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The Role of Agriculture in Oregon's Economic Base: Findings from a Social Accounting Matrix

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Most studies of a state's economic base count as "basic" only the "traditional" exports of goods, federal spending, and business investment. "Nontraditional" elements of the economic base (including exports of services, federal transfers to state/local governments and households, and extraregional property income) are typically ignored. We construct a social accounting matrix (SAM) for Oregon and estimate Oregon's economic base accounting for both traditional and nontraditional elements. Almost 20% of Oregon's jobs depend on extraregional income to households (including government transfers and outside property income), 11% depend on lumber and wood and paper products, and 8% depend on agriculture.

Key words: agriculture, economic base, employment dependency, export base, IMPLAN, social accounting matrix

Introduction

People have an enduring interest in understanding the importance of their work in the larger scheme of things. This fascination seems to be especially pronounced among those working in industries whose economic contributions are increasing or decreasing and whose "rank" is being challenged. The flurry of recent studies on the importance of high-technology industries is one example of this phenomenon (Charney and Leones; Beyers and Lindahl). Natural resource industries also have shown a particularly strong interest in understanding their contributions to the larger economy. Leones, Schluter, and Goldman identified 27 state-level studies completed between 1987 and 1994 that examined the role of agriculture in their state economies, not counting studies focusing on subsectors within agriculture.

The conceptual underpinning of these studies is economic base theory—the notion that what drives the regional economy is "basic" economic activity. The economic or "export" base is defined as activity that creates an inflow of money from outside the region, usually in return for goods or services sold to buyers outside the region. Export dollars received by basic activities are assumed to purchase productive inputs of goods

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and services, including labor and capital. The degree to which regional producers and households supply these goods and services determines the amount of nonbasic activity generated. It is assumed that nonbasic activity is induced, and therefore could not exist without basic activity. In this sense, then, the entire regional economy is "dependent" on the export base. There is an extensive and contentious literature on economic base theory dating back to the 1950s (Andrews 1954a, 1954b, 1955, 1956; Archibald; Crosson; Farness; Greenhut; Isserman; Leven; Merrifield; Romanoff; Tiebout). A more recent assessment of the history and significance of the economic base literature is provided by Krikelas. The formal identity of multipliers derived from the economic base model and the input-output model was established in 1969 (Billings).

Many studies examining the role of a given sector in the economy (or the dependence of the economy on a given sector) use input-output (I-O) models. About half of those studies identified by Leones, Schluter, and Goldman used input-output models. These models provide a consistent accounting framework that allows tracing the impact of changes in final demand for agricultural products through the various nonagricultural sectors of the economy. Input-output models have been criticized both on conceptual grounds and because of methodological problems in model construction. Conceptual criticisms point to the static nature, fixed-price production technology, and "perfectly elastic supply of factors" assumptions. Methodological critiques emphasize the shortcomings of techniques to estimate the trade flows and production relationships in the models.

These criticisms have merit and, in some cases, undoubtedly produce some inaccuracy in the estimates of the contribution of any given sector to a region's economic base. However, we believe that a more significant flaw in the I-O estimation of the contribution of a sector to a state's economy lies in the inability of I-O models to account for the growing importance of federal transfer payments to households and extraregional property income to a state's economic base. Given their exogenous nature, these sources should be included properly in any estimate of the regional economic base. The logic is that these flows indirectly contribute to the demand for nonbasic goods and services in much the same way that commodity exports do. While the theoretical importance of these elements of the economic base has been recognized for some time (Farness), empirical work has failed to incorporate the theory.[1]

In this analysis, we use a social accounting matrix (SAM)[2] to estimate the "economic base" of the state of Oregon and to show the contribution of agriculture in a context that includes "nontraditional" components of the economic base. In the next section of the article, we describe the 1993 Oregon SAM and discuss how it is used to construct our "employment dependency indices" measures of the relative contribution of each component of the economic base. This is followed by a presentation of our findings about the economic base of Oregon. The study concludes with a discussion of the policy implications of this view of Oregon's economy.

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[1] Farness identified several components of what he calls the "nontraditional" economic base: (*a*) production for independent nonresident visitors, and (*b*) production for residents who finance their purchases with independent, extraregional sources of legal and illegal income.

[2] A social accounting matrix is a table showing industry sales to and purchases from other industries in a region along with transactions involving the income and expenditures of regional households and government. The industry-commodity portion of a SAM is derived from industry-commodity input-output accounts.

