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Small Community Level Social Accounting Matrices and their Application to Determining Marine Resource Dependency

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Abstract *Social accounting matrices (SAMs) are constructed for two communities on the West Coast which have previously been classified as natural resource dependent; Westport, Washington and Newport, Oregon. The SAMs are constructed in an innovative way that allows for the economic dependency and utilization of natural resources, especially marine resources, to be examined in detail. The SAM utilizes data from a mix of publically available secondary sources and data collected directly from local governments. The SAMs are then subjected to an economic base analysis to develop indices of economic dependence.*

The results of this study indicate that while fishing and fish processing are no longer a major source of gross measures of output, employment, wages, or gross regional product (GRP) in any state or even county on the West Coast; from an economic export income perspective cities such as Westport, Washington are heavily dependent on these industries for their economic base.

Key words Marine resource dependency, social accounting matrix, economic base.

JEL Classification Codes R11, R15, Q22.

Introduction

Many coastal communities on the West Coast of the USA have seen dramatic growth and transformation over the past decade with a shift in employment away from traditional extractive natural resource-based industries, such as fishing and logging, to service and trade industries. Questions remain, however, as to the continued importance of these traditional industries in the community's economic base.

The need for federal, state, and local policy makers to assess the effects of policy, taxes, and development strategies is an increasingly important goal. Information on the role of specific sectors in the local economy and the sources of local tax revenue is an important analysis for community officials. At the federal level, estimating community economic impacts of policy and management decisions is mandated by congressional acts for all federal agencies that manage natural resources and interface with coastal communities. The Magnuson-Stevens Fishery Conservation and Management Act's National

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Standard 8 mandates that community economic effects of fisheries management decisions must be considered when NOAA Fisheries sets marine resource policy. Likewise, the United States Forest Service (USFS) and Bureau of Land Management (BLM) have legal mandates to consider the economic impacts of management decisions on resource-dependent communities.[1] Additionally, provisions in the National Environmental Policy Act mandate that all federal management alternatives must address the economic impacts of government policies on affected parties (including communities).

Newport, Oregon and Westport, Washington have been characterized as two of the most fishery-dependent communities on the West Coast (Sepez, Norman, and Felthoven 2007). These two communities are engaged in both commercial and recreational fishing, as well as nonfishery related marine resource use such as surfing and beachcombing. However, the extent to which marine resources contribute to the economic base of these communities, or any other small community on the West Coast, has not been fully quantified. This article presents a methodology for determining marine resource dependency at the community level by first modifying the methods of Schwarm and Cutler (2003) for constructing a social accounting matrix (SAM) for small communities. Then, modifying the methodology outlined in (Waters, Holland, and Weber 1999), the SAM is used to calculate the economic base contribution of each sector in terms of both gross regional product (GRP)[2] and employment by associating the total economic activity in the community to the sector whose exports support the respective economic activity. These base contributions are then converted to a dependency index for the respective sectors.

Sepez, Norman, and Felthoven (2007) were among the first to attempt to calculate fishery dependency at the community level. Prior to this, fishery dependency and the economic impacts of the fishery were evaluated at the state, multicounty, or county level (Seung and Waters 2006a). The methodology used in this article differs from Sepez, Norman, and Felthoven (2007) in how fishery dependency is characterized. They utilized a data envelope analysis (DEA) model which did not include the contribution of an industry to the community's economic base as criteria for determining fishery dependency. Their results characterized a large number of communities on the West Coast as fishery dependent. For example, Sepez, Norman, and Felthoven (2007) found large, economically diverse cities, such as Seattle, to be fishery dependent and, all totaled, identified 125 distinct communities on the West Coast as either fishery dependent or fishery engaged.

Why Small Coastal Communities are Unique

In general, small communities are distinct from larger regions in many fundamental aspects, which must be taken into account when the effects on these communities are modeled (Robison 1997). Small communities are more open than are larger regional economies. Commuters, local industry sales to nonresidents, higher than average degrees of cross-hauling, and outside remittances are all potentially important components of a small region's economy (Rose and Stevens 1991). The failure to account for these can significantly bias results of regional economic analysis.

