THE ECONOMIC IMPACT OF POTATO PRODUCTION AND PROCESSING IN WASHINGTON STATE

By

NICK JOHN BELEICIKS

A thesis submitted in partial fulfillment
of the requirements for the
degree of

MASTERS OF ARTS IN AGRICULTURAL ECONOMICS

WASHINGTON STATE UNIVERSITY
Department of Agricultural Economics

May 2005

To the Faculty of Washington State University:

The members of the Committee appointed to examine the thesis of NICK JOHN BELEICIKS find it satisfactory and recommend that it be accepted.

_____
Chair

_____

_____

ACKNOWLEDGEMENTS

I wish to express gratitude to Dr. David Holland for introducing me to IMPLAN, giving me this opportunity, and helping me with every aspect of this project. I would also like to thank Dr. Tom Schotzko and Dr. Hayley Chouinard for giving me helpful information and a heads-up whenever needed. To the faculty, staff, and students in the Department of Agricultural Economics, thank you for always answering my seemingly endless string of questions.

My thanks go out to Dennis Conley, 2004 Washington State Potato Industry Honoree, who provided detailed information about the Washington State potato processing industry. And thanks to Scott Steinback who provided the technical knowledge necessary for modifying IMPLAN.

Special thanks to the Washington State Potato Commission for funding this research.

My love goes out to my wife Mollie, and son Harvey, who inspired and supported me throughout the M.A. program. If it were not for their patience while I was away working, and their amazing tolerance for listening to potato facts, this thesis would not have been possible. Thank you Mollie and Harvey.

Last, but not least, thank you to my parents and in-laws for their support and encouragement throughout my schooling.

THE ECONOMIC IMPACT OF POTATO

PRODUCTION AND PROCESSING

IN WASINGTON STATE

Abstract

by Nick John Beleiciks, M.A.
Washington State University
May 2005

Chair: David W. Holland

The potato industry is a large part of the agricultural base in Washington State and the Columbia Basin area of Oregon. Potato production and processing activities purchase some of their inputs from other local industries. The employees of potato farms and processing plants spend part of their income on local goods and services. These purchases magnify the total economic impact of potatoes on the regional economy. The goal of this thesis is to accurately estimate the potato's economic impacts on the Washington economy.

Using IMPLAN Input-Output software, a customized model of the Washington-CB area's economy is constructed for the year 2003. The model focuses on the potato industry in more detail than possible with an ordinary IMPLAN model. Instructions for IMPLAN modification are included to explain the customization process.

Data from the model show that the 2003 Washington-CB potato crop, worth $577 million, is manufactured into $1,626 million of potato products. The potato producing

and processing industry employs 9,114 people in the study area, with 5,907 of them employed in the frozen potato sector.

Results from the impact analysis show that the Washington-CB area exports $1,402 million worth of potatoes and potato products in 2003. The regional effects of these foreign and domestic exports are measured in terms of Output (Sales) at $3,480 million in sales; Value Added at $1,374 million; and Employment at 20,703 jobs. The largest non-potato benefactor from exports is Motor Freight and Transportation at $286 million in sales and 2,359 in jobs.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Overview of Local Potato Production

One of the most productive potato producing areas in the world is the Central Columbia Basin of the Pacific Northwest, consisting of Adams, Benton, Franklin, Grant and Walla Walla Counties in Washington State, and Morrow and Umatilla Counties in Oregon. Although the Columbia Basin counties straddle the Columbia River, which separates them into two different states, the counties are agriculturally and industrially similar. For the purposes of this thesis, these seven counties and the rest of Washington State are referred to as the Washington-CB area.

The Columbia Basin's agricultural environment is characterized by rich volcanic soil, a long season, and semi-arid weather (Buteau 1986). Water availability increased with improvements to the Columbia Basin Irrigation Project beginning in 1949 (USBR 1998). Large-scale production of the Russet Burbank potato in the area was made possible by this near perfect combination of conditions.

Potato yields of 573 cwt an acre were average in Washington and Oregon for 2003, while the average yield for the rest of the United States was 367 cwt an acre (USDA 2004). Morrow County and Umatilla County produced 7.17 million cwt and 6.115 million cwt of potatoes respectively, in 2003 (ODA 2004). Washington State produced 93.15 million cwt of potatoes in 2003, making the total Washington-CB

production 106.435 million cwt, or 23 percent of the 2003 United States potato crop.

Table 1.1 details the 2003 potato crop at local county and national levels.

Table 1.1 Washington-CB and U.S. Potato Crop, 2003

County	Acres Harvested	Yield (cwt/acre)	Production (cwt)
Benton	31,500	640	20,175,000
Grant	34,500	580	20,025,000
Adams	30,500	585	17,850,000
Franklin	32,000	555	17,770,000
Walla Walla	11,000	680	7,480,000
Morrow	12,900	556	7,170,000
Umatilla	10,900	561	6,115,000
Skagit	10,000	370	3,695,000
Lincoln	5,000	600	3,000,000
Klickitat	1,500	560	840,000
Yakima	2,000	395	790,000
Whatcom	2,000	375	750,000
Rest of WA	1,500	375	570,000
Kittitas	500	410	205,000
Rest of U.S.	1,062,800	331	351,379,000
WA-CB Totals	185,800	573	106,435,000
U.S. Totals	1,248,600	367	457,814,000
WA-CB Percent of U.S. Crop	15%	156%	23%

Source: USDA, Quick Stats: Agricultural Statistics Data Base, www.nass.usda.gov/QuickStats/

Overview of Local Potato Processing

The Washington-CB potato-processing industry in 2003 consisted of the fourteen frozen potato processors, three dehydration processors, and potato chip manufacturers listed in Table 1.2. as well as numerous fresh pack potato sheds

Frozen French fries are the main product manufactured by frozen potato producers. Byproducts from French fries are typically frozen hash brown or puffs, which are made from cuttings of potatoes to short to become fries. Unusable pieces are often turned into potato slurry and used as cattle feed, leaving very little solid waste and associated disposal costs (Conley 2005). Washington-CB French fry producers also benefit from shorter shipping routes to Asia than their Idaho and Canadian competitors.

Dehydrated processors manufacture instant mashed potatoes, potato flour and starch from potatoes that graded-out from fresh pack houses and frozen processors. Much of these products are manufactured into other food products before final consumption.

Potato chip manufacturing usually occurs in factories with the ability to produce non-potato based snacks as well. As opposed to other potato processors, which are often located in rural areas where potatoes are grown, chip producers are often located near metropolitan areas to reduce the high costs of shipping packaged potatoes.

Fresh pack sheds are smaller in scale than other potato processors, and also are located near where potatoes are produced. These sheds are where fresh potatoes are graded and washed before being packaged for wholesale and retail sale.

Washington-CB Model Objectives

The goal of this thesis is to construct an accurate Input-Output model of the Washington State and Oregon Columbia Basin potato production and processing industry, while at the same time demonstrating how IMPLAN can be modified to provide custom detail for industries of interest. An impact analysis is run with the model to estimate how potato and potato product exports affect the overall Washington-CB economy. The results are detailed with concern to Value Added, Output, and Employment.

Table 1.2. Regional Potato Processors, 2003

Processor	Plant	Product
Basic American Foods	Moses Lake, WA	Dehydrated
Frito-Lay, Inc.	Vancouver, WA	Chips
Jones Produce Dehy	Quincy, WA	Dehydrated
J.R. Simplot Co.	Hermiston, OR*	Frozen
	Moses Lake, WA	Frozen
	Othello, WA	Frozen
	Pasco, WA	Frozen
Lamb-Weston	Boardman, OR	Frozen
	Connell, WA	Frozen
	Hermiston, OR	Frozen
	Pasco, WA	Frozen
	Quincy, WA	Frozen
	Richland, WA	Frozen
Logan International	Boardman, OR	Frozen
McCain Foods, Inc.	Othello, WA	Frozen
Ochoa Foods	Warden, WA	Frozen
Oregon/Washington Potato Co.	Boardman, OR	Dehydrated
Reser's Fine Foods	Pasco, WA	Frozen
Snakcorp, Inc.	Hermiston, OR	Chips
Tim's Cascade Snacks	Algona, WA	Chips
Twin City Foods	Prosser, WA	Frozen

* Closed November, 2004

CHAPTER 2

INPUT-OUTPUT AND IMPLAN

Input-Output Economics

Input-Output (I/O) economic analysis was developed by Wassily Leontief, for which he received the Nobel Prize in 1973 (Leontief 1986). Leontief's model starts with equations of supply and demand for the whole economy. Supply is assumed to meet demand. Industry supply responds with a new level of output that meets the changes in demand, and a new general equilibrium in the economy is reached. In this study, the economic impact of potato production and processing final demand in Washington State is found using I/O analysis. A model is built that reveals how the output of potato and non-potato industries in the Washington-CB economy respond to meet the demand generated by potato product exports.

An I/O model is a system simultaneous of simultaneous linear equations that traces the supply of and demand for products at a point in time (year) for an economy. The two basic types of I/O models are Type I models, where consumption by households is considered exogenous, and Type SAM models, where household consumption is considered endogenous (Holland and Yeo 2001). The exogenous variables in a Type SAM model are capital investment, inventory additions and deletions, government spending, and domestic and foreign trade. The Washington-CB model is Type SAM, again with final demand for potato products being a result of exports to the rest of the United States and foreign exports.

There are two important assumptions in Input-Output models that need to be considered. First, I/O models are assumed to have fixed prices, where the price of an input does not respond to a change in demand. This is because each industry uses a combination of fixed inputs for the production of its commodity, a Leontief production function. The second assumption is that industries in an I/O model experience constant returns to scale, meaning a doubling of demand for a commodity necessitates an exact doubling of all inputs to meet the increased demand. While these assumptions may not accurately reflect all industries, they are necessary to provide the framework I/O analysis uses.

Construction of an I/O model begins with the formation of a matrix of technical coefficients, called the **A** matrix. The **A** matrix is a table of all the production functions within an economy. The production functions are arranged so each is a column in the **A** matrix. Each element in the **A** matrix is an input coefficient representing the amount of the row industry needed to produce one unit of the column industry. The rows then represent the supply from each industry needed to produce the column industry output. These elements are called Gross Absorption Coefficients.

Table 2.1. is an overly simple example of an **A** matrix for a hypothetical economy that consist of three industries, Agriculture, Ag-Related, and Other. In this simple economy for example, the Agriculture sector produces agricultural output where total production costs are a function of 5 percent Agricultural products (itself), 35 percent Ag-Related products, and 30 percent Other products. The remaining 30 percent consists of value added inputs such as labor and returns to capital, which are not included in the **A**

matrix. Units of output here are in dollar terms, so when inter-industry requirements are not considered, $1 million of Agriculture output requires $50,000 of Agriculture inputs, $350,000 of Ag-Related inputs, $300,000 of Other inputs, and $300,000 of Value Added inputs.

Table 2.1. Simple **A** Matrix

into / *from*	Agriculture Industry 1	Ag-Related Industry 2	Other Industry 3
1 Agriculture Commodity	0.05	0.16	0.13
2 Ag-Related Commodity	0.35	0.12	0.25
3 Other Commodity	0.30	0.52	0.37

The column vector **Y** contains the final demands for each industry. For the Washington-CB model, the exports of potato products and the marketing margins required to export them are the elements that make up the **Y** vector, and are in dollar measurements. The column vector **X** represents the output (sales) of each industry. For the Washington-CB model, each element of the column vector **X** is the output of one of the 472 industries in the study area, also measured in dollar terms. The **I** is an identity matrix of the same dimensions as the **A** matrix. With these components, the Leontief inverse is algebraically derived from the **A** matrix through these steps:

(1) $\mathbf{X} = \mathbf{AX} + \mathbf{Y}$

(2) $(\mathbf{I} - \mathbf{A})\mathbf{X} = \mathbf{Y}$

(3) $\mathbf{X} = (\mathbf{I}\text{-}\mathbf{A})^{-1}\mathbf{Y}$

The $(I\text{-}A)^{-1}$ Leontief inverse can then be used to calculate changes in supply due to changes in final demand. Table 2.2. is the $(\mathbf{I}\text{-}\mathbf{A})^{-1}$ matrix for the hypothetical economy in Table 2.1. Multiplying the Leontief inverse by the column vector of final demands **Y,** results in the solution output for each industry shown in the column vector **X**.

Table 2.2. Simple (**I-A**) Inverse

	into	Agriculture Industry	Ag-Related Industry	Other Industry
from		1	2	3
1	Agriculture Commodity	1.42	0.57	0.52
2	Ag-Related Commodity	0.99	1.88	0.95
3	Other Commodity	1.5	1.82	2.62

Equation (4) is the matrix representation of the impact from a $2 million increase in agricultural final demand and a $1 million increase in agricultural related final demand, when inter-industry requirements are considered. The change in output is the left side of the equation, the **X** column vector.

(4)
$$\begin{vmatrix} \mathbf{X} \\ 3.41 \\ 3.86 \\ 4.81 \end{vmatrix} = \begin{vmatrix} \text{Ag.} & \text{Ag. Related} & \text{Other} \\ 1.42 & .57 & .52 \\ .99 & 1.88 & .95 \\ 1.5 & 1.82 & 2.62 \end{vmatrix} \text{ x } \begin{vmatrix} \mathbf{Y} \\ 2.00 \\ 1.00 \\ 0.00 \end{vmatrix}$$

Results from the hypothetical model show a $2 million increase in final demand for agricultural and related products requires an increase of $3.41 million in the Agriculture sector, a $3.86 million increase the in Ag-Related sector, and a $4.81 Million increase in the Other sector.

The **X** vector output increases are driven from two sources, Direct and Indirect effects. Direct effects are the changes to the industry in which the final demand change occurs. Direct effects in equation (4) are the $2 million for Agriculture and $1 million for Ag-Related final demands, which are embedded in the **X** vector output response. Indirect effects are output changes caused by inter-industry purchases of goods in response to changes in final demand. In equation (4), Indirect effects are the $1.41 million for Agriculture, $2.86 million for Ag-Related, and $4.81 million for Other that make up the remainder of the vector **X** output response.

IMPLAN Software

IMPLAN (Impact Analysis for PLANing) was developed in 1979 by the USDA Forest Service to assist in land and resource management planning. In 1987, work on the databases was transferred over to the University of Minnesota, and in 1993 the Minnesota

IMPLAN Group, Inc. (MIG) was formed to privatize development of IMPLAN. Version 2 was released in 1999 (MIG 2004).

IMPLAN is the most widely used Input-Output software. The commonality of IMPLAN allows easy comparison between different impact models of the same year. The database is combined from numerous government sources, such the Bureau of Census and the Bureau of Labor Statistics, and closely follows the Bureau of Economic Analysis I-O study of the U.S. Economy.

