1%

Source: BST Associates, data from Washington State Department of Revenue

A preliminary estimate of the individual components of the intermodal economic activity was determined by estimating the value of economic activity occurring and remaining in the state. Such value is directly dependent on port handling charges.

Approximately $200 per container, including port charges, longshore labor and other port-related expenses (for equipment etc.) are stevedoring charges. At 1.75 TEUs per container, there are 512,000 full containers eastbound and 512 full/empty containers westbound or 1,024,000 containers in total generating an estimated $204.8 million in 1999. The Intermodal containers represented approximately 28% of all stevedore income from all domestic and international cargoes. (SIC 4491)

SUMMARY

Determining the value added transportation of commodities and corridors can be done with the methodology identified in this study. However the general results, and restrictive assumptions and data deficiencies necessary for statewide analysis, cast doubt on specific findings. Regional or highway segment analysis can be more precise, if the data are locally developed.

The case study approach did serve as a good analytical vehicle to attempt to identify and evaluate a potential methodology to determine value-added of freight moved in Washington corridors. It identified the data needs and the availability, or lack thereof, of data on an ongoing basis. The conceptual approach of determining tonnage, then value of that tonnage, then the amount of that value that was value-added to the state was also found to be appropriate.

It was also determined that a truck is not just a truck, and a ton is not just a ton, when estimating the value to the economy of the state. Even a commodity that appears high value, like a truckload of Canadian retail products, if it is essentially just a pass through for the state, yields a low value-added to the state. Imports and exports through our ports, if only pass through, have the same characterization. Manufactured products from firms in the state are a good example of high value-added truck movements, resulting in a potential higher priority for infrastructure investment. Agricultural bulk products, having a low value per ton, have the characteristic that most of the added value occurs within the state, thus increasing the potential interest in infrastructure investment. Local delivery movements do create value by allowing the efficient and timely production of other value-added products but documenting this contribution is difficult.

IMPLICATIONS

It appears that the use of value-added information can be a positive addition to decision making about public and private investments in the state. It reflects the contribution of a particular movement to the state's economy and specifies more clearly the benefits of decreased congestion and improved efficiency.

This analysis found that doing a statewide corridor-by-corridor study was not easy. The continuing lack of data on the composition of commodities on all roads is a limiting factor. The availability of EWITS origin-destination data offers a one time look at such composition; but, these data can become outdated and do not offer information on local distribution, warehousing and retail movements. New data sets of commodity/product composition in a corridor or region would have to be undertaken. Additionally, the use of aggregate I-O coefficients in corridor analyses produces only general estimates of value-added. The cost of obtaining a continuous time series of value-added coefficients and origin-destination flows would be substantial, since even statewide I-O model studies have been done only every 10-15 years in the state of Washington.

Analysis on a corridor or within a county may be more feasible and useful, mainly because at the project level local information can be developed, or existing data, reported for other reasons, can be utilized. Project funding can be focused on the project environments to determine the general benefits accruing to that project.

Planning is a systematic check on economic feasibility and political reality. Long term planning can be aided even by value-added analysis done with aggregate or partial data, with restrictive assumptions. Making short term planning decisions would require better commodity data and more specific value-added coefficients than is currently available.

The identified benefits of having value-added estimates for decision making do suggest continued efforts to develop a cost sensitive sample frame for commodity flows should be pursued. The new Strategic Freight Transportation Analysis (SFTA) project will provide information only on the major corridors, with little information on local distribution or county movements. The feasibility of constructing value-added coefficients by using budget studies, cost of production estimates or economic-engineering evaluation of input and output relationships deserves further consideration.

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