The 1993 Oregon SAM and Employment Dependency Indices

A set of input-output accounts for the Oregon economy was constructed using IMPLAN[3] (Alward et al.). Sectors of interest such as livestock, crops, nurseries, logging, wood and paper products, and high-tech manufacturing were maintained as separate sectors. The IMPLAN accounts were augmented and verified using data from other sources [the U.S. Department of Commerce/Bureau of Economic Analysis (BEA), and the State of Oregon Employment Department] to produce an Oregon regional SAM that is consistent with the BEA Regional Economic Information System (REIS) data and State of Oregon government accounts (refer to appendix table A1). Special attention was given to the revenue and expenditure accounts for state and local governments to bring them into agreement with estimates from the State of Oregon Legislative Revenue Office. Special attention was also given to estimation of the agricultural production sectors (livestock, crops, and nurseries). Data on farm sales from the Economic Information Office at Oregon State University, Department of Agricultural and Resource Economics, provided the base for output estimates for these sectors.

The 1993 Oregon SAM includes 34 aggregate industry categories, three factor types, three household income classifications,[4] two state and local government accounts, and several categories of exogenous demand and income including the following: domestic exports, foreign exports, business investment expenditures, federal government expenditures on regional goods and services, federal transfers to households, other property income payments, federal grants to state and local government, and "outside" revenues of state and local government.

The IMPLAN-based input-output accounts were used to calculate the proportion of total exports (foreign and domestic) of regionally produced goods and services accounted for by livestock, crops, nurseries, logging, wood and paper products, and other industries—which are the traditional elements of the regional economic base.

Model Closure—The Missing Links

A major problem with the input-output accounts is that they do not trace either place of work factor payments or indirect business taxes to their respective place of residence household and government institutional accounts. As a result, it is impossible to close an input-output model based on such accounts by treating either household spending or government spending as endogenous variables. A number of alternative "closures" have emerged to simulate the missing linkage (Robison and Miller; Romanoff). IMPLAN uses a population-driven Type III closure that simulates the population/household income/consumption relationship. Other economists have approximated an economic base closure by assuming that the sum of household consumption, private investment, and government spending was a function of regional value-added. In such a model, the value-added row is included with the industry rows, and a column is added to the

[3] IMPLAN (Alward et al.) is an economic modeling system and continuously updated regional database. Using IMPLAN, it is possible to construct an internally consistent set of current economic flow accounts for any region (defined as an aggregation of counties) in the U.S.

[4] Refer to appendix table A2 for a description of the distribution of Oregon households by income category.

industry columns representing the sum of household consumption, state and local government spending, and private investment. Such an approach fails to account for regional leakage of savings, taxes, and profits, and overstates regional consumption and government effects.

The SAM accounts help trace factor payments and tax payments by place of work to institutional spending accounts by place of residence. From the Oregon SAM accounts, an "economic base" SAM model was constructed. The SAM model was "closed" by treating expenditures by regional households, state and local government, and residential investment as endogenous. Household income is assumed to drive household consumption. State and local government revenues are assumed to drive state and local government expenditures.

In industries where proprietors' income is a relatively large component of value-added, we assumed that "other property income" accrues to households in the region. In other words, if the capital stock in a given industry seems likely to be owned by Oregon residents (as evidenced by a large proportion of proprietors' earnings), then that entire sector's other property income, net of depreciation allowances and retained earnings, was allocated to Oregon households. This is in contrast to an IMPLAN Type II input-output model closure where only returns to labor and proprietors are considered endogenous.

Although some economists would quarrel with these assumptions, perhaps a more debatable issue involves the model's treatment of investment. In order to achieve an economic base closure, we have incorporated that portion of private investment most likely to be influenced by regional economic flows: residential construction. In the Oregon economic base SAM model, residential construction is assumed to be driven by household saving, which is in turn an endogenous function of household income and expenditure.[5]

Exogenous Demand: Traditional and Nontraditional Economic Base

Spending by the federal government and by firms for business investment is assumed to be determined largely outside the state and was treated as exogenous. In contrast to state and local taxes, revenue derived from federal grants and financial and natural capital (rents, royalties, and interest received from public trusts and investments) was treated as exogenous income to state and local government. These "nontraditional" revenues tend to be ignored in standard economic base analysis. However, they support important components of state and local government demand, including public employee retirement pensions, public assistance payments, and economic development and natural resource management initiatives.

Essentially the same treatment was accorded the nonemployment income of households. Such income consists of federal government transfers and that portion of property

[5] Other approaches to an economic base type model (Robison) also close the model with a portion of investment treated as endogenous, but they are ambiguous regarding just what portion. Although we have included residential construction, investment in the form of commercial and retail buildings is arguably largely endogenous. The problem comes in identifying this type of investment in the input-output accounts. IMPLAN identifies commercial and industrial construction (IMPLAN sector 49), but does not distinguish commercial construction from industrial construction. Since industrial construction is, in our view, not endogenously determined, we left the entire account as exogenous. The impact of the feedback effect from investment in our model is likely conservative.

income (interest, dividends, and rent) originating outside the region. Exogenous income payments to households, largely ignored in standard economic base analysis, have emerged as a major component of personal income. This is especially true in Oregon since it has become an important retirement destination.