In addition to the characteristics listed above, small coastal communities are unique in their access to marine resources; both extractive-based industries, such as commercial fishing and seafood processing, and amenity-based sectors, such as recreation and tour-

[1] The National Forest Planning Act and the Federal Land Management and Policy Act are legal mandates for the Forest Service and the Bureau of Land Management, respectively. For an in-depth discussion of the legal mandates for economic analysis in public land management, see Loomis (2002).

[2] Gross regional product (GRP) is the regional analog of gross domestic product (GDP) and is equivalent to total regional value added as per the National Income and Product Accounts (NIPA).

ism, as well as in their opportunities for ocean shipping. Commercial fishing and the associated fish processing have long been an important source of GRP in many coastal communities. While fishing is no longer a major economic driver of any state on the West Coast, it remains important in some communities (Sepez, Norman, and Felthoven 2007).

Prior models that have been used to estimate regional economic impacts of public land and marine resource management have focused primarily on county- or multicounty-level impacts and have been built using standard IMPLAN data for the broader regional economy with additional detail added regarding the fishing, forestry, livestock, or mining sectors (Darden *et al*. 2000, 2001; Seung and Waters 2006b; Steinback 2004; Weiler *et al*. 2002). While this is a convenient concession to the data availability and has simplified the construction of regional economic input-output models for analysis, the ability to look at smaller community impacts has advantages. Local cities and towns may depend a great deal on natural resource-based industries, and aggregating communities into counties or multicounty regions may mask the effects of management decisions on an individual municipality's tax base and the services that it supplies. Additionally, the percentage of a small local community's employment that is dependent on natural resources may differ substantially from that of the state or even county as a whole. Therefore, looking at the effects of management decisions on communities using county-level models may mask substantial impacts on employment and economic activity in a constituent community.

IMPLAN's county-level economic data are based on a combination of national average industry production functions, state-specific equations for estimating the proportion of local demand for any given good or service that is met by local supply, and county-specific data on employment (Olson and Lindall 1999).

This SAM model is built from the ground up using locally specific data sources and techniques that acknowledge the openness of small communities and the importance of all types of household income, including non-labor income and transfer payments.

Economic Base Theory

In addressing the openness of small communities, it is beneficial to couch the analysis in terms of economic base theory. Base industries are those that sell at least some of their products or services outside the local region, thus bringing in new dollars to the region. Traditional sectors that are primarily base include manufacturing, agriculture, mining, and commercial fishing. The tourism industry is also a base sector, as it brings in new dollars to the region by way of tourist spending. Nonbase industries are those that depend primarily on local spending for their revenues. A nonbase industry does not primarily generate new dollars for the economy; they do, however, serve the important role of keeping money within the region by way of local purchases. Industries traditionally thought of as nonbase include retail and most service-sector establishments. Industries generally are not 100% base or nonbase, as most sell a percentage of their output locally and a percentage outside the region.

This analysis investigates the role of marine resources in two complimentary methods for measuring economic activity. One is a "gross" measure, which simply counts the different metrics of economic activity (output, employment, wages, or value-added) that is generated from all sales within an industry. The other is a "base" measure, which gives credit to the industry that brings new dollars into the region for the economic activity that it supports in the regional economy. For example, if a fishing net manufacturer sells a fishing net to a local commercial fisherman, in a "gross analysis" the value of this sale (and the associated employment, wages, and value-added) would be counted in the manufacturing industrial sector. However, because this sale is only possible because of the new dollars that are brought into the region by commercial fishing, the "base analysis" gives credit to the commercial fishing sector for this sale. In this way, all of the measures of economic activity are attributed to the industry that is responsible for originally generating the new dollars into the economy which then supports other businesses. The total gross and base measures equal each other in total but differ by the contribution of each sector.

The base contribution can be further broken down into the "direct," "indirect," and "induced" components. The direct effect is the economic activity that is generated by the exports of the respective industries. The indirect effects are generated by the respective industries purchasing inputs from other local businesses that support the sales of exports. The induced effects are generated by the respective industries paying wages to employees who are involved in the export activities and the wages are then used to purchase goods and services from other local businesses. The ratio of the sum of the direct, indirect, and induced effects to the direct effects is called the multiplier.