Through the year 2000 database there were 528 sectors organized according to the Standard Industrial Classification. In 2001, the IMPLAN database was changed to 509 sectors organized according to the North American Industrial Classification System (NAICS).

IMPLAN software can be used to construct balanced social accounts at the national, state, county, and ZIP Code level. The software also allows for some modification of the base model data to more accurately reflect local industries. IMPLAN data can be used to provide a descriptive model of a regional economy by providing social and industrial statistics, as well as listing inter-industry purchases and sales in a regional economy. IMPLAN software can also be used as a predictive model of a regional economy of the kind described in equation (4) on page 10.

IMPLAN reports effects to a regional economy in terms of changes to three categories: Output (sales), Value Added, and Employment. Direct and Indirect effects are reported for all models. In Type SAM models however, households are considered endogenous and Induced effects are also reported. Induced effects are output changes in

response to changes in household income because of increases or decreases in final demand.

The Washington-CB model is a Type SAM, year 2000 IMPLAN model with 472 industries, 5 of which are potato industries that have been added manually. The model impact is run in the year 2003, and results are reported in 2003 dollars. The impact is the value of potato industry exports and associated margins. These values are the **Y** column vector of final demand. The Type SAM **A** matrix consists of the 472 industries plus the 2,301,436 households included in the Washington-CB model. The impact results reported in Chapter 5 are the **X** column vector of outputs, which is the economic impact of potato production and processing in Washington State.

CHAPTER 3

PREVIOUS STUDIES

Previous studies have shown that potato production provides an important part of Washington State's annual agricultural output. The potato processing industries provide jobs in rural locales with limited employment opportunities. Processed potato products are also one of the state's largest foreign exports. Detailed studies of the entire Washington State potato industry need to be conducted periodically to provide decision makers with a complete understanding of the potato's contribution to the State's economy.

The first comprehensive report on the Washington State processed potato industry by Buteau and O'Rourke (1986) describes the major changes to the industry as frozen potato production became the dominant processing form. The focus of the report is Washington's potato processing industry. Oregon and Idaho potato processing is included for certain comparisons, and some data is presented as "Washington and Oregon (except Malheur Co.)" (Buteau 1986, p.12). Providing French fries for the fast food market and for export to Asia explained the growing demand for Washington's frozen potatoes in the years leading up to the study. The state has comparative advantage over other potato processing areas in the country due to environmental conditions, economical inputs, and close proximity to foreign markets. The authors predict that future demand for frozen potato products may weaken as the U.S. population matures, but demand from Pacific Rim countries should continue to grow.

An attempt to measure the socioeconomic impacts of the potato processing industry by Bean and Runsten (1993) concentrates on the environmental, labor, and tax issues that relate to potato processing in the Mid-Columbia Basin. The five Washington counties and two Oregon counties that make up the Mid-Columbia Basin are included in this study (Walla Walla County is included). The paper presents results from an employee survey for processing plants in Connell and Othello, Washington. These surveys show the average factory wage to be 82 percent above the current minimum wage.

Holland and Yeo (2001) provide the only Input-Output model based analysis that measures economic impacts of potatoes in Washington State. The model is constructed using 1996 IMPLAN data with custom production functions provided for five potato related industries. Washington State and Umatilla County, Oregon make up the region included in this study. The flow of potatoes through the processing complex is diagramed, and balance sheets are provided for each industry. Additional impacts are generated due to potato processing waste providing feed for the State's cattle feedlot industries. Results show the Output Impact to be $3,014 million, and the Employment Impact to be 27,583.

Globalwise, Inc. (2004) reports the economic impact of closing the J. R. Simplot frozen French fry plant in Hermiston, Oregon. An IMPLAN model is constructed with Umatilla County as the impact area, but acknowledges that impacts from the closure will occur in Morrow County and Washington State as well. The study mentions possible alternative uses for the building, and includes these uses in the impact.

This results in hypothetical, yet realistic impact scenarios that attempt not to overestimate the closure impacts on the county. The results indicate a loss of between 945-1,080 jobs, based on the building scenario used.

Other potato producing states report the economic impact of their respective potato industries such as Maine's report by Planning Decisions, Inc. (2003), and North Dakota's study by Coon and Leistritz (2001). When an I/O model is constructed to estimate impacts, the potato's relative importance in each state's overall economy can be compared.

Estimated impacts from other industries generated through I/O models can be used to compare the relative importance of that industry to a state's economy. Similar studies in Washington have been carried out with other commodities, such as the tree fruit industry by Jensen (2004).

CHAPTER 4

WASHINGTION-CB POTATO MODEL

Base Model

The Washington-CB model is created using 2000 IMPLAN data for Washington State, plus Morrow County and Umatilla County, Oregon. Year 2000 is the last year where IMPLAN's sectoring scheme is organized according to the Standard Industrial Classification (SIC). Beginning in 2001, IMPLAN is organized using the North American Industrial Classification System (NAICS), which is not backward compatible with SIC.

Although the 2001 IMPLAN database was the most current available when work began on the Washington C-B model, using the year 2000 base model is justifiable for three reasons. First, the 1996 production functions given in Holland and Yeo are transferable into the 2000 sectoring scheme. Second, the SIC based IMPLAN structure provides more detail for agricultural models with eight more farming sectors and three more food manufacturing sectors than the NAICS based IMPLAN. And finally, most coefficients do not vary much from year-to-year, and price changes specific to this model have been adjusted manually. The impact results from the Washington-CB model should be comparable to results from a future year 2003 base model.

A Social Accounting Matrix (SAM) is then built with IMPLAN using a total of 533 sectors, 528 original IMPLAN sectors plus 5 new potato industry sectors. A Type SAM model consists of industries and households, which are endogenous to the system.

Industry use of commodities provides the intermediate demand that drives the indirect impact effects. Household use of commodities provides the final demand that drives the induced impact effects. Domestic and foreign exports are exogenous to the system. These exports provide the final demand that drives the direct impact effects.

IMPLAN Modification

Five new potato sectors are added to the IMPLAN Input-Output table according to procedures outlined by Steinback (2005). The five new production functions are added to IMPLAN's base absorption table, along with industry values for employment, foreign exports, total output, and the value added accounts. Each new sector has an equivalent IMPLAN sector where the industry would ordinarily occur, as shown in Table 4.1.

Table 4.1. New Potato Industry IMPLAN Equivalents

New IMPLAN Sector	Sector Description	Equivalent IMPLAN Sector	Sector Description
530	Potato	18	Vegetables
531	Fresh Pack Potato	18	Vegetables
532	Dehydrated Potato	68	Dehydrated Food Products
533	Frozen Potato	70	Frozen Fruits, Juices and Vegetables
534	Potato Chips	100	Potato Chips and Similar Snacks

No downsizing adjustments are made to the original equivalent sectors where IMPLAN would normally capture potato production and processing. These sectors are

left untouched in order to capture the indirect effects of purchases by other industries that use potato based products, but are not linked with the added potato sectors in this model. This approach at measuring indirect effects is necessary due to aggregation in the IMPLAN sectors. An industry such as Eating & Drinking makes purchases of Vegetables, but IMPLAN has no way to differentiate whether it actually is buying fresh potatoes or some other type of vegetable. Therefore it is impossible to accurately estimate the linkages between Eating & Drinking and the new sector, just Fresh Pack Potato. The value of this intermediate purchase is still captured in Vegetables, and since Fresh Pack Potato has no indirect effects, there is no danger of double counting.

Industry Data

Washington potato use at the state level for fresh pack, dehydrated, frozen, and potato chips is monitored by the Washington State Potato Commision (WSPC 2004). The disposition for Morrow and Umatilla counties is then estimated in the model using the Washington potato use percentages. Table 4.2. illustrates the disposition of the 2003 crop using actual and estimated figures.

The Washington State Employment Security Division tracks the numbers of employees and average wages for all industries, and publishes the information at the 6-digit NAICS level. The average annual wage for employees of the new potato sectors is assumed the same as the wages for their equivalent NAICS sector. The number of jobs in each new sector is estimated by dividing this average wage by the sector's Employee

Compensation shown on the industry balance sheets. Table 2.3. lists the estimated employment for each sector needed to modify the IMPLAN database.

Table 4.2. Washington-CB Disposition and Prices, 2003

Use	Washington Disposition (cwt)	Use %	Morrow & Umatilla Estimated Disposition (cwt)	Total Washington-CB	Price/cwt ($)	Potato Use Value ($)
Fresh Pack	10,280,376	11.04	1,466,181	11,746,558	5.25	61,669,428
Dehydrated	6,625,662	7.11	944,948	7,570,610	3.00	22,711,831
Frozen	61,650,323	66.18	8,792,534	70,442,857	5.75	405,046,427
Chips	1,315,902	1.41	187,673	1,503,575	5.25	7,893,770
Other Processed	637,789	0.68	90,961	728,750	5.25	3,825,939
Seed/Shrink	5,036,000	5.41	718,231	5,754,231	5.25	30,209,715
Unidentified	7,603,948	8.16	1,084,471	8,688,418	5.25	45,614,196
Crop Total	93,150,000	100.00	13,285,000	106,435,000		576,971,305

SOURCE: Conley, Conversations and E-mail, 2005;
USDA, Quick Stats: Agricultural Statistics Data Base, 2005;
WSPC, Disposition Report 03-04, 2004.

Table 4.3. Potato Industry Estimated Employment and Average Wage, 2003

Sector	Industry	Employee Compensation ($)	NAICS Equivalent	WA Average Wage ($/year)	Estimated Employment
530	Potato	43,304,302	111211	24,341	1,779
531	Fresh Pack Potato	18,757,492	42248	27,481	683
532	Dehydrated Potato	13,281,682	311411	35,527	374
533	Frozen Potato	172,822,115	311423	29,259	5,907
534	Potato Chips	15,669,130	311919	42,257	371

Source: WSESD, www.workforceexplorer.com, 2005

Production Function Construction

Five new industries are added to provide more detail and accurately reflect the local potato complex. Each industry is represented by a production function, or industry balance sheet, which contains the use coefficients for each commodity the industry requires. The coefficients for each new production function are derived from a variety of sources.

Two new sector Input-Output accounts are based on enterprise budgets prepared at Washington State University. The Potato's industry production function contains the coefficients for all the inputs that are involved with producing potatoes under central pivot irrigation in the Columbia Basin. The coefficients are derived from Hinman, et al.'s (2001) potato farm enterprise budget. The Fresh Pack industry production function contains the coefficients for all the inputs involved with packaging potatoes for the wholesale and retail fresh vegetable markets. These coefficients are derived from Schotzko and Sund's (2002) costs of packing potatoes.

These two enterprise budgets are transformed into an I/O accounting structure that can be used in IMPLAN based on procedures set forth by Willis and Holland (1997). Each enterprise budget item is mapped into a corresponding IMPLAN sector. Each commodity is reported in purchaser prices and then converted to producer prices through margining. The intermediate industries embedded in purchaser prices are allocated their share of the purchaser price when the commodity is margined. IMPLAN provides the State and Local Government marketing margins that are used to estimate margins encountered by potato producers and packers. The input commodity Potato and is a new

sector unique to the Washington-CB model, so there are no IMPLAN provided margins. To estimate Potato's margins, it's equivalent sector, Vegetables, margins are used.

The production functions for Dehydrated Potatoes and Frozen Potatoes are modified from Holland and Yeo (2000). The production methods used in these sectors are guarded heavily by the industry, so no enterprise budgets are available publicly. However, a Washington potato industry veteran reviewed the input coefficients and the recommended changes were made (Conley 2005). Gas and electric prices have increased significantly between 1996 and 2003, so they are adjusted according to Bureau of Labor Statistics (USDL 2005) commodity price indexes. Condensed and Evaporated Milk is added to reflect powdered milk that is sometimes added to dehydrated potato products. The Value Added Proprietary Income section is removed since there are no sole-proprietarily owned potato dehydration facilities in the Columbia Basin.

The Frozen Potatoes production function is modified to reflect greater efficiencies in manufacturing. Since less of the Potato input now goes to waste, its coefficient is reduced to reflect a smaller percentage of the final output cost. Gas and electricity prices are inflated accordingly for Frozen Potatoes, just as they were in Dehydrated Potatos.

The Potato Chips production function is used straight from Holland and Yeo. This is the IMPLAN sector for Potato Chips & Similar Snacks, and represents a generalized production function for all of Washington's salty snack industry in 1996. The new sector for Potato Chips is different from the year 1996 Potato Chips & Similar

Snacks IMPLAN sector only in that it is scaled to reflect the actual amount of potatoes that are used for Potato Chips in 2003.

Industry Balance Sheets

Each IMPLAN sector's social account is reported on the Industry Balance Sheets in Tables 4.4. through 4.8., and the Commodity Balance Sheets in Tables 4.9. through 4.13. These balance sheets are used to describe industry data contained in the Washington-CB model.

The Industry Balance Sheet provides a printout of the production function, Gross Inputs, Regional Purchase Coefficients (RPC), Regional Absorption Coefficients, and Regional Inputs. Also normally included on the Industry Balance Sheets are Byproducts that the industry may produce, however the new potato industries are assumed to produce only a single product, so no byproducts are listed.

The Industry Balance Sheet also lists the amount of Value Added by the industry. Value Added includes Employee Compensation, Proprietary Income, Other Property Income, and Indirect Business Taxes. The potato-complex businesses in the Washington-CB area are all assumed to be corporations, so the Proprietary Income for each industry is set at zero. Employee Compensation includes all income that employers pay to employees, including all benefits. Proprietary Income is income received by private business owners and for self-employed work. Other Property Income is profits earned by corporations, as well as well as capital consumption allowances such as

depreciation. Indirect Business Taxes include sales and excise taxes incurred during normal operation of business, but does not include taxes on profit or income (MIG 2004).

The total value of the 2003 Washington-CB crop is $577 million, which can be found on Table 4.4. Potato Industry, IMPLAN Report. Total output from all potato processing is found by summing the Production values on Tables 4.5. through 4.8., for a total of $1,626 million dollars.