The following accounts were treated as exogenous: total exports of goods and services, federal government expenditures, federal transfers to households, business investment, exogenous household income, federal transfers to state and local government, and "other" revenues of state and local government. The sum of these components gives the total exogenous "demand" or economic base for goods and services produced in Oregon.

In the IMPLAN accounts, the value of trade and transportation margins is shown in the various trade and transportation sectors. Thus, these margins are not included in the export value of the various sectors that produce for export, even though the purchaser's price includes the margin. While this accounting practice accurately captures the value that these sectors individually add to the regional economy, it does not recognize the extent to which trade and transportation sectors are dependent on the various exporting sectors, and thus understates the contribution of the exporting sectors to the regional economy. We attempted to correct this by adding a trade and transportation margin (from the IMPLAN accounts for each sector) to the total value of exports in the various goods exporting sectors.[6]

Employment Dependency Indices

The Oregon economic base SAM model, constructed using the aforementioned specification, was used to estimate the total (direct, indirect, and induced) output and employment generated by the exogenous sources of demand. Total employment attributable to economic activity generated in supplying each industry's final demand was expressed as a percentage of total state employment. These "employment dependency indices" are economically sound (defensible on theoretical and empirical grounds) and represent what we believe to be the best estimate of the contribution of any given industry or exogenous payment to total employment in Oregon.

The main elements in the Oregon economic base SAM are illustrated in figure 1. Those accounts treated as endogenous are located in the upper left portion of the figure. The result of export base closure is a partitioned SAM shown as follows:

$$\mathbf{S} = \begin{bmatrix} \mathbf{A} & \mathbf{0} & \mathbf{0} & \mathbf{C} & \mathbf{G} & \mathbf{HI} \\ \mathbf{V} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{E} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{F} & \mathbf{D} & \mathbf{0} & \mathbf{TR} & \mathbf{0} \\ \mathbf{IBT} & \mathbf{SS} & \mathbf{PT} & \mathbf{HT} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{SH} & \mathbf{0} & \mathbf{0} \end{bmatrix},$$

[6] Estimates of transportation and trade margins were taken from the IMPLAN margin tables. For most sectors, margins for sales to the federal government were used. For sectors where no federal government margin was given, household margins were used.

	ENDOGENOUS ACCOUNTS						EXOGENOUS ACCOUNTS			
	INDUSTRIES	FACTORS	ENTER-PRISES	HOUSE-HOLDS	STATE & LOCAL GOV'T.	HOUSE-HOLD INVESTMENT	TRADE	GOVERN-MENT	OTHER	TOTAL
INDUSTRIES	Interindustry Demand			Household Demand	S&L Gov't. Demand	Residential Investment	Export Demand	Federal Gov't. Demand	Gross Business Investment	Total Industry Output
FACTORS	Payments to Labor & Capital (place of work)									Total Factor Receipts
ENTERPRISES		Payments to Enterprises								Total Enterprise Receipts
HOUSEHOLDS		Factor Payments to Households (wages, inter-est & rent)	Dividends to Households		S&L Gov't. Transfers to Households			Federal Gov't. Transfers to Households	Financial Returns from Capital Outside Oregon	Total Household Income (place of residence)
STATE & LOCAL GOVERNMENT	Indirect Business Taxes for S&L Gov't.	S&L Factor Taxes	State Corporate Income Tax	Household S&L Taxes (property & income)				Federal Transfers to S&L Gov't.	S&L Gov't. Borrowing; Income from Leases, Trusts & Investments	Total State & Local Government Revenue
HOUSEHOLD SAVINGS				Household Savings						Total House-hold Savings
EXOGENOUS ACCOUNTS	Federal Indirect Business Taxes; Imports	Federal Factor Taxes; Other Leakage	Federal Corp. Profit Tax; Retained Earnings	Federal Income Tax; Imports	Leakage of S&L Gov't. Income; Imports	Leakage of Household Savings		Imports	Imports	Total Exogenous Accounts Receipts
TOTAL	Total Industrial Outlays	Total Factor Payments	Enterprise Payments	Household Payments	State & Local Government Payments	Household Savings Payments	Total Exogenous Accounts Payments			

Figure 1. Schematic SAM for export base model of the Oregon economy

where:

S = matrix of SAM direct coefficients,
A = matrix of input-output coefficients,
V = matrix of primary factor payments coefficients,
IBT = matrix of state and local indirect business tax coefficients,
E = matrix of capital payments to enterprise coefficients,
F = matrix of factor payments to household coefficients,
SS = matrix of state and local factor tax coefficients,
D = matrix of dividend payments to household coefficients,
PT = matrix of state and local corporate profit tax coefficients,
C = matrix of household consumption coefficients,
HT = matrix of state and local-direct household tax coefficients,
SH = matrix of household saving coefficients,
G = matrix of state and local government expenditure coefficients,
TR = matrix of state and local government transfer coefficients, and
HI = matrix of residential investments by household coefficients.