The base contribution in terms of both GRP and jobs is then calculated as the percentage of the total GRP or employment that is attributable to a given sector's export sales (Waters, Holland, and Weber 1999). The economic base model gives credit to the industry that brings new dollars into the region for the economic activity that it supports in the regional economy. The export base model employed here can be summarized as:

$$\boldsymbol{Z} = (\boldsymbol{I}\text{-}\boldsymbol{S})^{-1}\ \boldsymbol{TY},$$

where $\boldsymbol{Z}$ is an nxn matrix of total base contributions, $\boldsymbol{I}$ is an nxn identity matrix, $\boldsymbol{S}$ is an nxn matrix of expenditure coefficients for the endogenous regional SAM accounts, and $\boldsymbol{TY}$ is an nxn diagonalized matrix of exogenous demands. The column sum of the $\boldsymbol{Z}$ matrix represents the total economic base contribution of the respective industry.

Economic base analysis is not a complete picture of the local economy. Looking exclusively at which current industries are basic and concluding that those industries are solely responsible for driving the local economy is overly simplistic (Power 1996). Economic base considerations are only one part of the picture of regional economic development and other factors, such as quality of life, endogenous growth, productivity measures, and institutions, also play an important role in regional economic development. However, despite the limitations of economic base theory, small, highly open local economies will need to have base sectors of some kind that will bring new revenue into the region. The information contained in the base analysis can be used as one piece of the puzzle to make informed decisions as to how policy actions will affect the local economy and, potentially, help determine what new base sectors might be developed through policy decisions.

This study will serve to connect every job and the GRP that exists in the community to the export industry that supports it. In this way, the sum of the direct, indirect, and induced employment; wages; and GRP in all the sectors will sum to their respective totals for the community as a whole. The common criticism in regional economic analysis of "double counting" is avoided, and the sum of all the industries' contributions is equal to the total output, employment, earnings, or value added in the economy, respectively. We argue this is a more appropriate methodology for conducting regional economic contribution analysis than is a traditional input-output impact analysis (Watson *et al*. 2007).

Social Accounting Matrices

A SAM is a step above the standard input-output transaction table in its ability to characterize the economic linkages that take place in a community. The structure of the SAM is presented in table 1. The primary elements of the SAM are:

Table 1. Social Accounting Matrix

	Endogenous Accounts						Exogenous Accounts				Total
	Industries	Commodities	Housing	Factors	Households	City/County Gov.	State/Federal Gov.	Savings/ Investment	Commuting	Rest of World	
Industries		Industry Output									Gross Output
Commodities	Intermediate Inputs		Housing Commodity Purchases		Household Consumption	Local Gov. Consumption	State/Fed Gov. Consumption	Investments		Exports	Demand
Housing					Household Pymts. to Housing						Returns to Housing
Factors (Land, Labor & Capital)	Value-Added (Factor Payments)		Housing Payments to Land and Cap.								Total Factor Income
Households (HHs)				Factor Payments to HHs			HH Taxes		HH Income from Out Commuters	Household Remittance Income	Household Income
City/County Government	Industry Taxes	Sales Taxes			Property Tax, Other Local Taxes					Transfer Income to Local Gov.	Government Income
State/Federal Government	Industry Taxes	Sales Taxes			Income Tax, Property Tax						Payments to State/Fed Gov.
Savings/ Investment					Household Savings				Commuting Balance		Savings
Commuting				Labor Payments to In Commuters							Commuting Outflows
Rest of World		Imports		Factor Income Transfers Out of Region	Household Remittances						Flows Out of Region
Total	Total Inputs	Supply Expend.	Housing Payments	Factor Expend.	HH Expend.	City/County Expend.	State/Fed Expend.	Investment	Commuting Inflows	Flows Into the Region	

- Production activities, which use commodities and factors of production as inputs to produce commodity outputs.

- Commodities, which are both produced by the production activities and used as intermediate inputs by production activities, and which are consumed by institutional demand. Commodities are produced locally as well as imported and exported to and from the region.

- Factors of production, such as labor and capital which are used as inputs by production activities and provide income to households that own the factors. Factors represent the value-added portion of the regional economy and account for the GRP. In a SAM model, all factors are owned by households, and as such, the financial returns to factors are distributed to households as income.

- Institutions, such as households, government, and investments which consume commodities, receive payments from factors, levy taxes, and provide services. Institutions serve to distribute payments between the other elements of the SAM.