Table 4.4. Potato Industry, IMPLAN Report

INDUSTRY BALANCE SHEET

Commodity Production

Commodity Code	Description	Production*	Regional Market Shares	Byproducts Coefficient
530	Potato	576.971	1.00000	1.0000
	TOTAL	576.971		

Value Added

Description	Value Added*	Coefficients
Indirect Business Taxes	1.866	0.003
Other Property Income	35.083	0.061
Proprietary Income	0.000	0.000
Employee Compensation	43.304	0.075
TOTAL	80.253	0.139

Commodity Demand (Production Function)

	TOTAL	0.861	496.719		0.531	306.241
Commodity Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*
26	Agricultural- Forestry- Fishery Services	0.04545	26.22597	0.80225	0.03647	21.03988
189	Inorganic Chemicals Nec.	0.03235	18.66348	0.05281	0.00171	0.98563
202	Nitrogenous and Phosphatic Fertilizers	0.07847	45.27580	0.15570	0.01222	7.04957
204	Agricultural Chemicals- N.E.C	0.14973	86.39202	0.12619	0.01890	10.90214
209	Chemical Preparations- N.E.C	0.00036	0.20981	0.33026	0.00012	0.06929
210	Petroleum Refining	0.00954	5.50199	0.77773	0.00742	4.27906
309	Farm Machinery and Equipment	0.01705	9.83884	0.51922	0.00885	5.10853
433	Railroads and Related Services	0.00592	3.41397	0.72100	0.00427	2.46147
435	Motor Freight Transport and Warehousing	0.08898	51.33783	0.87254	0.07764	44.79436
436	Water Transportation	0.00048	0.27565	1.00000	0.00048	0.27565
437	Air Transportation	0.00021	0.12254	0.46210	0.00010	0.05663
438	Pipe Lines- Except Natural Gas	0.00009	0.05359	0.09750	0.00001	0.00522
443	Electric Services	0.01880	10.84614	0.91630	0.01722	9.93832
445	Water Supply and Sewerage Systems	0.01429	8.24307	0.94429	0.01349	7.78381
447	Wholesale Trade	0.07606	43.88463	0.99567	0.07573	43.69458
451	Automotive Dealers & Service Stations	0.00002	0.01191	0.95000	0.00002	0.01131
456	Banking	0.04005	23.10662	0.60750	0.02433	14.03727
459	Insurance Carriers	0.00108	0.62257	0.63310	0.00068	0.39415
462	Real Estate	0.16919	97.61527	0.70000	0.11843	68.33069
473	Equipment Rental and Leasing	0.00038	0.21692	0.75600	0.00028	0.16399
530	Potato	0.11241	64.85992	1.00000	0.11241	64.85992

NOTE: * millions of dollars

Table 4.5. Fresh Pack Potato IMPLAN Report

INDUSTRY BALANCE SHEET

Commodity Production

Commodity Code	Description	Production*	Regional Market Shares	Byproducts Coefficient
531	Fresh Pack Potato	113.056	1.00000	1.0000
	TOTAL	113.056		

Value Added

Description	Value Added*	Coefficients
Indirect Business Taxes	0.375	0.003
Other Property Income	8.965	0.079
Proprietary Income	0.000	0.000
Employee Compensation	18.757	0.166
TOTAL	28.097	0.249

Commodity Demand (Production Function)

	TOTAL	0.751	84.959		0.640	72.358
Commodity Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*
56	Maintenance and Repair Other Facilities	0.01575	1.78086	1.00000	0.01575	1.78086
122	Cordage and Twine	0.00557	0.62941	0.02640	0.00015	0.01661
164	Paperboard Containers and Boxes	0.05446	6.15650	0.61706	0.03360	3.79896
167	Bags- Plastic	0.03484	3.93931	0.00228	0.00008	0.00897
198	Surface Active Agents	0.03532	3.99368	0.13880	0.00490	0.55433
204	Agricultural Chemicals- N.E.C	0.00845	0.95540	0.12619	0.00107	0.12057
205	Adhesives and Sealants	0.00540	0.61023	0.33458	0.00181	0.20417
433	Railroads and Related Services	0.00035	0.03973	0.72100	0.00025	0.02865
435	Motor Freight Transport and Warehousing	0.00603	0.68148	0.87254	0.00526	0.59462
436	Water Transportation	0.00017	0.01916	1.00000	0.00017	0.01916
437	Air Transportation	0.00016	0.01808	0.46210	0.00007	0.00836
443	Electric Services	0.00457	0.51718	0.91630	0.00419	0.47389
444	Gas Production and Distribution	0.00163	0.18383	0.74140	0.00121	0.13629
445	Water Supply and Sewerage Systems	0.00163	0.18383	0.94429	0.00154	0.17359
447	Wholesale Trade	0.00894	1.01104	0.99567	0.00890	1.00666
456	Banking	0.00318	0.35899	0.60750	0.00193	0.21808
459	Insurance Carriers	0.00626	0.70721	0.63310	0.00396	0.44773
469	Advertising	0.00118	0.13322	0.75600	0.00089	0.10071
470	Other Business Services	0.00073	0.08294	0.61628	0.00045	0.05112
473	Equipment Rental and Leasing	0.00821	0.92866	0.75600	0.00621	0.70207
494	Legal Services	0.00028	0.03116	0.79270	0.00022	0.02470
503	Business Associations	0.00263	0.29690	0.65235	0.00171	0.19368
507	Accounting- Auditing and Bookkeeping	0.00028	0.03116	0.79270	0.00022	0.02470
530	Potato	0.54547	61.66943	1.00000	0.54547	61.66943

NOTE: * millions of dollars

Table 4.6. Dehydrated Potato IMPLAN Report

INDUSTRY BALANCE SHEET

Commodity Production

Commodity Code	Description	Production*	Regional Market Shares	Byproducts Coefficient
532	Dehydrated Potato	55.170	1.00000	1.0000
	TOTAL	55.170		

Value Added

Description	Value Added*	Coefficients
Indirect Business Taxes	0.425	0.008
Other Property Income	4.036	0.073
Proprietary Income	0.000	0.000
Employee Compensation	13.282	0.241
TOTAL	17.742	0.322

Commodity Demand (Production Function)

	TOTAL	0.678	37.398		0.593	32.703
Commodity Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*
56	Maintenance and Repair Other Facilities	0.03400	1.87583	1.00000	0.03400	1.87583
63	Condensed and Evaporated Milk	0.01750	0.96547	0.51787	0.00906	0.49999
122	Cordage and Twine	0.00210	0.11613	0.02640	0.00006	0.00307
164	Paperboard Containers and Boxes	0.00866	0.47766	0.61706	0.00534	0.29475
167	Bags- Plastic	0.00659	0.36379	0.00228	0.00002	0.00083
168	Bags- Paper	0.00848	0.46773	0.00257	0.00002	0.00120
198	Surface Active Agents	0.02034	1.12227	0.13880	0.00282	0.15577
205	Adhesives and Sealants	0.00207	0.11437	0.33458	0.00069	0.03827
433	Railroads and Related Services	0.00012	0.00673	0.72100	0.00009	0.00485
435	Motor Freight Transport and Warehousing	0.00142	0.07823	0.87254	0.00124	0.06826
436	Water Transportation	0.00006	0.00314	1.00000	0.00006	0.00314
437	Air Transportation	0.00007	0.00381	0.46210	0.00003	0.00176
443	Electric Services	0.00865	0.47702	0.91630	0.00792	0.43709
444	Gas Production and Distribution	0.10275	5.66892	0.74140	0.07618	4.20294
445	Water Supply and Sewerage Systems	0.02650	1.46206	0.94429	0.02502	1.38060
447	Wholesale Trade	0.00168	0.09291	0.99567	0.00168	0.09250
459	Insurance Carriers	0.00400	0.22068	0.63310	0.00253	0.13971
469	Advertising	0.00040	0.02207	0.75600	0.00030	0.01668
470	Other Business Services	0.01220	0.67307	0.61628	0.00752	0.41481
473	Equipment Rental and Leasing	0.00860	0.47446	0.75600	0.00650	0.35869
530	Potato	0.41167	22.71183	1.00000	0.41167	22.71183

NOTE: * millions of dollars

Table 4.7. Frozen Potato Industry, IMPLAN Report

INDUSTRY BALANCE SHEET

Commodity Production

Commodity Code	Description	Production*	Regional Market Shares	Byproducts Coefficient
533	Frozen Potato	1350.155	1.00000	1.0000
	TOTAL	1350.155		

Value Added

Description	Value Added*	Coefficients
Indirect Business Taxes	19.548	0.014
Other Property Income	224.090	0.166
Proprietary Income	0.000	0.000
Employee Compensation	172.822	0.128
TOTAL	416.460	0.308

Commodity Demand (Production Function)

Commodity Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*
	TOTAL	0.692	933.695		0.499	673.066
72	Flour and Other Grain Mill Products	0.00782	10.55551	0.06146	0.00048	0.64870
81	Sugar	0.00817	11.02671	0.09132	0.00075	1.00698
90	Shortening and Cooking Oils	0.09560	129.07074	0.22608	0.02161	29.18038
122	Cordage and Twine	0.00464	6.26607	0.02640	0.00012	0.16540
130	Automotive and Apparel Trimmings	0.00570	7.70263	0.92899	0.00530	7.15564
164	Paperboard Containers and Boxes	0.04619	62.35690	0.61706	0.02850	38.47822
167	Bags- Plastic	0.02077	28.04136	0.00228	0.00005	0.06387
168	Bags- Paper	0.02596	35.05272	0.00257	0.00007	0.08995
189	Inorganic Chemicals Nec.	0.00789	10.65407	0.05281	0.00042	0.56265
205	Adhesives and Sealants	0.00457	6.16886	0.33458	0.00153	2.06398
209	Chemical Preparations- N.E.C	0.00573	7.74044	0.33026	0.00189	2.55636
433	Railroads and Related Services	0.00221	2.98384	0.72100	0.00159	2.15135
435	Motor Freight Transport and Warehousing	0.04413	59.57693	0.87254	0.03850	51.98331
436	Water Transportation	0.00032	0.42935	1.00000	0.00032	0.42935
437	Air Transportation	0.00015	0.20117	0.46210	0.00007	0.09296
443	Electric Services	0.04430	59.80745	0.91630	0.04059	54.80156
444	Gas Production and Distribution	0.03433	46.34791	0.74140	0.02545	34.36242
445	Water Supply and Sewerage Systems	0.01343	18.13911	0.94429	0.01269	17.12851
446	Sanitary Services and Steam Supply	0.00276	3.72103	1.00000	0.00276	3.72103
447	Wholesale Trade	0.01414	19.08444	0.99567	0.01407	19.00179
476	Detective and Protective Services	0.00276	3.72103	0.63842	0.00176	2.37560
530	Potato	0.30000	405.04644	1.00000	0.30000	405.04644

NOTE: * millions of dollars

Table 4.8. Potato Chips Industry, IMPLAN Report

INDUSTRY BALANCE SHEET

Commodity Production

Commodity Code	Description	Production*	Regional Market Shares	Byproducts Coefficient
534	Potato Chips	107.942	1.00000	1.0000
	TOTAL	107.942		

Value Added

Description	Value Added*	Coefficients
Indirect Business Taxes	0.976	0.009
Other Property Income	25.115	0.233
Proprietary Income	0.000	0.000
Employee Compensation	15.669	0.145
TOTAL	41.760	0.387

Commodity Demand (Production Function)

	TOTAL	0.613	66.182		0.313	33.779
Commodity Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*
12	Feed Grains	0.00757	0.81690	0.10100	0.00076	0.08251
13	Hay and Pasture	0.00813	0.87810	0.10113	0.00082	0.08880
20	Miscellaneous Crops	0.01488	1.60660	0.21657	0.00322	0.34794
21	Oil Bearing Crops	0.00063	0.06833	0.01151	0.00001	0.00079
23	Greenhouse and Nursery Products	0.00572	0.61764	0.46169	0.00264	0.28516
27	Landscape and Horticultural Services	0.00026	0.02763	0.64366	0.00016	0.01779
37	Coal Mining	0.00139	0.15004	0.11983	0.00017	0.01798
56	Maintenance and Repair Other Facilities	0.00660	0.71252	1.00000	0.00660	0.71252
68	Dehydrated Food Products	0.01524	1.64470	0.08922	0.00136	0.14674
70	Frozen Fruits- Juices and Vegetables	0.00255	0.27547	0.12582	0.00032	0.03466
72	Flour and Other Grain Mill Products	0.01523	1.64362	0.06146	0.00094	0.10101
76	Wet Corn Milling	0.00804	0.86839	0.05576	0.00045	0.04842
81	Sugar	0.00028	0.03012	0.09132	0.00003	0.00275
86	Cottonseed Oil Mills	0.00114	0.12327	0.13305	0.00015	0.01640
87	Soybean Oil Mills	0.00538	0.58105	0.08874	0.00048	0.05156
88	Vegetable Oil Mills- N.E.C	0.01075	1.16015	0.30180	0.00324	0.35013
90	Shortening and Cooking Oils	0.01510	1.62981	0.22608	0.00341	0.36847
100	Potato Chips & Similar Snacks	0.00186	0.20066	0.76999	0.00143	0.15451
103	Food Preparations- N.E.C	0.00014	0.01490	0.62106	0.00009	0.00925
123	Textile Goods- N.E.C	0.00017	0.01878	0.00403	0.00000	0.00008
126	Housefurnishings- N.E.C	0.00013	0.01457	0.35130	0.00005	0.00512
162	Paper Mills- Except Building Paper	0.00010	0.01090	0.00203	0.00000	0.00002
163	Paperboard Mills	0.00005	0.00529	0.00263	0.00000	0.00001
164	Paperboard Containers and Boxes	0.03097	3.34305	0.61706	0.01911	2.06288
165	Paper Coated & Laminated Packaging	0.01710	1.84612	0.00031	0.00001	0.00057