The endogenous variables are defined as follows:

X = vector of industry regional output,
V = vector of total primary factor payments,
K = vector of total capital income paid to enterprises,
Y = vector of total household income,
GT = vector of total state and local government income, and
HS = vector of regional household savings.

The exogenous variables may be defined as follows:

ex = vector of exogenous demand for regional output,
0 = vector of exogenous factor payments,
0 = vector of exogenous enterprise payments,
ey = vector of exogenous federal transfers and extraregional income to households,
eg = vector of federal transfers and extraregional income payments to state and local government, and
0 = vector of exogenous household savings.

The regional export base model then can be expressed as:

$$\begin{bmatrix} \mathbf{X} \\ \mathbf{V} \\ \mathbf{K} \\ \mathbf{Y} \\ \mathbf{GT} \\ \mathbf{HS} \end{bmatrix} = \mathbf{S} \begin{bmatrix} \mathbf{X} \\ \mathbf{V} \\ \mathbf{K} \\ \mathbf{Y} \\ \mathbf{GT} \\ \mathbf{HS} \end{bmatrix} + \begin{bmatrix} \mathbf{ex} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{ey} \\ \mathbf{eg} \\ \mathbf{0} \end{bmatrix}. \tag{1}$$

Solving for the vector of endogenous variables, the $(\mathbf{I} - \mathbf{S})$ matrix can be inverted to specify a matrix equation that expresses levels of industry supply, factor income, enterprise income, household income, state and local government revenue, and household saving as a function of the set of exogenous variables. This results in the following system of equations:

$$\begin{bmatrix} \mathbf{X} \\ \mathbf{V} \\ \mathbf{K} \\ \mathbf{Y} \\ \mathbf{GT} \\ \mathbf{HS} \end{bmatrix} = (\mathbf{I} - \mathbf{S})^{-1} \begin{bmatrix} \mathbf{ex} \\ \mathbf{0} \\ \mathbf{0} \\ \mathbf{ey} \\ \mathbf{eg} \\ \mathbf{0} \end{bmatrix}, \tag{2}$$

where $(\mathbf{I} - \mathbf{S})^{-1}$ represents the matrix of SAM Leontief inverse coefficients.

The vector of exogenous demand has three nonzero elements: **ex**, **ey**, and **eg**. The components of **ex** are export sales, sales to the federal government, and sales to private industry investment except residential housing. The components of **ey** are federal government transfers to households and household returns from financial capital outside of Oregon. The components of **eg** are federal government transfers to state and local government, and state and local government claims on income-producing capital.

Next, the $n \times n$ matrix of total impacts (**Z**) was generated by multiplying the $n \times n$ matrix **TY** by the SAM inverse $(\mathbf{I} - \mathbf{S})^{-1}$:

$$\mathbf{Z} = (\mathbf{I} - \mathbf{S})^{-1}\mathbf{TY}, \tag{3}$$

where **TY** is the diagonalized vector of exogenous demand.

Each row of **Z** was divided by the corresponding ratio of sectoral output-to-employment to produce a matrix of employment impacts (**E**). The column sums of **E** represent total employment associated with a given sector's exports or exogenous payment. These sums were divided by total Oregon employment to generate the employment dependency indices.

Oregon's Economic Base

A common way to describe the Oregon economy identifies the output and employment in each sector that provides goods and services. Using a sales measure (as shown in table 1), the largest industry is the Other Manufacturing (non-natural resource, non-high tech) sector, accounting for 11.8% of the state's output. By this measure, other principal industries are Finance, Insurance, and Real Estate (11.1%), Construction (11%), Other Services (nonbusiness, nonhealth) (6%), Business Services (5.7%), and Health Services (5.4%).

If one takes an "export base" view of the economy, however, a different picture emerges. Note in the final set of columns in table 1 that now extraregional payments to households and to state and local government are included as sources of exogenous demand. Other Manufacturing is still the top sector, accounting for 16.1% of the state's

Table 1. Output and Exogenous Demand by Sector in the Oregon Economy (1993)