- Exogenous accounts, which represent the imports and exports to and from the community. These include traded commodities, spending by people from outside the region on goods and services in the region (tourism), household income from outside the community, commuter income, and investment in the region from outside.

The columns of the SAM represent the demand for (or payment to) the given element for a corresponding element in the row. The rows represent the supply of (or payment from) the given element to the corresponding element in the columns. In this way, the columns are thought of as the expenditures or costs and the rows represent sources of demand. Because of the neoclassical assumptions of the SAM model, such as market clearing, income balance, and zero profits, the row and column totals will be equivalent. The general requirements of the SAM are commodity balance, where supply equals demand for every commodity and factor; flow of funds balance, where total income equals total expenditure for each institution; and balance of payments, where savings equals investment.

The advantage of a SAM analysis over the traditional input-output analysis is that a SAM accounts for not only interindustry linkages, but also for transactions that are typically very important in small communities; such as the distribution of labor income, household expenditures, the flows of income to households from non-labor sources, transfer payments into the community from outside the region, and commuting patterns.

Methods for Building Small Coastal Community SAMs

The small coastal community models grew from the framework and assumptions provided in Schwarm and Cutler (2003) for creating small city and town SAMs and CGE models. The model outlined in this article is differentiated by features that account for some of the unique attributes of small communities and is constructed in a way that enables analysis of natural resource dependency in the respective communities.

In contrast to the method employed by Schwarm and Cutler (2003), the SAM model is initially constructed in an "Industry by Commodity" (IxC) framework, rather than the "Industry by Industry" (IxI) framework. In an IxC framework, each industry both purchases and produces a bundle of "commodities." The commodities demanded by local businesses, households, and institutions are supplied by both local industries and imported. The IxC SAM framework allows for industries to have multiple outputs and differentiates between what an industry is and what it produces. For example, an IxC

SAM allows for two fishing sectors, say a limited-access fleet and an open-access fleet to produce the same mix of outputs (*e.g.,* trawl caught groundfish and crab) but use different commodity input bundles (production functions). This is an important attribute in the construction of computable general equilibrium (CGE) models where industries have multiple commodity outputs and commodities are differentiated by price and importability. The IxC SAM does not differentiate between local purchases of commodity inputs and imported commodity inputs; the column sum of the industry is simply the total demand for commodity inputs and value-added factors such as land, labor, and capital. For the aggregated commercial fishing sector that is examined here, the commodity input and factor demands were obtained through cost-earning surveys administered by NOAA Fisheries' Northwest Fisheries Science Center.

The IxC SAM is then converted to an IxI SAM in order to generate the Leontief Inverse matrix of total output in the economy that is generated by exogenous demand for an industry's production. The interindustry intermediate demands in the IxI SAM are purged of imports, accounting only for industry purchases from other local industries. The percentage of the total commodity demand that is accounted for by local demand is used to convert the IxC matrix to the IxI matrix. Estimates of the percentage of base GDP generated by the respective sectors create the economic base dependency indices.

Thirdly, the models incorporate new publically available secondary data sources that have been recently released by the Census Bureau (LED and LEHD). Secondary data sources eliminate problems associated with using employment and wage data from confidential unemployment insurance records in the SAM. These two features also ensure that each community's economic contribution can be compared to any other community's contribution using the same model design.

The data required for building the small community SAMs were gathered from numerous public sources and from IMPLAN matrices (for a more detailed description of how these SAMs were generated see the Appendix). Most of the public data needed for the SAM are available online from federal websites at no cost. Local government data from the city's budget and the county assessor's office is publicly available, but may not be available online. When this is the case, these reports are gathered directly from the appropriate local agencies.