166	Paper Coated & Laminated N.E.C.	0.03777	4.07695	0.00029	0.00001	0.00118
167	Bags- Plastic	0.01651	1.78201	0.00228	0.00004	0.00406
168	Bags- Paper	0.00708	0.76412	0.00257	0.00002	0.00196
170	Sanitary Paper Products	0.00109	0.11776	0.00061	0.00000	0.00007
179	Commercial Printing	0.00110	0.11830	0.23300	0.00026	0.02756
186	Alkalies & Chlorine	0.00000	0.00043	0.00000	0.00000	0.00000
187	Industrial Gases	0.00001	0.00119	0.52433	0.00001	0.00062
188	Inorganic Pigments	0.00001	0.00130	0.43669	0.00001	0.00057
189	Inorganic Chemicals Nec.	0.00006	0.00680	0.05281	0.00000	0.00036
190	Cyclic Crudes- Interm. & Indus. Organic Chem.	0.00024	0.02645	0.42862	0.00011	0.01134
196	Soap and Other Detergents	0.00207	0.22322	0.05478	0.00011	0.01223
197	Polishes and Sanitation Goods	0.00214	0.23099	0.20420	0.00044	0.04717
205	Adhesives and Sealants	0.00015	0.01652	0.33458	0.00005	0.00553
210	Petroleum Refining	0.00387	0.41817	0.77773	0.00301	0.32522
213	Lubricating Oils and Greases	0.00195	0.21081	0.56271	0.00110	0.11863
220	Miscellaneous Plastics Products	0.06479	6.99396	0.00110	0.00007	0.00768
273	Metal Cans	0.00379	0.40877	0.21525	0.00082	0.08799
293	Crowns and Closures	0.00020	0.02170	0.02122	0.00000	0.00046
305	Metal Foil and Leaf	0.00176	0.19008	0.03948	0.00007	0.00750
321	Special Dies and Tools and Accessories	0.00016	0.01727	0.20513	0.00003	0.00354
330	Food Products Machinery	0.00068	0.07329	0.73706	0.00050	0.05402
335	Packaging Machinery	0.00006	0.00702	0.58048	0.00004	0.00407
347	Refrigeration and Heating Equipment	0.00038	0.04145	0.12966	0.00005	0.00537
354	Industrial Machines N.E.C.	0.00081	0.08776	0.00000	0.00000	0.00000
355	Transformers	0.00044	0.04803	0.12559	0.00006	0.00603
367	Electric Lamps	0.00032	0.03465	0.00039	0.00000	0.00001
386	Motor Vehicle Parts and Accessories	0.00040	0.04274	0.10283	0.00004	0.00440
428	Brooms and Brushes	0.00020	0.02170	0.00393	0.00000	0.00009
433	Railroads and Related Services	0.00587	0.63318	0.72100	0.00423	0.45653
434	Local- Interurban Passenger Transit	0.00116	0.12521	0.74080	0.00086	0.09276
435	Motor Freight Transport and Warehousing	0.03876	4.18403	0.87254	0.03382	3.65073
436	Water Transportation	0.00292	0.31540	1.00000	0.00292	0.31540
437	Air Transportation	0.00437	0.47160	0.46210	0.00202	0.21792
441	Communications- Except Radio and TV	0.00140	0.15101	0.52760	0.00074	0.07967
443	Electric Services	0.00567	0.61257	0.91630	0.00520	0.56130
444	Gas Production and Distribution	0.00726	0.78355	0.74140	0.00538	0.58092
445	Water Supply and Sewerage Systems	0.00093	0.09995	0.94429	0.00087	0.09438
446	Sanitary Services and Steam Supply	0.00231	0.24967	1.00000	0.00231	0.24967
447	Wholesale Trade	0.06966	7.51877	0.99567	0.06935	7.48621
448	Building Materials & Gardening	0.00048	0.05160	0.94030	0.00045	0.04852
449	General Merchandise Stores	0.00104	0.11215	0.92700	0.00096	0.10396
450	Food Stores	0.00131	0.14140	0.95000	0.00124	0.13433
451	Automotive Dealers & Service Stations	0.00061	0.06541	0.95000	0.00058	0.06214
452	Apparel & Accessory Stores	0.00055	0.05991	0.94030	0.00052	0.05633
453	Furniture & Home Furnishings Stores	0.00056	0.06023	0.94030	0.00052	0.05664
454	Eating & Drinking	0.00255	0.27503	0.90000	0.00229	0.24753
455	Miscellaneous Retail	0.00150	0.16191	0.94030	0.00141	0.15225
456	Banking	0.01089	1.17527	0.60750	0.00661	0.71397

458	Security and Commodity Brokers	0.00023	0.02537	0.59898	0.00014	0.01519
459	Insurance Carriers	0.00259	0.27978	0.63310	0.00164	0.17713
462	Real Estate	0.00447	0.48282	0.70000	0.00313	0.33798
463	Hotels and Lodging Places	0.00668	0.72072	0.68879	0.00460	0.49643
464	Laundry- Cleaning and Shoe Repair	0.00022	0.02396	0.75010	0.00017	0.01797
469	Advertising	0.02307	2.49042	0.75600	0.01744	1.88276
470	Other Business Services	0.00326	0.35200	0.61628	0.00201	0.21693
472	Services To Buildings	0.00104	0.11247	0.65180	0.00068	0.07331
473	Equipment Rental and Leasing	0.00136	0.14669	0.75600	0.00103	0.11090
474	Personnel Supply Services	0.00406	0.43846	0.72724	0.00295	0.31886
475	Computer and Data Processing Services	0.00189	0.20433	0.75600	0.00143	0.15448
476	Detective and Protective Services	0.00073	0.07891	0.63842	0.00047	0.05038
477	Automobile Rental and Leasing	0.00176	0.18998	0.67388	0.00119	0.12802
479	Automobile Repair and Services	0.00142	0.15285	0.90000	0.00127	0.13756
480	Electrical Repair Service	0.00062	0.06703	0.90000	0.00056	0.06033
482	Miscellaneous Repair Shops	0.00160	0.17238	0.75600	0.00121	0.13032
483	Motion Pictures	0.00031	0.03379	0.61062	0.00019	0.02063
489	Membership Sports and Recreation Clubs	0.00044	0.04793	0.60161	0.00027	0.02883
494	Legal Services	0.00061	0.06595	0.79270	0.00048	0.05228
503	Business Associations	0.00056	0.06077	0.65235	0.00037	0.03964
506	Engineering- Architectural Services	0.00063	0.06822	0.79270	0.00050	0.05408
507	Accounting- Auditing and Bookkeeping	0.00040	0.04296	0.79270	0.00032	0.03405
508	Management and Consulting Services	0.00264	0.28551	0.60665	0.00160	0.17320
509	Research- Development & Testing Services	0.00050	0.05429	0.75600	0.00038	0.04105
512	Other State and Local Govt Enterprises	0.00063	0.06854	1.00000	0.00063	0.06854
513	U.S. Postal Service	0.00074	0.07988	0.74990	0.00055	0.05990
516	Noncomparable Imports	0.00021	0.02234	0.00000	0.00000	0.00000
530	Potato	0.07313	7.89376	1.00000	0.07313	7.89376

NOTE: * millions of dollars

SOURCE: Holland and Yeo, 2000

Commodity Balance Sheets

The Commodity Balance Sheet shows where an industry's output is consumed. Commodity consumption is separated into two categories in the Commodity Balance Sheet: Industrial Demand and Institutional Demand. Potato is the only new commodity that is consumed directly by other new industries, and this intermediate demand is detailed under Industrial Demand.

In the Commodity Balance Sheets for the four new potato processing industries, Industrial Demands are set to zero. This is necessary due to the difficulty of estimating the values of potato commodities that other industries purchase. Results from an impact scenario will show no indirect effects for the potato processing industries. Instead the indirect effects from industries that are purchasing processed potato commodities are captured in original equivalent IMPLAN sectors.

To clarify how these indirect linkages operate, consider that in the un-aggregated 2003 Washington-CB model, potato product exports use $141,832,100 in Motor Freight Transport and Warehousing services, which is counted as a direct effect. The Motor Freight Transport and Warehousing sector in turns purchases $277,424 worth of services from the local Eating and Drinking sector, which is counted as an indirect effect. Eating and Drinking then purchases $172 worth of goods from the local Frozen Fruits, Juices and Vegetable sector, also counted as an indirect effect. Undoubtedly, some of Eating and Drinking's purchases will be of frozen potato products. However, since it is impossible to accurately separate frozen potatoes from the Frozen Fruit sector, the indirect effect needs to be captured in the old Frozen Fruit sector instead of the new

Frozen Potato sector. Indirect effects on the potato processing industries are still fully accounted for, but the results are reported in their old, equivalent IMPLAN sectors.

The Institutional Demand section contains the breakdown of household consumption by income and consumption by governments, as well as the values for Domestic and Foreign Trade of a commodity. In some cases, the sum of industrial and institutional demand for a commodity can be greater than what is supplied by local industry. When this happens, the commodity is imported into the region to make up the difference.

For the added potato sectors, the household and government consumption amounts are estimated based on percentages of consumption in the new potato sector's equivalent IMPLAN sectors. The Commodity Balance Sheets shown on Tables 4.9. through 4.13. are unique to the Washington-CB model.

Because of sales to households, the commodity with the most Institutional Demand is Frozen Potato with $108 million. Potato Chips have the highest proportion of Institutional Demand to Production at 79 percent. This means that most Potato Chips produced locally are consumed within the region, rather than exported.

Model Reconstruction

After all the desired adjustments have been made, the base model is reconstructed with the additional sectors to create a more detailed I/O model of the Washington potato economy. The Social Accounts and Type SAM Multipliers are

recreated by IMPLAN. Impact analysis can now be generated with this model to estimate the effects of potato industry exports on the regional economy.

Table 4.9. Potato Commodity, IMPLAN Report

COMMODITY BALANCE SHEET

Industrial Production

Industry Code	IndDes	Production*	Regional Market Shares	Byproducts Coefficient
530	Potato	576.9713	1.00000	1.0000
	TOTAL	576.9713		

Industrial Demand

TOTAL			562.1814			562.1814
Industry Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*
530	Potato	0.1124	64.8599	1.0000	0.1124	64.8599
531	Fresh Pack Potato	0.5455	61.6694	1.0000	0.5455	61.6694
532	Dehydrated Potato	0.4117	22.7118	1.0000	0.4117	22.7118
533	Frozen Potato	0.3000	405.0464	1.0000	0.3000	405.0464
534	Potato Chips	0.0731	7.8938	1.0000	0.0731	7.8938

Institutional Demand

	TOTAL	14.7899		0.000
Type Code	Description	Gross Final Demand*	Average RPC	Reg Inputs*
10001	Households LT10k	0.00000	1.00000	0.00000
10002	Households 10-15k	0.00000	1.00000	0.00000
10003	Households 15-25k	0.00000	1.00000	0.00000
10004	Households 25-35k	0.00000	1.00000	0.00000
10005	Households 35-50k	0.00000	1.00000	0.00000
10006	Households 50-75k	0.00000	1.00000	0.00000
10007	Households 75-100k	0.00000	1.00000	0.00000
10008	Households 100-150k	0.00000	1.00000	0.00000
10009	Households 150k+	0.00000	1.00000	0.00000
11001	Federal Government NonDefense	0.00000	1.00000	0.00000
11002	Federal Government Defense	0.00000	1.00000	0.00000
11003	Federal Government Investment	0.00000	1.00000	0.00000
12001	State/Local Govt NonEducation	0.00000	1.00000	0.00000
12002	State/Local Govt Education	0.00000	1.00000	0.00000
12003	State/Local Govt Investment	0.00000	1.00000	0.00000
14001	Capital	0.00000	1.00000	0.00000
14002	Inventory Additions/Deletions	0.00000	1.00000	0.00000
25001	Foreign Trade	4.935321		
28001	Domestic Trade	9.854610		

NOTE: * millions of dollars

Table 4.10. Fresh Pack Potato Commodity, IMPLAN Report

COMMODITY BALANCE SHEET

Industrial Production

Industry Code	IndDes	Production*	Regional Market Shares	Byproducts Coefficient
531	Fresh Pack Potato	113.0564	1.00000	1.0000
	TOTAL	113.0564		

Industrial Demand

TOTAL			0.0000			0.0000
Industry Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*

Institutional Demand

	TOTAL	113.0564		38.091
Type Code	Description	Gross Final Demand*	Average RPC	Reg Inputs*
10001	Households LT10k	1.40407	1.00000	1.40407
10002	Households 10-15k	1.25296	1.00000	1.25296
10003	Households 15-25k	3.68813	1.00000	3.68813
10004	Households 25-35k	4.05853	1.00000	4.05853
10005	Households 35-50k	6.56294	1.00000	6.56294
10006	Households 50-75k	8.27127	1.00000	8.27127
10007	Households 75-100k	5.00203	1.00000	5.00203
10008	Households 100-150k	4.31916	1.00000	4.31916
10009	Households 150k+	2.70731	1.00000	2.70731
11001	Federal Government NonDefense	0.00000	1.00000	0.00000
11002	Federal Government Defense	0.00000	1.00000	0.00000
11003	Federal Government Investment	0.00000	1.00000	0.00000
12001	State/Local Govt NonEducation	0.37558	1.00000	0.37558
12002	State/Local Govt Education	0.44924	1.00000	0.44924
12003	State/Local Govt Investment	0.00000	1.00000	0.00000
14001	Capital	0.00000	1.00000	0.00000
14002	Inventory Additions/Deletions	0.00000	1.00000	0.00000
26001	Foreign Trade	23.474667		
28001	Domestic Trade	51.490530		

NOTE: * millions of dollars

Table 4.11. Dehydrated Potato Commodity, IMPLAN Reoprt

COMMODITY BALANCE SHEET

Industrial Production

Industry Code	IndDes	Production*	Regional Market Shares	Byproducts Coefficient
532	Dehydrated Potato	55.1700	1.00000	1.0000
	TOTAL	55.1700		

Industrial Demand

TOTAL			0.0000			0.0000
Industry Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*

Institutional Demand

	TOTAL	55.1700		7.413
Type Code	Description	Gross Final Demand*	Average RPC	Reg Inputs*
10001	Households LT10k	0.26653	1.00000	0.26653
10002	Households 10-15k	0.23802	1.00000	0.23802
10003	Households 15-25k	0.69988	1.00000	0.69988
10004	Households 25-35k	0.77096	1.00000	0.77096
10005	Households 35-50k	1.24461	1.00000	1.24461
10006	Households 50-75k	1.56549	1.00000	1.56549
10007	Households 75-100k	0.94786	1.00000	0.94786
10008	Households 100-150k	0.81846	1.00000	0.81846
10009	Households 150k+	0.51302	1.00000	0.51302
11001	Federal Government NonDefense	0.00000	1.00000	0.00000
11002	Federal Government Defense	0.00000	1.00000	0.00000
11003	Federal Government Investment	0.00000	1.00000	0.00000
12001	State/Local Govt NonEducation	0.23270	1.00000	0.23270
12002	State/Local Govt Education	0.11585	1.00000	0.11585
12003	State/Local Govt Investment	0.00000	1.00000	0.00000
14001	Capital	0.00000	1.00000	0.00000
14002	Inventory Additions/Deletions	0.00000	1.00000	0.00000
26001	Foreign Trade	20.038542		
28001	Domestic Trade	27.718080		

NOTE: * millions of dollars

Table 4.12. Frozen Potato Commodity, IMPLAN Report

COMMODITY BALANCE SHEET

Industrial Production

Industry Code	IndDes	Production*	Regional Market Shares	Byproducts Coefficient
533	Frozen Potato	1350.1548	1.00000	1.0000
	TOTAL	1350.1548		

Industrial Demand

TOTAL			0.0000			0.0000
Industry Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*

Institutional Demand

	TOTAL	1350.1548		108.284
Type Code	Description	Gross Final Demand*	Average RPC	Reg Inputs*
10001	Households LT10k	3.73480	1.00000	3.73480
10002	Households 10-15k	3.33403	1.00000	3.33403
10003	Households 15-25k	9.80879	1.00000	9.80879
10004	Households 25-35k	10.79932	1.00000	10.79932
10005	Households 35-50k	17.44905	1.00000	17.44905
10006	Households 50-75k	21.97001	1.00000	21.97001
10007	Households 75-100k	13.29404	1.00000	13.29404
10008	Households 100-150k	11.47916	1.00000	11.47916
10009	Households 150k+	7.19528	1.00000	7.19528
11001	Federal Government NonDefense	6.71310	1.00000	6.71310
11002	Federal Government Defense	0.00000	1.00000	0.00000
11003	Federal Government Investment	0.00000	1.00000	0.00000
12001	State/Local Govt NonEducation	2.04656	1.00000	2.04656
12002	State/Local Govt Education	0.45995	1.00000	0.45995
12003	State/Local Govt Investment	0.00000	1.00000	0.00000
14001	Capital	0.00000	1.00000	0.00000
14002	Inventory Additions/Deletions	0.00000	1.00000	0.00000
26001	Foreign Trade	206.589054		
28001	Domestic Trade	1035.281620		