	Total Sales (TIO)			Exogenous Demand		
SECTOR	Total ($ mil.)	Share (%)	Sector Rank	Total ($ mil.)	Share (%)	Sector Rank
Livestock	869	0.7	24	512	0.8	23
Crops	1,360	1.2	20	931	1.4	18
Nurseries & Greenhouses	362	0.3	27	263	0.4	26
Logging	2,756	2.4	16	1,735	2.7	13
Commercial Fishing	70	0.1	32	57	0.1	32
Agricultural Services	445	0.4	25	136	0.2	30
Mining	403	0.3	26	346	0.5	24
Construction	12,850	11.0	3	4,714	7.2	4
Meat & Dairy Processing	1,079	0.9	23	208	0.3	28
Other Food Processing	3,690	3.2	12	2,911	4.5	9
Livestock Feed Processing	151	0.1	29	143	0.2	29
Seafood Processing	256	0.2	28	243	0.4	27
Other Manufacturing	13,727	11.8	1	10,523	16.1	1
Wood Products	5,801	5.0	8	4,674	7.2	5
Pulp & Paper Products	2,147	1.8	18	1,932	3.0	11
Agribusiness	151	0.1	30	64	0.1	31
Hi-Tech Manufacturing	5,245	4.5	9	3,878	5.9	7
Transportation	4,629	4.0	11	1,211	1.9	17
Communication	1,865	1.6	19	593	0.9	21
Utilities	3,183	2.7	14	1,344	2.1	15
Wholesale Trade	4,946	4.3	10	0	0.0	33
Retail Trade	6,062	5.2	7	782	1.2	19
Eating, Drinking, & Lodging	3,256	2.8	13	731	1.1	20
Finance, Insurance, & Real Estate	12,962	11.1	2	4,222	6.5	6
Other Services	6,921	6.0	4	1,762	2.7	12
Business Services	6,670	5.7	5	1,492	2.3	14
Health Services	6,259	5.4	6	517	0.8	22
Government Enterprise	1,106	1.0	22	271	0.4	25
Federal Government Industry	1,315	1.1	21	1,315	2.0	16
S/L Govt. Industry (education)	2,975	2.6	15	0	0.0	33
S/L Govt. Industry (noneducation)	2,698	2.3	17	0	0.0	33
Other	88	0.1	31	0	0.0	33
Low-Income Households				4,834	7.4	3
Middle-Income Households				7,223	11.1	2
High-Income Households				2,994	4.6	8
S/L Government Revenues				2,623	4.0	10
TOTAL	116,298	100%		65,184	100%	

Notes: The Transportation, Wholesale Trade, and Retail Trade estimates in the "exogenous demand" columns are net of the trade and transportation margins needed for commodity exports. Columns may not sum to totals due to rounding errors.

economic base. The sectors next most important in driving the state's economy, however, are federal and extraregional income payments to Middle- and Low-Income Households (11.1% and 7.4%, respectively), followed by Construction (7.2%), Wood Products (7.2%), and Hi-Tech Manufacturing (5.9%).[7]

The usual measure of an industry's contribution to regional employment counts the number of people employed in each sector. Such a view (table 2) shows Retail Trade (12%), Other Services (9.6%), and Business Services (9.2%) as the top three sectors, followed by Eating, Drinking, and Lodging (6.9%), and the State/Local Government Education sector (public schools, colleges, and universities) with 6.8% of regional employment.[8]

An export base view of the economy, using our SAM approach, captures the extent to which the state's jobs are dependent on exports of various sectors and the federal transfers and extraregional income to households and state/local government. As table 2 demonstrates, the five sectors employing the most workers are not the sectors driving the Oregon economy.[9] The sectors whose "exports" provide the exogenous demand that generates the most jobs are Other Manufacturing (13.4%), extraregional payments to Middle-Income Households (9.1%), Wood Products (7.1%), Construction (7%), and extraregional payments to Low-Income Households (6.7%). These sectors are followed by exogenous State and Local Government Revenues (6.4%), Finance, Insurance, and Real Estate (6.3%), Hi-Tech Manufacturing (5.2%), and Other Services (4.2%).

Implications

The SAM approach to estimating the economic base identifies the contributions of nontraditional and increasingly important components of the regional economic base and reinforces the contributions of traditional components by putting them in a larger and more defensible context. When nontraditional features are incorporated into a more complete view of Oregon's economic base, extraregional income to households (including government transfers and dividends from outside the region) emerges as the most important generator of jobs in the Oregon economy, providing the source of almost 20% of Oregon jobs in 1993.

The traditional export base sectors are found to be very significant generators of jobs: Other Manufacturing (non-natural resource, non-high tech) generates 13% of the jobs. The Lumber and Wood Products sectors (logging, wood products, pulp and paper products) generate 11%, and the agricultural sectors [livestock, crops, nurseries, agricultural services, the three agriculture processing sectors (meat and dairy, other food, and feed), and agribusiness] generate over 8% of jobs. Even though these sectors in our model constitute a smaller share of the economic base than they would in a conventional input-output model that ignored extraregional household and government

[7] Note that these estimates are for shares of exogenous demand, not total output. To calculate the total output and income generated by each component of the economic base, it is possible to premultiply the vector of exogenous demand by $(\mathbf{I} - \mathbf{S})^{-1}$ [as in equation (2)]. To simplify the exposition and focus attention on employment dependency, we have omitted this step.

[8] Note that the employment measure used here is total jobs rather than full-time equivalents.

[9] The total number of export-dependent jobs for each sector is the column sum of the associated sector in the matrix of employment impacts (**E**). Direct employment is the own employment impact, while indirect and induced employment represent the remainder of the column sum.

Table 2. Oregon Export Base Dependent Employment (1993)

	Sectoral Employment			Export-Dependent Employment				
SECTOR	No. of Jobs	Share (%)	Sector Rank	No. of Jobs	Direct	Indirect and Induced	Dependency Index (%)	Sector Rank
Livestock	21,560	1.3	17	21,418	13,414	8,004	1.3	20
Crops	25,615	1.5	16	36,768	17,743	19,024	2.1	16
Nurseries & Greenhouses	8,706	0.5	26	12,388	6,655	5,733	0.7	24
Logging	14,208	0.8	21	30,399	9,322	21,078	1.8	19
Commercial Fishing	1,139	0.1	30	2,017	921	1,096	0.1	30
Agricultural Services	20,987	1.2	18	9,106	6,416	2,689	0.5	26
Mining	2,129	0.1	28	10,395	1,835	8,560	0.6	25
Construction	108,027	6.3	7	119,203	43,067	76,137	7.0	4
Meat & Dairy Processing	4,034	0.2	27	4,675	892	3,783	0.3	29
Other Food Processing	19,548	1.1	19	56,760	15,952	40,809	3.3	13
Livestock Feed Processing	432	0.0	32	1,397	413	985	0.1	31
Seafood Processing	1,979	0.1	29	4,761	1,909	2,852	0.3	28
Other Manufacturing	103,430	6.0	9	229,338	85,443	143,895	13.4	1
Wood Products	42,663	2.5	13	122,217	38,085	84,132	7.1	3
Pulp & Paper Products	9,066	0.5	25	33,882	8,235	25,647	2.0	18
Agribusiness	891	0.1	31	1,100	429	671	0.1	32
Hi-Tech Manufacturing	35,569	2.1	15	88,681	30,233	58,448	5.2	8
Transportation	53,744	3.1	12	35,147	16,272	18,874	2.1	17
Communication	11,949	0.7	23	13,184	4,085	9,099	0.8	23
Utilities	10,384	0.6	24	20,025	4,507	15,518	1.2	21
Wholesale Trade	89,655	5.2	10	0	0	0	0.0	33
Retail Trade	204,792	12.0	1	41,563	28,892	12,671	2.4	14
Eating, Drinking, & Lodging	117,875	6.9	4	38,927	27,388	11,539	2.3	15
Finance, Insurance, & Real Estate	107,434	6.3	8	108,512	43,731	64,781	6.3	7
Other Services	163,907	9.6	2	72,431	46,138	26,294	4.2	9
Business Services	158,165	9.2	3	64,382	41,028	23,353	3.8	10
Health Services	112,021	6.5	6	18,440	10,159	8,281	1.1	22
Government Enterprise	15,328	0.9	20	8,374	3,793	4,581	0.5	27
Federal Government Industry	38,215	2.2	14	62,937	38,215	24,722	3.7	12
S/L Govt. Industry (education)	116,550	6.8	5	0	0	0	0.0	33
S/L Govt. Industry (noneducation)	79,370	4.6	11	0	0	0	0.0	33
Other	13,668	0.8	22	0	0	0	0.0	33
Low-Income Households				114,359	0	114,359	6.7	5
Middle-Income Households				156,076	0	156,076	9.1	2
High-Income Households				63,977	0	63,977	3.7	11
S/L Government Revenues				110,199	0	110,199	6.4	6
TOTAL	1,713,040	100%		1,713,040	545,175	1,167,865	100%	

Notes: Direct employment is the own employment impact for each sector from the matrix of employment impacts. Columns may not sum to totals due to rounding errors.

income, they all support a larger share of total jobs than is suggested by a simple employment shares calculation. The exports of some nontraditional sectors also are significant. The three services sectors generate 9% of jobs, and federal transfers and extraregional income payments to state and local governments generate over 6% of the state's jobs.

Economic base theory has long recognized the importance of extraregional flows of income to regional households and governments. This study moves applied research closer to the theory in measuring the magnitude of those flows and identifying their relative importance in an economic base context. Extraregional household income (e.g., government transfers and returns from financial capital) and the spending of that income account for more Oregon jobs than the goods or service exports of any major industry in our study. Likewise, the exogenous revenue of state and local governments (federal government transfers and returns to capital held by state government) is more important than the export of all but a handful of major industries.