NOTE: * millions of dollars

Table 4.13. Potato Chip Commodity, IMPLAN Report

COMMODITY BALANCE SHEET

Industrial Production

Industry Code	IndDes	Production*	Regional Market Shares	Byproducts Coefficient
534	Potato Chips	107.9416	1.00000	1.0000
	TOTAL	107.9416		

Industrial Demand

TOTAL			0.0000			0.0000
Industry Code	Description	Gross Absorption Coefficient	Gross Inputs*	RPC	Reg Abs Coef	Regional Inputs*

Institutional Demand

	TOTAL	107.9416		85.172
Type Code	Description	Gross Final Demand*	Average RPC	Reg Inputs*
10001	Households LT10k	3.15284	1.00000	3.15284
10002	Households 10-15k	2.81253	1.00000	2.81253
10003	Households 15-25k	8.28296	1.00000	8.28296
10004	Households 25-35k	9.11036	1.00000	9.11036
10005	Households 35-50k	14.74387	1.00000	14.74387
10006	Households 50-75k	18.59903	1.00000	18.59903
10007	Households 75-100k	11.24134	1.00000	11.24134
10008	Households 100-150k	9.70669	1.00000	9.70669
10009	Households 150k+	6.08428	1.00000	6.08428
11001	Federal Government NonDefense	0.00000	1.00000	0.00000
11002	Federal Government Defense	0.00000	1.00000	0.00000
11003	Federal Government Investment	0.00000	1.00000	0.00000
12001	State/Local Govt NonEducation	0.00000	1.00000	0.00000
12002	State/Local Govt Education	0.00000	1.00000	0.00000
12003	State/Local Govt Investment	0.00000	1.00000	0.00000
14001	Capital	0.00000	1.00000	0.00000
14002	Inventory Additions/Deletions	1.43849	1.00000	1.43849
26001	Foreign Trade	3.252404		
28001	Domestic Trade	19.517196		

NOTE: * millions of dollars

CHAPTER 5

IMPACT ANALYSIS

Final Demand

Final demand, also called institutional demand, is the demand for goods destined for final use in the study area, or exported from the study area. Institutional demand is equal to the output of goods that is not consumed by other local industries.

Domestic exports are products manufactured or produced within the Washington-CB geographic boundaries but consumed outside the model area, anywhere else in the United States. The domestic exports are estimated by IMPLAN an in this thesis as:

(5) Domestic Exports = Total Output - Intermediate Demand - Institutional Demand - Foreign Exports

Table 5.1 lists the values of Domestic Exports for potatoes in the Washington-CB model.

Table 5.1. Potato Industry Domestic Exports, 2003

Sector	Commodity	Domestic Exports
530	Potato Production	$9,854,610
531	Fresh Pack Potato	$51,490,530
532	Dehydrated Potato	$27,718,080
533	Frozen Potato	$1,035,281,620
534	Potato Chips	$19,517,196

Foreign exports are produced inside the model area, but consumed outside the United States. The United State Census Bureau reports foreign export commodity values at the state level categorized under Schedule B Harmonized System (HS) codes (USCB 2005). The 2003 potato industry values are mapped into their proper IMPLAN sectors in Table 5.2.

Table 5.2. Washington and Oregon Foreign Potato Exports, 2003

HS Code	Description	Value
701	Potatoes, fresh or chilled	$23,474,667
70110	Potatoes, seed	$4,842,901
71010	Potatoes, uncooked or cooked by steaming or boiling, frozen	$4,078,746
1105	Potatoes, flour, meal, powder, flakes, granules and pellets	$12,230,858
200410	Potatoes, prepared or preserved, frozen, French fries and other	$202,510,338
200520	Potatoes, prepared or preserved, not frozen, Potato chips, granules, and other	$11,060,088

IMPLAN Code	Sector Name	Value
530	Potato	$4,935,321
531	Fresh Pack Potato	$23,474,667
532	Dehydrated Potato	$20,038,542
533	Frozen Potato	$206,589,054
534	Potato Chips	$3,252,404

SOURCE: U.S. Census Bureau, Foreign Trade Statistics www.census.gov/foreign-trade/www/, 2003

Transportation and Marketing Margins

Part of what constitutes an impact analysis is the value added to a product when shippers and wholesalers handle it after it leaves the factory or farm gate. These marketing margins are provided by IMPLAN for commodities when appropriate. For the Washington-CB model, transportation and marketing margins for the new commodities are taken from their equivalent IMPLAN sectors. Because these margins cover an aggregated sector and based on the entire United States, the Air Transportation margin applied to the Vegetable sector seemed inappropriate for the Washington-CB area, and was removed from the new Potato and Fresh Pack Potato industries. Table 5.3. is the breakdown of margin values for the impact analysis.

The transportation and wholesale mark-up values are included with the summed foreign and domestic export values to complete the impact analysis. The values in Table 5.4. are then run through the IMPLAN SAM model, and the impact results are given.

Potato Industry Impact Results

IMPLAN reports economic impact results in three main categories, Output, Value Added, and Employment. The results reported in Tables 5.5 through 5.7. are in 2003 dollars, and are aggregated (AGG) for compact viewing. The aggregation scheme is broken out into individual IMPLAN sectors in Appendix A.

Table 5.3. Marketing Margins, 2003 dollars

Sector	Description	Margins	Value ($)
Potato:			
530	Potato	0.654	14,790,000
433	Railroads and Related Services	0.015	339,220
435	Motor Freight Transport and Warehousing	0.164	3,708,807
436	Water Transportation	0.004	90,459
447	Wholesale Trade	0.161	3,640,963
Fresh Pack:			
531	Fresh Pack Potato	0.654	74,966,000
433	Railroads and Related Services	0.015	1,724,678
435	Motor Freight Transport and Warehousing	0.164	18,856,479
436	Water Transportation	0.004	459,914
447	Wholesale Trade	0.161	18,511,543
Dehydrated Potato:			
532	Dehydrated Potato	0.912	47,757,000
433	Railroads and Related Services	0.009	471,286
435	Motor Freight Transport and Warehousing	0.012	628,382
447	Wholesale Trade	0.067	3,508,464
Frozen Potato:			
533	Frozen Potato	0.812	1,241,817,000
433	Railroads and Related Services	0.025	38,233,282
435	Motor Freight Transport and Warehousing	0.077	117,758,509
447	Wholesale Trade	0.086	131,522,490
Potato Chips:			
534	Potato Chips	0.621	22,769,000
433	Railroads and Related Services	0.039	1,429,937
435	Motor Freight Transport and Warehousing	0.024	879,961
436	Water Transportation	0.008	293,321
447	Wholesale Trade	0.308	11,292,837

NOTE: Potato and Fresh Pack Potato Margins Sum
To .98 Because 437: Air Transportation is Removed

It should be noted that an additional benefit from the potato-complex to the Washington-CB economy is the use of potato waste as feed for local cattle producers. This impact was included in Holland and Yeo's (2000) study because the potato processing and cattle industries form an important symbiotic relationship that lowers waste removal costs for the processors and lowers feed costs to feedlots. However, the cattle feedlot impact is purposely missing from the Washington-CB impact analysis as not to distract from the economic impact of the potatoes themselves.

Table 5.4. Impact Final Demand (Sales) Values (millions of 2003 dollars)

Sector Number	Sector Name	Value
433	Railroads and Related Services	42.198403
435	Motor Freight Transport and Warehousing	141.832137
436	Water Transportation	.843693
447	Wholesale Trade	168.476298
530	Potato	14.790000
531	Fresh Pack Potato	74.966000
532	Dehydrated Potato	47.757000
533	Frozen Potato	1,241.871000
534	Potato Chips	22.769000
	Total	1755.503531

An IMPLAN Output Impact report reveals the additional sales by each industry generated in the year of an impact event. Output (Sales) results on Table 5.5 show that direct effect of the 2003 potato industry in the Washington-CB area is $1.756 billion, indirect effect is $1.3 billion, induced effect is $425 million, for a total impact of $3.480 billion. The largest indirect effects are $486 million for Potato, $139 million for Motor Freight and Warehousing, and $88 million for Wholesale Trade. The largest induced effects are $73 million for Retail Trade, $59 million for Real Estate, and $56 million for Health Services.

Table 5.5. Output (Sales) Impact (2003 dollars)

MULTIPLIER: Type SAM		Aggregated Report		
Industry	Direct	Indirect	Induced	Total
1 Farms (AGG)	0	3,276,274	4,126,932	7,403,206
25 Commercial Fishing	0	1,139	13,738	14,877
26 Ag Services (AGG)	0	18,178,360	1,052,654	19,231,012
28 Other Mining (AGG)	0	1,047,783	157,651	1,205,433
48 Construction (AGG)	0	28,699,768	7,217,111	35,916,876
58 Food processing (AGG)	0	31,372,524	10,488,336	41,860,860
108 Textiles (AGG)	0	7,282,272	2,148,392	9,430,663
133 Wood products (AGG)	0	1,637,012	598,263	2,235,276
148 Furniture (AGG)	0	10,734	694,841	705,574
161 Pulp and paper (AGG)	0	40,751,964	577,053	41,329,016
174 Printing and publishing (AGG)	0	5,259,164	3,389,501	8,648,665
186 Chemicals and allied (AGG)	0	23,750,564	5,614,297	29,364,860
210 Petroleum products (AGG)	0	29,309,234	7,199,073	36,508,308
215 Rubber products (AGG)	0	300,548	24,227	324,775
221 Leather products (AGG)	0	81,882	92,221	174,103
230 Stone, glass and clay (AGG)	0	347,854	255,295	603,149
254 Primary metals (AGG)	0	139,151	16,667	155,817
273 Fabricated metal (AGG)	0	391,881	161,732	553,613
307 Industrial machinery (AGG)	0	5,900,578	647,104	6,547,682
355 Electrical equipment (AGG)	0	1,527,686	1,322,674	2,850,360
384 Transportation equipment (AGG)	0	766,043	1,863,963	2,630,006
400 Scientific instruments (AGG)	0	204,903	776,108	981,011
415 Miscellaneous mfg (AGG)	0	218,892	315,340	534,232

433 Railroads and Related Services	42,198,404	7,701,035	587,645	50,487,080
434 Other Transportation (AGG)	843,693	4,794,205	4,249,293	9,887,190
435 Motor Freight Transport and Warehousing	141,832,144	139,479,840	5,089,105	286,401,088
439 Transportation Services (AGG)	0	9,028,665	760,126	9,788,791
441 Communications (AGG)	0	12,523,269	9,881,044	22,404,312
443 Utilities (AGG)	0	69,327,416	7,673,444	77,000,856
447 Wholesale Trade	168,476,320	88,742,496	24,703,954	281,922,752
448 Retail Trade (AGG)	0	4,381,238	73,283,800	77,665,032
456 Banking and Insurance (AGG)	0	38,476,896	39,662,752	78,139,648
461 Real estate (AGG)	0	72,910,160	59,082,036	131,992,192
463 Hotels and Lodging Places	0	3,760,025	4,644,839	8,404,864
464 Personal services (AGG)	0	1,285,887	6,056,017	7,341,904
469 Business services (AGG)	0	62,568,660	30,194,490	92,763,152
477 Automotive services (AGG)	0	11,297,715	6,488,435	17,786,150
480 Repair services (AGG)	0	2,055,961	1,437,092	3,493,053
483 Motion Pictures	0	775,577	1,809,577	2,585,153
484 Recreation services (AGG)	0	940,204	6,986,717	7,926,921
490 Health services (AGG)	0	58,788	55,660,628	55,719,416
495 Education services (AGG)	0	185,436	4,988,230	5,173,666
498 Social services (AGG)	0	261,477	9,537,220	9,798,697
502 Non-profit organizations (AGG)	0	777,450	5,307,324	6,084,774
510 Government (AGG)	0	82,607,352	16,240,087	98,847,432
525 Domestic Services	0	0	752,626	752,626
530 Potato	14,790,000	485,606,144	206,106	500,602,272
531 Fresh Pack Potato	74,966,000	0	115,700	75,081,696
532 Dehydrated Potato	47,757,000	0	22,162	47,779,160
533 Frozen Potato	1,241,870,976	0	310,838	1,242,181,760
534 Potato Chips	22,769,000	0	262,559	23,031,560
30001 Instutitions (AGG)	0	0	0	0
Totals	1,755,503,537	1,300,002,102	424,747,015	3,480,252,570

An IMPLAN Value Added Impact report contains the sum of the additional Employee Compensation, Proprietary Income, Other Property Income, and Indirect Business Taxes that result from an impact event. Value Added results on Table 5.6. show that the direct value added from the potato industry in Washington-CB area is $631 million, indirect effect is $481 million, induced effect is $262 million, for a total impact of $1.374 billion. The largest indirect effects are $68 million for Potato, $62 million for

Motor Freight Transport and Warehousing, and $61 million for Wholesale Trade. The largest induced effects are $54 million for Retail Trade, $44 million for Real Estate, and $37 million for Health Services.