Those concerned about the future of Oregon agriculture and the economy can draw several implications from the findings in this study. First, the Oregon economy is more diversified than most people think. Over one-quarter of the jobs in the state depend on federal decisions about transfer payments to individuals and state and local governments, and on income from productive activities that take place outside of Oregon. Federal decisions about Social Security cost-of-living increases and levels of transfers to state and local governments are key determinants of Oregon jobs. Federal devolution of responsibilities to state and local governments and changes in federal timber payment formulas, to the extent that they affect state and local government revenues, can have a major impact on Oregon's economic base. The performance of non-Oregon businesses affects the dividends and rent earned by Oregonians.

Second, the Oregon agricultural economy is more diversified than many believe. Oregon jobs are about equally dependent on direct commodity exports (livestock, crops, and nursery products) and on export of processed agricultural goods (meat and dairy, other foods, and feed). Nurseries and greenhouse products have emerged as an important part of the new agricultural economy.

Finally, international market conditions and trade policy emerge as important drivers of the Oregon agricultural economy. Significant portions of the crops sales are to foreign markets, and the growth potential of crop and livestock exports depends on both the health of foreign economies and the outcomes of foreign trade agreements. The growing nursery and greenhouse sector serves primarily regional rather than international markets and can act as a buffer to some extent against international market downturns.

Nonregional sources of income and government demand have become prominent features of many economies throughout the West. Yet much of the regional analysis of these economies is centered on an economic base paradigm that recognizes only the export of goods. As this investigation demonstrates, it is possible to use IMPLAN accounts in conjunction with other sources of regional economic data to develop an empirical economic base model with an extended model closure that both is more consistent with regional economic theory and better characterizes the economic structure of the new West.

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References

Alward, G., E. Siverts, O. Olsen, J. Wagner, O. Senf, and S. Lindall. *Micro IMPLAN Software Manual.* USDA, Forest Service Land Management Planning Staff, Fort Collins CO, 1989.

Andrews, R. B. "Mechanics of the Urban Economic Base: The Problem of Base Measurement." *Land Econ.* XXX, 1(February 1954a):51–60.

———. "Mechanics of the Urban Economic Base: The Problem of Base Area Delineation." *Land Econ.* XXX, 4(November 1954b):309–19.

———. "Mechanics of the Urban Economic Base: Causes and Effects of Change in the Base Ratios and the Ratio Elements (I)." *Land Econ.* XXXI, 2(May 1955):144–55.

———. "Mechanics of the Urban Economic Base: The Base Concept and the Planning Process." *Land Econ.* XXXII, 1(February 1956):69–84.

Archibald, G. C. "Regional Multiplier Effects in the U.K." *Oxford Econ. Papers, New Series* 19(1967): 22–45.

Beyers, W. B., and D. P. Lindahl. "The Economic Impact of Technology-Based Industries on Washington State." Report prepared for the Technology Alliance, Seattle WA, January 1997.

Billings, B. R. "The Mathematical Identity of the Multipliers Derived from the Economic Base Model and the Input-Output Model." *J. Regional Sci.* 9(1969):471–72.

Charney, A., and J. Leones. "Impact of High Technology Industry on the Arizona Economy." College of Business and Public Administration and College of Agriculture, University of Arizona, Tucson, October 1995.

Crosson, P. R. "Further Comment on Economic Base Theory." *Land Econ.* XXXVI, 2(May 1960): 197–201.

Farness, D. H. "Detecting the Economic Base: New Challenges." *Internat. Regional Sci. Rev.* 12(1989): 319–28.

Greenhut, M. L. "Comments on Economic Base Theory." *Land Econ.* XXXV, 1(February 1959): 71–75.

Isserman, A. M. "Estimating Export Activity in a Regional Economy: A Theoretical and Empirical Analysis of Alternative Methods." *Internat. Regional Sci. Rev.* 5(1980):155–84.

Krikelas, A. C. "Why Regions Grow: A Review of Research on the Economic Base Model." Federal Reserve Bank of Atlanta, *Econ. Rev.* 77,4(1992):16–29.

Leones, J., G. Schluter, and G. Goldman. "Redefining Agriculture in Interindustry Analysis." *Amer. J. Agr. Econ.* 76,5(December 1994):1123–29.

Leven, C. L. "An Appropriate Unit for Measuring the Urban Economic Base." *Land Econ.* XXX, 4(November 1954):369–71.

Merrifield, J. A. "Neoclassical Anatomy of the Economic Base Multiplier." *J. Regional Sci.* 27,2(1987): 283–94.

Robison, M. H. "Community Input-Output Models for Rural Area Analysis with an Example from Central Idaho." *Annals Regional Sci.* 31(1997):325–51.