Table 5.6. Total Value Added Impact (2003 dollars)

MULTIPLIER: Type SAM		Aggregated Report		
Industry	Direct	Indirect	Induced	Total
1 Farms (AGG)	0	1,195,420	1,433,679	2,629,099
25 Commercial Fishing	0	1,069	12,894	13,963
26 Ag Services (AGG)	0	11,272,933	655,509	11,928,442
28 Other Mining (AGG)	0	442,432	66,406	508,838
48 Construction (AGG)	0	19,740,888	4,387,105	24,127,994
58 Food processing (AGG)	0	5,036,311	2,431,086	7,467,397
108 Textiles (AGG)	0	1,556,866	585,138	2,142,004
133 Wood products (AGG)	0	675,855	245,549	921,404
148 Furniture (AGG)	0	3,146	248,378	251,524
161 Pulp and paper (AGG)	0	11,877,047	169,789	12,046,837
174 Printing and publishing (AGG)	0	2,462,499	1,560,844	4,023,343
186 Chemicals and allied (AGG)	0	10,724,797	3,456,920	14,181,716
210 Petroleum products (AGG)	0	3,677,365	906,266	4,583,632
215 Rubber products (AGG)	0	92,078	7,463	99,541
221 Leather products (AGG)	0	13,603	38,559	52,162
230 Stone, glass and clay (AGG)	0	147,625	108,735	256,360
254 Primary metals (AGG)	0	48,780	5,486	54,266
273 Fabricated metal (AGG)	0	150,499	65,497	215,996
307 Industrial machinery (AGG)	0	1,922,717	245,468	2,168,186
355 Electrical equipment (AGG)	0	540,438	407,192	947,630
384 Transportation equipment (AGG)	0	207,286	439,889	647,175
400 Scientific instruments (AGG)	0	73,151	232,330	305,481
415 Miscellaneous mfg (AGG)	0	106,682	153,098	259,781
433 Railroads and Related Services	22,832,872	4,166,906	317,965	27,317,744
434 Other Transportation (AGG)	315,233	2,364,846	2,371,278	5,051,358
435 Motor Freight Transport and Warehousing	63,172,068	62,124,356	2,266,689	127,563,120
439 Transportation Services (AGG)	0	6,749,969	556,369	7,306,338
441 Communications (AGG)	0	6,987,058	5,572,483	12,559,541
443 Utilities (AGG)	0	29,798,056	3,792,129	33,590,184
447 Wholesale Trade	116,483,600	61,356,076	17,080,178	194,919,840
448 Retail Trade (AGG)	0	3,045,452	53,751,984	56,797,436
456 Banking and Insurance (AGG)	0	23,774,828	24,737,780	48,512,608
461 Real estate (AGG)	0	51,863,272	43,789,668	95,652,936

463 Hotels and Lodging Places	0	2,317,806	2,863,235	5,181,041
464 Personal services (AGG)	0	571,232	3,293,114	3,864,346
469 Business services (AGG)	0	42,579,576	20,512,834	63,092,412
477 Automotive services (AGG)	0	6,890,116	3,904,141	10,794,256
480 Repair services (AGG)	0	1,000,784	679,635	1,680,419
483 Motion Pictures	0	217,660	507,844	725,504
484 Recreation services (AGG)	0	500,081	4,020,694	4,520,775
490 Health services (AGG)	0	35,989	36,806,516	36,842,508
495 Education services (AGG)	0	99,480	2,972,302	3,071,782
498 Social services (AGG)	0	151,183	4,501,934	4,653,117
502 Non-profit organizations (AGG)	0	556,165	2,810,038	3,366,203
510 Government (AGG)	0	34,642,704	6,294,946	40,937,648
525 Domestic Services	0	0	752,622	752,622
530 Potato	2,057,188	67,544,496	28,668	69,630,352
531 Fresh Pack Potato	18,630,710	0	28,754	18,659,464
532 Dehydrated Potato	15,358,082	0	7,127	15,365,210
533 Frozen Potato	383,059,552	0	95,879	383,155,424
534 Potato Chips	8,808,734	0	101,577	8,910,312
30001 Instutitions (AGG)	0	0	0	0
Totals	630,718,039	481,307,581	262,281,660	1,374,307,268

An IMPLAN Employment Impact reports shows the additional number of average annual jobs created in each industry due to an impact event. Employment is measured in total number of wage, salary, and self-employed jobs, both full-time and part-time. Employment results on Table 5.7. show the number of jobs in each industry created to support the potato industry in the Washington-CB area. Direct jobs created are 8,763, indirect jobs are 7,301, and induced jobs are 4,639, for a total employment impact of 20,703 jobs. The bulk of indirect job creation is 1,446 for Potatoes, 1,149 for Motor Freight Transport and Warehousing, and 864 for Business Services. The largest impacted sectors in terms of number of jobs supported by induced effects are 1,426 for Retail Trade, 691 for Health Services, and 379 for Business Services.

Table 5.7. Employment Impact (number of jobs)

MULTIPLIER: Type SAM	Aggregated Report			
Industry	Direct	Indirect	Induced	Total
1 Farms (AGG)	0	41.5	44.7	86.2
25 Commercial Fishing	0	0	0.1	0.1
26 Ag Services (AGG)	0	666.6	30.2	696.8
28 Other Mining (AGG)	0	5.4	0.8	6.3
48 Construction (AGG)	0	350.4	78.6	428.9
58 Food processing (AGG)	0	55.9	39.1	94.9
108 Textiles (AGG)	0	50.6	18.6	69.2
133 Wood products (AGG)	0	12.7	4.4	17.1
148 Furniture (AGG)	0	0.1	6.6	6.7
161 Pulp and paper (AGG)	0	171	2.4	173.4
174 Printing and publishing (AGG)	0	42.7	26.4	69.1
186 Chemicals and allied (AGG)	0	72	7.6	79.6
210 Petroleum products (AGG)	0	11	2.8	13.8
215 Rubber products (AGG)	0	1.6	0.1	1.8
221 Leather products (AGG)	0	0.4	1	1.4
230 Stone, glass and clay (AGG)	0	2.3	2	4.4
254 Primary metals (AGG)	0	0.5	0.1	0.6
273 Fabricated metal (AGG)	0	2.4	1	3.4
307 Industrial machinery (AGG)	0	29	3	32
355 Electrical equipment (AGG)	0	6.3	6.5	12.7
384 Transportation equipment (AGG)	0	3.1	4	7.1
400 Scientific instruments (AGG)	0	1	3.8	4.8
415 Miscellaneous mfg (AGG)	0	2.3	2.7	5
433 Railroads and Related Services	199.9	36.5	2.8	239.2
434 Other Transportation (AGG)	2.9	32.6	41.9	77.4
435 Motor Freight Transport and Warehousing	1,168.00	1,148.60	41.9	2,358.50
439 Transportation Services (AGG)	0	117.3	10.3	127.6
441 Communications (AGG)	0	35.6	27	62.6
443 Utilities (AGG)	0	116.4	14.2	130.6
447 Wholesale Trade	1,352.60	712.5	198.3	2,263.40
448 Retail Trade (AGG)	0	82	1,425.70	1,507.70
456 Banking and Insurance (AGG)	0	288.4	282.2	570.6
461 Real estate (AGG)	0	390.6	111.9	502.5
463 Hotels and Lodging Places	0	59.5	73.5	133
464 Personal services (AGG)	0	25.1	146.8	171.9
469 Business services (AGG)	0	863.8	379.2	1,243.00
477 Automotive services (AGG)	0	110.2	70.4	180.6
480 Repair services (AGG)	0	25.4	18.1	43.5
483 Motion Pictures	0	10	23.2	33.2
484 Recreation services (AGG)	0	12.3	179.6	191.9

490 Health services (AGG)	0	0.9	690.6	691.5
495 Education services (AGG)	0	3.7	133.7	137.4
498 Social services (AGG)	0	5.3	198.4	203.7
502 Non-profit organizations (AGG)	0	17.4	140.6	158
510 Government (AGG)	0	232.4	71.5	303.9
525 Domestic Services	0	0	67.1	67.1
530 Potato	44	1,445.90	0.6	1,490.50
531 Fresh Pack Potato	436.2	0	0.7	436.8
532 Dehydrated Potato	308.4	0	0.1	308.6
533 Frozen Potato	5,175.90	0	1.3	5,177.20
534 Potato Chips	74.6	0	0.9	75.5
30001 Instutitions (AGG)	0	0	0	0
Totals	8,762.50	7,301.20	4,638.80	20,702.60

Table 5.8. provides an un-aggregated detail of the non-potato industries that are most affected by potato industry exports in terms of number of jobs created. For industries with no direct impacts, Agricultural-Forestry-Fishery Services is affected the most with 653 Indirect jobs and 665 Total. Eating & Drinking has the most Induced jobs with 472.

There are a total of 3,631,683 jobs in the Washington-CB model area. The exports from the potato industry support nearly .6 percent of these jobs. However, because the industry is concentrated in the Columbia Basin area, most of the employment impact is felt this six county area. There are 227,132 jobs in the Columbia Basin, making support of the potato industry responsible, both directly and indirectly, for over 9 percent of the workforce in those seven counties.

Table 5.8. Fifteen Most Affected Non-Potato Industries, Jobs

Sector	Industry	Direct	Indirect	Induced	Total
435	Motor Freight Transport and Warehousing	1,168	1,149	42	2,359
447	Wholesale Trade	1,353	713	198	2,263
26	Agricultural- Forestry- Fishery Services	0	653	12	665
454	Eating & Drinking	0	40	472	512
462	Real Estate	0	391	112	503
56	Maintenance and Repair Other Facilities	0	341	66	407
474	Personnel Supply Services	0	256	81	337
455	Miscellaneous Retail	0	12	316	329
490	Doctors and Dentists	0	0	272	272
433	Railroads and Related Services	200	37	3	239
457	Credit Agencies	0	148	87	235
492	Hospitals	0	0	223	224
450	Food Stores	0	4	178	181
164	Paperboard Containers and Boxes	0	170	2	172
512	Other State and Local Govt Enterprises	0	136	26	162

CHAMPTER 6

SUMMARY AND ADDITIONAL RESEARCH

Summary

Input-Output economics can be an effective way to measure economic impacts of an industry on an economy. Using a packaged computer program such as IMPLAN makes constructing an I/O model and analyzing impacts easy, but some industry detail is lost in aggregation. Modifying IMPLAN allows the user to retain detail by specifically adjusting the model to match local industries.

The Washington-CB model is a customized I/O model that is detailed around the potato industry. The economic impact of potato production and processing in Washington was estimated using the Washington-CB model. Results from the model show that in 2003, $1,626 million of potato products are manufactured from the Washington-CB potato crop, by itself worth $577 million. The potato producing and processing industry directly employs 9,114 people.

The Washington-CB area exports $1,402 million worth of potatoes and potato products in the year 2003. Results from the export base type impact analysis show the total effect of potatoes and potato product exports on the Washington-CB economy is $1,374 million in Value Added, and $3,480 billion in Output (Sales). The total number of jobs needed to support the potato export industry is 20,703. The largest non-potato benefactor from potato-complex exports is Motor Freight and Transportation at $286 million in Output (Sales), and 2,359 jobs.

Additional Research

The accuracy of any model is only as good as the information used to build it. Additional research in the area of potato economics may benefit from knowledge of the stumbling blocks encountered during the creation of this Washington-CB model.

The lack of published enterprise budgets for Dehydrated Potatoes, French fries and Potato Chips hinders the development of their Industry Balance Sheets. This Washington-CB study was fortunate to have a potato industry veteran review the production functions for accuracy, but the ideal situation would be a comprehensive enterprise budget produced with actual industry data. Due to the competitive nature of these industries however, actual industry production functions will most likely never be available publicly.

Since the processed potato market is relatively mature, future growth will probably occur from the demand for new potato products, rather than in the traditional industries represented in the Washington-CB model. Newer products where any growth is more likely to occur, such as frozen potato skins or frozen mashed potatoes, likely have different production functions than French fries. In this study, all frozen potato products are aggregated into the Frozen Potato production function. Therefore, more detail is needed on the Industry Balance Sheet for Frozen Potato. An ideal potato I/O model would contain a unique Industry Balance Sheet for every type of potato product produced in the study area.

LITURATURE CITED

Bean, William, and David Runsten. "Value Added and Subtracted: The Processed Potato Industry in the Mid-Columbia Basin." Portland, OR: Columbia Basin Institute, 1993.

Buteau, Joanne, A.Desmond O'Rourke. "The Processed Potato Industry in Washington State: Structure and Markets." Information Series No. 10, Coll. of Agr. and Home Econ. IMPACT Ctr., Wash. State U., Pullman, 1986.

Conley, Dennis, Personal conversations and e-mail correspondents, Jan-Apri 2005.

Coon, Richard C. and F. Larry Leistritz, "Economic Impact of Production and Processing of Irrigated Potatoes in Central North Dakota," Agri. Bus. And Applied Econ. Report No. 452, Ag. Experiment Station, North Dakota State U., Fargo, 2001.

Cutter, Eric, "IMPLAN Balance Sheet Export," 100th Meridian, www.100thmeridian.com.

Globalwise, Inc. "The Economic Impacts of Food Plant Closure: Analysis of the J.R. Simplot Company Plant in Hermiston, Oregon," Portland, OR: Northwest Food Processors Association, 2004.

Hinman, Herbert, Gary Pelter, and Erik Sorensen. "2001 Cost of Producing Processing and Fresh Potatoes Under Center Pivot Irrigation Columbia Basin, Washington." EB1906, Coll. of Agr. and Home Econ., Wash. State U., Pullman, 2001.

Holland, David, and Jun Ho Yeo. "The Economic Impact of Potatoes in Washington State." EB1925, Coll. of Agr. and Home Econ., Wash. State U., Pullman, 2001.

Jensen, William S., "Economic Impact of The Tree Fruit Industry in Washington State and the Northwest," Wenatchee, Wash. State Hort. Assn., 2004.

Leontief, Wassily, Input-Output Economics, 2nd ed. New York: Oxford University Press, 1986

MIG, Inc. IMPLAN Pro. User's Guide, 3rd ed. Stillwater, Minn: Minnesota IMPLAN Group, Inc., 2004.

Planning Decisions, Inc. "A Study of the Maine Potato Industry: Its Economic Impact 2003," Presque Isle, ME, Maine Potato Board, 2003.

Schotzko, R. Thomas, and Kevin W. Sund. "Potatoes for the Fresh Market: The Costs of Growing and Packing." AE 02-8, Coll. of Agr. and Home Econ., Wash. State U., Pullman, 2002

Steinback, Scott. "Northeast Region Commercial Fishing Input-Output Model," National Marine Fisheries Service, NOAA, Woods Hole, Mass, Forthcoming.

U.S. Bureau of Reclamation, "Columbia Basin Project History," www.usbr.gov, 1998.

U.S. Census Bureau, Foreign Trade Statistics, www.census.gov/foreign-trade/www/, 2003

U.S. Census Bureau, Foreign Trade Statistics, "Schedule B Export Codes," www.census.gov/foreign-trade/schedules/b/index.html, 2005.

U.S. Department of Agriculture, "Washington Agri-Facts," September 15, 2004, www.nass.usda.gov/wa/agri1sep.pdf, Olympia, WA, 2004.

U.S. Department of Labor, Bureau of Labor Statistics, "Consumer Price Index," www.bls.gov/cpi/home.htm, 2005.

Willis, David and David Holland. "Translating Farm Enterprise Budgets into Input-Output Accounts: Another Example from Washington State." Staff Paper 97-1, Coll. of Agr. and Home Econ., Wash. State U., Pullman, 1997.

WSESD, "Covered Employment and Wages," Washington State Employment Security Division, www.workforceexplorer.com, 2003.

WSPC, "Disposition Report 03-04," Washington State Potato Commission, Moses Lake, Wash., 2004.

APPENDIX A

IMPACT AGGREGATION

Table A.1. Aggregation Scheme

Number	Aggregated Sector	IMPLAN Sector
1	Farms	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25	Commercial Fishing	25
26	Ag Services	26 27
28	Other Mining	28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 57
48	Construction	48 49 50 51 52 53 54 55 56
58	Food Processing	58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107
108	Textiles	108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132
133	Wood Products	133 134 135 136 137 138 139 140 141 142 143 144 145 146 147
148	Furniture	148 149 150 151 152 153 154 155 156 157 158 159 160
161	Pulp and Paper	161 162 163 164 165 166 167 168 169 170 171 172 173
174	Printing and Publishing	174 175 176 177 178 179 180 181 182 183 184 185
186	Chemicals and Allied	186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 207 208 209
210	Petroleum Products	210 211 212 213 214
215	Rubber Products	215 216 217 218 219 220
221	Leather Products	221 222 223 224 225 226 227 228 229
230	Stone, Glass, and Clay	230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253
254	Primary Metals	254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272
273	Fabricated Metal	273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306
307	Industrial Machinery (continued on page 57)	307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339

	Industrial Machinery (continued)	340 341 342 343 344 345 346 347 348 349 350 351 352 353 354
355	Electrical Equipment	355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 376 377 378 379 380 381 382 383
384	Transportation Equipment	384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399
400	Scientific Instruments	400 401 402 403 404 405 406 407 408 409 410 411 412 413 414
415	Miscellaneous Mfg.	415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432
433	Railroads and Related	433
434	Other Transportation	434 436 437 438
435	Motor Freight Transport and Warehousing	435
439	Transportation Services	439 440
441	Communications	441 442
443	Utilities	443 444 445 446
447	Wholesale Trade	447
448	Retail Trade	448 449 450 451 452 453 454 455
456	Banking and Insurance	456 457 458 459 460
461	Real Estate	461 462
463	Hotels and Lodging Places	463
464	Personal Services	464 465 466 467 468
469	Business Services	469 470 471 472 473 474 475 476 494 506 507 508 509
477	Automotive Services	477 478 479
480	Repair Services	480 481 482
483	Motion Pictures	483
484	Recreation Services	484 485 486 487 488 489
490	Health Services	490 491 492 493
495	Education Services	495 496 497
498	Social Services	498 499 500 501
502	Non-Profit Organizations	502 503 504 505
510	Government	510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 526 527 528
525	Domestic Services	525
530	Potato	530
531	Fresh Pack Potato	531
532	Dehydrated Potato	532
533	Frozen Potato	533
534	Potato Chips	534

APPENDIX B

IMPLAN MODEL MODIFICATION

Acknowledgements

This appendix is a general form set of instructions based on procedures created by Scott Steinback for his Northeast Region Commercial Fishing Input-Output Model. Eric Cutter created the Balance Sheet Export macro that deals with the report errors. Further technical help was provided by Doug Olson and Scott Lindall of Minnesota IMPLAN Group, Inc.

IMPLAN Modification Overview

The 2000 IMPLAN database contains information for 528 sectors, which are generalized aggregations of multiple industries. The IMPLAN Pro software allows for adjustments to the database information, which allows the user to accurately reflect local model industries. However, the software does not allow for disaggregating of a sector when more industry specific detail is required. Disaggregating can be accomplished by adding new sectors to an IMPLAN model with Microsoft ACCESS. This appendix attempts to describe the procedures required for IMPLAN modification.

The 2001 and beyond IMPLAN databases have only 509 sectors, but the procedures for modification are exactly the same.

Note that changes made in IMPLAN or ACCESS are instantaneous and permanent. Make back up copies and save changes as you go under different file names to prevent costly mistakes!

ACCESS Overview

An IMPLAN model consists of ACCESS tables and queries that can be viewed by opening the .iap file in ACCESS 2000. All IMPLAN models have an .iap file extension, so it is necessary to select Files Of Type >> All Files in order to view available IMPLAN files when opening with ACCESS.

ACCESS may need to make automatic formatting changes if opening an older IMPLAN model for the first time. Allow ACCESS to make the changes.

A file retrieved from a CD-ROM will automatically write protect itself. This write protect needs to be removed to open in IMPLAN or be modified in ACCESS. Copy the file onto the computer. Left-click on the file and select Properties, then uncheck Read Only. This will allow IMPLAN to open the file and to write changes.

The sixteen IMPLAN tables that need to be modified are listed in Table B.1. Appendix E in the IMPLAN User's Guide provides a detailed description of the data contained in each table. The Margins and Margin Codes tables can also be modified if desired, but this is not necessary to make the model run correctly. The procedure for changing each table is similar:

1. Export and save each file as a Microsoft EXCEL file.
2. Make the necessary additions or changes to the file.
3. Import the new file back into ACCESS as an ACCESS table.
4. Check the table for proper indexes.

Once all the tables are adjusted, the Social Accounts and Multipliers are rebuilt in IMPLAN, and the new model is complete.

Table B.1. Modified ACCESS Tables

Deflators1	Industry/Commodity Codes	→Observed RPCs
RPC Methods	RptSAFinal Demands	RptSAIndustry Data
SACommodity Sales	SAEmployment	SAFinal Demands
SAForeign Exports	SAOutput	SAValue Added
Type Codes	→US Absorption Table	→US Absorption Totals
→US Byproducts		

→ Indicates Linked ACCESS Table

ACCESS Table Exportation

To export an ACCESS file into EXCEL, highlight the table and click File >> Export. Save the table with it's original file name as an EXCELL file by choosing Save As Type >> Microsoft EXCEL. Save the tables in an easily accessible folder to make the importation step easier.

Tables marked with an arrow in ACCESS are linked to other IMPLAN models on the same computer. Do not alter these tables in ACCESS; doing so will affect other IMPLAN models on the same computer. Export these tables into EXCEL, and then delete the table in ACCESS to destroy the linkage. When the table is imported back into ACCESS, the arrow should be gone.

EXCEL File Importation

When importing the adjusted EXCEL file back into ACCESS, a few details need to be noted. Import the file by clicking File >> Get External Data >> Import. Select Files of type: Microsoft Excel to allow the EXCEL files to appear. Select an EXCEL file to import. When prompted by the Import Wizard, check First Row Contains Column Headings. Also check No Primary Key when prompted by the Import Wizard. Underscores are placed in place of spaces in the table name, remove the underscores and replace with spaces so IMPLAN can find the proper tables. Be sure that table names are written exactly the same as when IMPLAN named them.

Table Indexes

Each ACCESS table has an index that controls the layout of the table. These indexes need to be correct for IMPLAN to function properly. View a table index by highlighting a table and clicking Design. Then click View >> Indexes to see the current index scheme. Sometimes importation of EXCEL files into ACCESS will change the table's index. All the indexes need to be formatted correctly, but the most important index is SACommodity Sales. This contains the IMPLAN version code. It should read something like Ver 2_0_1024 under the Index Name heading, where the numbers represent the version of IMPLAN the model was built with. A proper SACommodity Sales table is shown in Table B.2.

Table B.2. Index View For SACommodity Sales ACCESS Table

	Index Name	Field Name	Sort Order
▸	Ver 2_0_1024	Commodity Code	Ascending
		Type Code	Ascending

The best way to check for proper indexes is to compare the tables of the modified model with the indexes of another IMPLAN model, making sure all the adjusted table indexes are correct.

Potential Errors

IMPLAN .iap files cannot be opened from a CD-ROM. Copy the file onto the computer, then right-click on the file, select Properties, and uncheck Attributes: Read-only.

Error: 22002 Invalid procedure call or argument Code:5 – This error is caused because there is no IMPLAN version code embedded in the SACommodity Sales Index. Open the SACommodity Sales table in Design View and enter the correct IMPLAN version number under Index Name.

filename.iap is not an IMPLAN database! – Most likely caused because the .iap file was modified in ACCESS 97 or ACCESS XP instead of ACCESS 2000. Be sure to use ACCESS 2000 for IMPLAN modifications.

IMPLAN will sometimes have problems displaying a Commodity or Industry Balance Sheet. For example, the Gross Inputs might show up as zeros or absurdly large

numbers. This is due to a known bug in the exporting software. Eric Cutter has developed an EXCEL macro, which overcomes this problem and is available for download at www.100thmeridian.com. The macro requires that the Microsoft EXCEL 10.0 Object Library be installed to run. Cutter's macro was used to export the Social Account reports in this thesis.

APPENDIX C

SCOTT STEINBACK'S FISHERIES APPENDICES

Northeast Region Commercial Fishing Input-Output Model

Scott Steinback
NOAA / National Marine Fisheries Service
166 Water Street
Woods Hole, MA 02543

January 2005

IMPLAN Pro Modification Procedures

An IMPLAN Pro model consists of over 60 underlying Microsoft Access tables (Table A-1). These tables can be grouped into four general categories. The tables in the first category contain unique code numbers for industries, commodities, margins, value-added sectors, household expenditure groups, institutions, transfer payments, and trade. Tables in the second category contain raw input data used in the impact assessment portion of the program. Default model building information about the study area and model specs are contained in the third category of tables; and the remaining tables contain report data that are created during the model construction stage, the impact analysis stage, and for viewing final impact runs. In constructing the Northeast Region input-output model, changes were made to the majority of the ACCESS tables in the first and second categories and a few of the ACCESS tables in the fourth category (modified ACCESS tables indicated with an * in Table A-1).

The modification procedure generally consisted of exporting the data contained in the relevant Microsoft ACCESS tables to Microsoft Excel, adding new data, and then importing the modified tables back into Microsoft Access. A brief summary of the modification procedure is shown in Table A-2, and the detailed steps involved in building the Northeast Region input-output model are presented below. A description of the adjustments made to each of the individual Microsoft ACCESS tables is shown in Appendix B.

Step 1

Opened the IMPLAN Pro software and created a Northeast Region input-output model using the default 2001 IMPLAN data for all of the counties in Table ?.

Step 2

Opened the new Northeast Region model in Microsoft ACCESS 2000. The IMPLAN Pro data bases are not compatible with other versions of Microsoft ACCESS.

Step 3

In Microsoft ACCESS, deleted the three US tables and the Observed RPCs table. All IMPLAN Pro models on a PC share the following five tables (as indicated by black arrows to the left of the tables when the model is opened in ACCESS):

- US Absorption Table
- US Absorption Totals
- US Byproducts Table
- Observed RPCs
- Margin Codes

The linkages to these tables must be disconnected so that the changes that are made will not affect other IMPLAN models that may exist on the PC. No changes were made to the Margin Codes table so it was not necessary to remove the link to this table.

Step 4

In ACCESS, imported the three US tables and the Observed RPCs table from the 2001 IMPLAN Pro structural matrix file 01NAT509.IMS.

Step 5

In ACCESS, exported the default data in the 16 ACCESS tables that were going to be modified to Excel. The US Absorption table consisted of over 80,000 rows of data, however, so it was necessary to create two Excel tables to house this information since Excel is limited to 65,536 rows.

Step 6

Deleted all of the default data in the 16 ACCESS tables, but kept the layout of the tables and the table names the same so that the updated Excel data could be imported back into the original ACCESS file structures.

Step 7

Modified the data in the 16 Excel tables to better reflect the sectoral linkages among fisheries-related industries (see Appendix B). Maintained the default variable names and record formats so that the files were compatible with the original ACCESS file structures.

Step 8

Imported the seventeen updated Excel files into ACCESS. An append query in ACCESS was used to combine the two US Absorption Excel files into one US Absorption table.

Step 9

Opened the modified model in IMPLAN Pro and reconstructed the model and multipliers. The IMPLAN Pro software is not capable of recognizing the direct changes made to the underlying ACCESS tables, so the model must be reconstructed to load the updated data.

IMPLAN Pro Table Adjustments

Industry/Commodity Codes

This table contains unique code numbers for industries and commodities. Industries and commodities share the same name and number in an IMPLAN Pro model. Modifications began by removing the default commercial fishing sector (IMPLAN sector number 16) and adding 394 new harvesting sectors to the model (Table B-1). These industry sectors designate different commercial fishing gear and vessel length categories in each of the subregions in the Northeast. However, no harvesting sectors were added for the North Carolina north subregion or the North Carolina central inshore and offshore lobster harvesting sectors. An IMPLAN Pro model is limited to 1,000 industry sectors and this constraint would have been exceeded after adding all of the harvesting sectors and the remaining fisheries-related sectors to be discussed below. Therefore, since there were no recording landings in the North Carolina north subregion in 2001 or for the North Carolina central inshore and offshore lobster harvesting sectors in 2001, these industries were excluded from the model. Industry sectors were created for all of the remaining harvesting sectors in all 23 subregions, even if there were no reported landings in 2001.

Additional changes included adding 23 wholesale seafood dealer sectors (sector's 904-926 in Table B-1), 4 fish exchange sectors (sector's 927-930 in Table B-1), 23 midwater trawl bait supplying sectors, and 23 medium bottom trawl bait supplying sectors (sectors's 931-976 in Table B-1). Finally, removed the default seafood

processing sector (IMPLAN sector number 71) and added 23 subregional processing sectors (sector's 977 - 999 in Table B-1).

Type Codes

The Type Codes table contains coding information on all transaction types in the data sets. For this table, we added the 490 industry/commodity code designations as assigned above and the associated 490 SAM Commodity codes. Transaction codes associated with Factors, Households, Institutions, Transfers, Employment, Output, and Trade remained the same.

US Absorption

This table contains the United States absorption matrix, which in input-output terminology is the coefficient form of the use table. The default 2001 table contains 80,285 rows of data that show the proportions of commodities each industry uses in its production process (i.e., its production function). We removed the 213 rows of data contained in the production functions for the default commercial fishing sector (sector 16) and the default seafood processing sector (sector 71), and then added 55,425 rows of data that contained the production functions of each of the 490 fisheries-related sectors that we added to the model.

Production function adjustments to sectors that purchase commodities from the default commercial fishing sector (i.e., seafood) and the default seafood processing sector were also required, since these sectors were removed from the Northeast Region input-output model. Adjustments were made by first identifying the industries that purchase

seafood from these sectors. The commodity balance sheet report option in IMPLAN Pro provides information on all industry sectors that purchase from a particular sector. Using this option, we were able to identify the 11 industry sectors that purchase seafood from the default commercial fishing sector, and the 27 industries that purchase from the default seafood processing sector in the 2001 data (Table's B-2 and B-3). However, our Northeast Region model wholesale seafood dealers are assumed to purchase 100% of the commercial fishing output. Thus, it was necessary to change the assignment of seafood purchases for the 11 industry sectors that purchase commercial fishing output. We assumed that 7 of the 11 sectors would purchase seafood from seafood processors and the remaining 4 would purchase from wholesale seafood dealers (see Table B-2).