Robison, M. H., and J. Miller. "A Technique for Constructing a Non-Survey Regional Economic Base, Input-Output Model." Unpub. pap., University of Idaho, Moscow, September 1989.

Romanoff, R. "The Economic Base Model: A Very Special Case of Input-Output Analysis." *J. Regional Sci.* 14,1(1974):121–29.

State of Oregon, Employment Department. Oregon Covered Employment and Payrolls for 1990–1994. Employment Dept./Research, Tax, and Analysis Div., Salem OR, 1990–94.

Tiebout, C. M. "The Community Economic Base Study." Supplementary Pap. No. 16, Committee for Economic Development, New York, December 1962.

U.S. Department of Commerce, Bureau of Economic Analysis. Regional Economic Information System (REIS), Employment and Income Data for Oregon Counties. CD ROM. Washington DC: U.S. Government Printing Office, 1995.

Appendix: Industry Sectoring Scheme

Table A1. Aggregated Sector Titles and IMPLAN Industry Codes

AGGREGATED SECTOR	IMPLAN INDUSTRY CODES
Livestock	1, 2, 3, 4, 5, 6, 7, 8, 9, 22
Crops	11, 12, 13, 14, 16, 17, 18, 19, 20, 21
Nurseries & Greenhouses	23
Logging	24, 133
Commercial Fishing	25
Agricultural Services	26, 27
Mining	28, 29, 31, 33, 34, 37, 38, 40, 41, 42, 46, 47
Construction	48, 49, 50, 51, 52, 53, 54, 55, 56, 57
Meat & Dairy Processing	58, 59, 60, 61, 62, 63, 64, 65
Other Food Processing	66, 67, 68, 69, 70, 71, 72, 73, 75, 77, 79, 80, 81, 82, 83, 85, 87, 88, 89, 90, 91, 93, 94, 95, 96, 99, 100, 101, 102, 103
Livestock Feed Processing	78
Seafood Processing	97, 98
Other Manufacturing	108, 112, 116, 122, 123, 124, 125, 126, 127, 128, 129, 130, 132, 143, 144, 146, 148, 149, 150, 151, 152, 154, 155, 156, 157, 158, 159, 160, 167, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 195, 196, 197, 199, 200, 205, 207, 209, 210, 211, 212, 213, 215, 216, 217, 218, 219, 220, 221, 222, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 238, 240, 241, 242, 243, 244, 245, 247, 248, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 261, 262, 263, 265, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 280, 281, 282, 283, 284, 285, 286, 287, 289, 290, 292, 294, 295, 296, 297, 299, 301, 302, 303, 304, 306, 307, 308, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 326, 327, 328, 329, 330, 331, 332, 334, 335, 336, 337, 338, 351, 352, 354, 361, 366, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 397, 399, 401, 402, 405, 407, 409, 414, 415, 416, 417, 418, 419, 420, 421, 423, 424, 425, 426, 427, 428, 429, 432
Wood Products	134, 135, 136, 137, 138, 139, 140, 141, 142, 145, 147
Pulp & Paper Products	161, 162, 163, 164, 165, 166, 168, 169, 170, 171, 172, 173
Agribusiness	202, 203, 204, 309, 310
Hi-Tech Manufacturing	339, 340, 341, 342, 343, 344, 345, 347, 349, 353, 355, 356, 357, 359, 367, 368, 369, 370, 371, 372, 373, 374, 376, 377, 378, 379, 381, 383, 400, 403, 404, 406, 408, 410, 411, 412, 413
Transportation	433, 434, 435, 436, 437, 438, 439, 440
Communication	441, 442
Utilities	443, 444, 445, 446, 511, 514
Wholesale Trade	447

(continued . . .)

Table A1. Continued

AGGREGATED SECTOR	IMPLAN INDUSTRY CODES
Retail Trade	448, 449, 450, 451, 452, 453, 455
Eating, Drinking, & Lodging	454, 463
Finance, Insurance, & Real Estate	456, 457, 458, 459, 460, 461, 462
Other Services	464, 465, 466, 467, 468, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 495, 496, 497, 499, 500, 501, 502, 503, 504, 505
Business Services	469, 470, 471, 472, 473, 474, 475, 476, 494, 498, 506, 507, 508, 509
Health Services	490, 491, 492, 493
Government Enterprise	510, 512, 513, 515
Federal Government Industry	519, 520
S/L Govt. Industry (education)	522
S/L Govt. Industry (noneducation)	523
Other	525, 528

Table A2. Distribution of Oregon Households by Income Category

Household Income Category	Income Range ($1990)	% of Oregon Households
Low	< $20,000	35.5
Middle	$20,000–$40,000	34.9
High	> $40,000	29.6
TOTAL	1,105,362 households	100%