This reassignment strategy, however, entailed an additional step because the Northeast Region model includes 23 subregional wholesale seafood dealer sectors and 23 subregional seafood processing sectors. A method had to be developed to determine which of the subregional dealers and processors the industries in Table's B-2 and B-3 would purchase their seafood from. At the suggestion of the software vendor, we decided to allocate purchases according to output proportions in each subregion. In other words, we used the subregional shares of total wholesale seafood dealer output and seafood processing output in the Northeast Region to allocate purchases. These shares were then multiplied by the default commercial fishing sector's and/or the default seafood processing sector's gross absorption coefficient contained in the production functions of each of the sectors shown in Table's B-2 and B-3. The resulting vector of absorption coefficients was then inserted into the US Absorption Table in place of the default values

for each of the sectors shown in Table's B-2 and B-3. Note that the sum of the values contained in the vector of absorption coefficients must sum exactly to the absorption coefficient contained in the default data or the model will not build correctly.

US Absorption Totals

The US Absorption Totals table contains the sum of the absorption coefficients for each industry sector. We removed the default commercial fishing sector's total absorption coefficient and the default seafood processing sector's total absorption coefficient, and then added the appropriate absorption coefficients for the 490 new sectors in the Northeast Region model. The sum of the coefficients from each sector in the US Absorption table must match the coefficients in the US Absorption Totals table.

US Byproducts

This table contains US estimates of the proportions of each commodity an industry produces. In input-output terminology it is the coefficient form of the make table derived by dividing each element by the make table row totals. Industries often produce more than one commodity. Commodities other than primary commodities are called secondary commodities or byproducts. For this table, we first examined if any of the 509 default industry sectors produced commercial fishing seafood or processed seafood as a byproduct. The commodity balance sheet report option in IMPLAN Pro provides information on commodity production by all industries. From this report we found that no other industries produced commercial fishing seafood as a byproduct in the 2001 data. However, there were three industries (Frozen food manufacturing, Fruit and vegetable

canning and drying, and Meat processed from carcasses) that produced processed seafood as a byproduct. If we allowed these sectors to produce processed seafood as a byproduct, the model would not construct properly because the default seafood processing sector was removed from the model. Therefore, we removed the proportion associated with processed seafood for these three sectors and added it to their primary commodity share, so that the sum of each sector's byproducts remained equal to one. The byproducts coefficients, which include the primary commodity share coefficient, must sum to one for each sector in the model in order for the model to construct properly.

We also assumed that each of the 490 new sectors that were added to the model would produce only primary commodities. Thus, we added a single record to the US Byproducts table for each of the 490 new sectors and set each sector's primary commodity share coefficient to one.

SACommodity Sales

This table shows sales of commodities by households and institutions in the study area. There were no sales of seafood by households in the default data so no changes were made to the commodity sales rows for the nine household expenditure sectors (i.e., Type Codes 10001 - 10009). There were also no institutional sales of raw harvested seafood or processed seafood. However, zeros are entered into the commodity sales field when no sales are present so we had to remove the records that pointed to these commodity codes in the default institutional sales data. In addition, since we've assumed that there are no institutional sales of commodities produced by the 490 new industries

we added to the model, rows with zeros in the commodity sales field were inserted into the table.

We also had to remove inventory additions (Type Code 14002) that existed in the default data for the seafood processing sector (Sector 71) since we eliminated this sector from the Northeast Region model. Subregional seafood processing sectors were added to the model, however, so we simply reassigned the single Northeast Region default inventory value to the 23 new subregional seafood processing sectors in the model. This was done by constructing 23 separate subregional IMPLAN Pro models to obtain the default inventory seafood processing values in each subregion. These default values were then assigned to the 23 subregional seafood processing commodity codes in the SA Commodity Sales table.

SAEmployment

The SA Employment table delineates average annual jobs for each industry in the study area. Jobs are measured in terms of both full-time and part-time workers combined. For this table, we removed the employment estimates for the default commercial fishing sector (Sector 16) and the default seafood processing sector (Sector 71), and then inserted our employment estimates for the 490 new sectors.

SAFinal Demands

The final demand table consists of purchases of commodities for final consumption by households and institutions. Several modifications were made to this

table. The first step entailed removing final demands associated with the default commercial fishing sector and the default seafood processing for all nine of the household expenditure type codes and for all of the institution type codes. We then used these default values in combination with output data and the dealer transaction matrix (see Section ?) to estimate final demands by type codes for the new harvesting sectors, seafood dealer sectors, and seafood processing sectors.

Final demands for each of the 394 new harvesting sectors were estimated by first calculating the proportion of a sector's output to the total output across all 394 sectors, and then multiplying this proportion by each default commercial fishing sector's (Sector 16) final demand value contained in a Northeast Region-level model across type codes.

Final demands at the wholesale seafood dealer level were more difficult to calculate because the wholesale seafood dealer sector is lumped into in an all encompassing wholesale trade sector in an IMPLAN Pro model. Thus, there were no default final demand values specifically for seafood purchased at the wholesale level to use as a benchmark in our new model. However, using the average 2001 wholesale seafood mark-up from Fulton fish market (40%) in combination with the dealer transaction matrix we estimated final demands by type code for all 23 wholesale seafood dealers in the model. Assuming all commercially landed seafood flows through wholesale dealers, we first divided the commercial fishing final demand sales calculated above by 0.4 to calculate the wholesale dealer final demand sales associated with each of the 394 new harvesting sectors. We then multiplied these values by the proportions contained in the dealer transaction matrix to determine final demand sales by wholesale

dealer and type code associated with each new harvesting sector. Lastly, we summed the final demand sales across harvesting sectors for each wholesale dealer by type code. The resulting final demand vector contained final demand sales for all 23 wholesale seafood dealers by type code and was incorporated into the SA Final Demands table. These final demands were also subtracted from the default wholesale trade final demand values since they were reassigned to 23 new sectors in our model.

Finally, final demands for the 23 seafood processing sectors were calculated in the same manner as the harvesting sector's final demands. The proportion of a sector's output to the total output across all 23 sectors was multiplied by each default seafood processing sector's (Sector 71) final demand value contained in a Northeast Region-level model across type codes.

SAForeign Exports

The SA Foreign Exports table shows demands made for goods and services by consumers and industries outside the US. For this table, we removed the foreign export estimates for the default commercial fishing sector (Sector 16), re-estimated foreign exports for raw seafood from new data (see below), and assumed that foreign exports of raw seafood occur at the wholesale level and not the harvesting level. Additionally, foreign exports for the 23 new processing sectors added to the model were estimated by constructing 23 separate subregional IMPLAN Pro models to obtain the default inventory seafood processing export values in each subregion.

Foreign exports of seafood produced at the wholesale-level in the Northeast Region were calculated according to the following six steps.

Step 1 - Northeast dealer reports were used to calculate the value of landings by species for the top three to five species landed (by value) for each harvesting sector gear type in the model.

Step 2 - Calculated the proportion of total value by species and product type that is exported out of the US. New England and Mid-Atlantic foreign trade data by species and product type is available from the Fisheries Statistics & Economics Division of the National Marine Fisheries Service (NMFS) at http://www.st.nmfs.gov/st1/trade/index.html. This data is purchased from the Foreign Trade Division of the U.S. Census Bureau and provides information on trade ($'s and lbs) through specific U.S. customs districts such as New England and the Mid-Atlantic regions. We divided the value exported by species and product type, by the region-wide export value of total landings (average export price multiplied by total landings) to obtain the proportion of total sales exported out of the U.S. by product type.

Step 3 - Assumed fresh fillets and fresh and frozen whole fish would be exported by wholesalers. The remaining product type categories (frozen fillets, salted, dried, minced frozen, smoked, and an other product type category) were assumed to be exported by seafood processors. We summed the export proportions from Step 2 across the three wholesale product type categories to estimate total Northeast Region export proportions (in terms of value) by species.

Step 4 - Calculated weighted average wholesaler export proportions derived from the harvesting gear types. The export proportions from Step 3 were weighted by the proportions of landed value by species (for the top three to five valued species) to total landed value for each of the harvesting gear types. These species-level proportions for each gear type were then summed across species to obtain the proportions of wholesaler output that will be exported out of the U.S. originating from the 18 different gear types in the model. Note that the export rates derived from each gear type are assumed to be the same across the 23 subregions.

Step 5 - The wholesale export rates from Step 4 were then multiplied by the output values contained in the dealer transaction matrix (adjusted upward assuming a margin of 40%) to obtain the wholesale dealer export values across the 23 wholesale sectors associated with each harvesting sector in the model.

Step 6 - We then summed the wholesale export values from Step 5 across harvesting sectors for each of the 23 wholesalers and divided this value by the total sales from each wholesale sector. The resulting values show the average proportion of total seafood sales that is exported out of the U.S. by each wholesaler. These proportions were then multiplied by the margined wholesale output values contained in the SAOutput table (the wholesale sectors are treated as margin sectors in the model) to determine the value of foreign exports for each of the 23 wholesale sectors in the model.

SAOutput

The SAOutput table is a vector of output values in millions of dollars that represent an industries total production. There is a single value for each of the 997

sectors in the model. We removed the default commercial fishing sector's output value and the default seafood processing sector's output value, and then added the appropriate production values for the 490 new sectors in the Northeast Region model.

SAValue Added

This table details payments made/received by each industry to employee compensation (wage and salary payments, insurance, retirement, etc.), proprietary income (all income received), other property type income (payments from interest, rents, royalties, dividends, corporate profits, etc.), and indirect business taxes (primarily excise and sales taxes). The value added transactions associated with the default commercial fishing and seafood processing sectors were removed, and the appropriate values for the 490 new sectors were added to the table.

Observed RPCs

The Observed RPCs table contains forced regional purchase coefficient values for all states in the model. We removed the values associated with the default commercial fishing and seafood processing sectors and added the appropriate RPC values by state FIPS codes for the 490 new sectors added to the model. We used the average RPC option in IMPLAN Pro so the same RPC value was applied across states for each of the 490 new sectors. However, because of the way the model calculates impacts across sectors, virtually all of the RPC values for the new sectors were set to zero - the RPCs for the bait sectors were set to one.

RPC Methods

This table contains information for creation of the regional purchase coefficients. Similar to the modifications made for to many of the other tables, we removed the information associated with the default commercial fishing and seafood processing sectors and then added the relevant information for the 490 new sectors to the table.

Deflator1

The Deflator1 table contains deflators that account for relative price changes during different time periods. The IMPLAN Pro deflators are derived from the Bureau of Labor Statistics Growth Model. The 2001 IMPLAN Pro data base contains deflators from 1977 to 2010 for each commodity in the model. We eliminated the default commercial fishing sector deflators and applied these same values to the 394 new harvesting sectors in the table. We also removed the default seafood processing sector and applied those deflators to the 23 new subregional seafood processing sectors that we added to the table.

rptSAFinal Demands

This is a report table that is used by the IMPLAN Pro software to view final demand purchases of industry outputs. Report tables are not used by the IMPLAN Pro software for model construction or impact analysis; they simply provide a means to view data from within the IMPLAN Pro system. Therefore, modifications to this table are not absolutely necessary, but are required in order to use the IMPLAN Pro reporting feature.

To keep the software fully functional we modified the final demand values in this table. We removed the final demand values associated with both the default commercial

fishing and seafood processing sectors, and added the appropriate data from the SAFinal Demands and SAForeign Exports table. Note that modifications in ACCESS are not acknowledged by the IMPLAN Pro software so the social accounts must be regenerated after changes are made in order for the reporting features in IMPLAN Pro to work properly.

rptSAIndustry Data

This is another report table that is used by the IMPLAN Pro software to view industry output, employment, and value added information by sector. Changes to this table will not effect model construction or impact analysis, but need to be made in order to use the reporting feature in the IMPLAN Pro software. We eliminated the industry data associated with the default commercial fishing and processing sectors, and added the appropriate data from the SAOutput table, SAEmployment table, and the SAValue Added table.

Table C-1 - IMPLAN Pro Tables

Table Name	Description	Category
***Industry/Commodity Codes**	**Codes (Modified)**	**1**
*Type Codes	Codes (Modified)	
Margins Codes	**Codes**	
***US Absorption Table** ***US Absorption Totals** ***US Byproducts Table**	**Raw input data (Modified)**	**2**
***SACommodity Sales** ***SAEmployment** ***SAFinal Demands** ***SAForeign Exports** ***SAOutput** ***SAValue Added**	**Raw input study area data (Modified)**	
SATransfers	**Raw input study area data**	
***Observed RPCs**	**Raw input data (Modified)**	
***RPC Methods**	**Raw input data (Modified)**	
Margins	**Raw input data**	
***Deflators**	**Raw input data (Modified)**	
General Information	**Model-building information**	**3**
Model Specs **Multiplier Specs**	**Model-building information**	
SARatios	**Ratios for impact and multiplier calculations**	
IMCommodity Transactions **IMEvents** **IMFactor Transactions** **IMGroups** **IMIndustry Transactions** **IMInstitutions Transactions** **IMMargins** **IMProjects**	**Impact report data** **(Empty before impact analysis)**	**4**
Regional Absorption **Regional Byproducts** **Regional Commodity Balances** **Regional Direct Institutional Requirements** **Regional Factor Balances** **Regional Industry Balances** **Regional Institution Balances** **Regional Institution Demand** **Regional IxI** **Regional Market Shares** **Regional Multipliers Induced** **Regional Multipliers Type I** **Regional SAM Balances** **Regional SAM Balances Aggregated** **Regional SAM Balances Industry Detail** **Regional SAM Balances IxI** **Regional SAM Balances IxI Industry Detail** **Regional Sam Distribution** **Regional Value Added Coefficients**	**Output/report data for regional I-O model** **(Empty before 'Construct Model')**	
rptEC Multipliers **rptEmployment Multipliers** **rptIBT Multipliers** **rptOPTI Multipliers** **rptOutput Multipliers** **rptPersonal Income Multipliers** **rptPropInc Multipliers** **rptTotal VA Multipliers**	**Output reports**	
***rptSAFinal Demands**	**Data from SAFinal Demands and SAForeign Exports (Modified)**	
***rptSAIndustry Data**	**Data from SAOutput, SAEmployment & SAValue Added (Modified)**	
SAM Rollup	**SAM report data**	
Tax Impacts	**Tax report data**	
Type Code Rollup	**Type code report data**	
CGE Account	**Output data for computable general equilibrium models**	

Table C-2 - Summary of IMPLAN Modification Procedure

General Steps for Model Construction	General Instruction
1	In IMPLAN, select new model, name the new model, locate the relevant regional data, build study area
2	Open the new model in ACCESS
3	Delete the three US tables and the Observed RPCs table
4	Import the three US tables and the Observed RPCs table from 01NAT509
5	Export the default data in the 16 ACCESS tables that will be modified to EXCEL
6	Delete all default data in the 16 ACCESS tables
7	Create 16 new tables with modified data in Excel
8	Import the 16 updated tables from EXCEL into ACCESS
9	In IMPLAN, reconstruct the model and multipliers