IMPLAN Data

In some cases, a single zip code or a collection of zip codes could serve as a reasonable approximation of a small community's economy. However, this strategy suffers from multiple potential limitations. First, zip code level IMPLAN models are based on a mix of zip code level and county level data. IMPLAN's estimates of zip code level economic activity uses County Business Patterns (CBP) zip code level employment data to provide the total number of establishments in a given industrial code and the number of establishments in nine size classes (*e.g.,* 1-4 employees, 5-9 employees, 10-19 employees, etc.). IMPLAN then takes the midpoint estimate of the size class and multiplies that by the total number of establishments in the size class. This gives an estimate of the total employment in the industry. The rest of the data in the IMPLAN zip code model is directly proportional to the percent of estimated employment within the zip code compared to the surrounding county's model. This method may, in some cases, be an appropriate approximation of a city economy, however, given the unique circumstances of small, natural resource-dependent communities we found the zip code level IMPLAN model to be insufficient for many of the reasons stated previously and outlined in Robison (1997). Also, upon obtaining zip code level models for both Westport and Newport, industries that were known to be present in the respective communities were absent in the model.

Secondly, in many cases zip code boundaries and community boundaries are not necessarily aligned. In these cases a decision would need to be made to either include areas that are outside of the community boundary or exclude small portions of the community. The data sources used in this study and outlined below are available at the community level and are not necessarily limited by zip code boundaries.

The Input-Output coefficients used in this SAM are based on the 2002 Benchmark Input-Output tables published by the U.S. Bureau of Economic Analysis (BEA). In order to expedite the construction of the SAM, the purchased zip code level IMPLAN model was used to help calculate intermediate inputs, industry output, and household consumption. This data could be obtained directly from the BEA and aggregated into our user-defined sectoring scheme; however, the use of IMPLAN to automate this step greatly decreased the time needed to construct the SAM. If the Input-Output coefficients are obtained directly from BEA data, the national make and use tables would simply need to be aggregated into the industry and commodity groups used in the SAM. State-level regional purchase coefficients (RPCs) from IMPLAN are also used as one of multiple options to calculate the proportion of local demand that is met by local supply. IMPLAN RPCs are not necessary for the SAM to be functional; however, if an IMPLAN model is purchased, the associated RPCs offer an estimate of the percentage of local demand that is accounted for by local supply. Other options available in the SAM to serve as estimates of the RPCs are supply-demand pooling, location quotients, and the method employed and outlined in Schwarm and Cutler (2003). Ultimately, the IMPLAN RPCs are used in the results reported here.

The commodity by industry coefficients are multiplied by total community payments for land, labor, capital, and taxes from public sources to calculate the value of local industry purchases of commodities. Industry output and household consumption values are calculated in a similar fashion using IMPLAN model reports as a starting point. Coefficients for the industries by commodity matrix are based on the IMPLAN Regional Make report. The coefficients are multiplied by the industry gross output to calculate the value of local industry outputs. Household consumption values are based on the IMPLAN Household Commodity Demand report. Household purchases are adjusted based on the number of households in the community and average household expenditure information from the consumer expenditure survey (CES).

Local Government

City revenue and expenditures were taken from the annual city budget provided by the city's finance department. Detailed information on sources of city revenue is used to identify payments of taxes from industry (property and other taxes), commodities (sales taxes), households (property and other taxes), and the rest of the world (government transfers). Information about city government expenditures by department is used to divide the government into four city government aggregated sectors: 'protective services;' 'parks, recreation, and libraries;' 'city infrastructure;' and 'city other.' Each sector's purchases are calculated independently based on departmental budget expenditures and distributed according to the commodity sectors used in the model.

Land and Capital

The real market value of the community's land and buildings is provided by the county assessor's office with some detail. The level of detail depends on the community's property tax schedule, which levies differing rates on parcels depending on usage. Commercial and residential property breakouts are always available, and usually there is some additional detail available, such as hotel or industrial property. For the commercial fishing sector, data from NOAA's Northwest Fisheries Science Center was provided to account for the assessed value of the fishing vessel and gear used in that sector. This was added to the data from the county assessor's office value of buildings to obtain the total capital account for commercial fishing. For all other sectors, the county assessor's data is used to estimate the value of land and capital. The real assessed values are annualized based on a 10% depreciation rate before being entered into the SAM.

Commercial and industrial property values are distributed across the industry sectors based on levels of employment. Residential housing in the SAM is counted in the three housing stock sectors. There is one housing stock sector for homes worth less than $150,000, one for homes worth $150,000 to $300,000, and one for homes worth over $300,000. The total value of housing stock in each group is usually available from the county assessor's office. If not, the total value in each group can be derived proportionately based on the estimated number of households by income and housing stock.

Land and capital are modeled as primary factors of production and are used by all industries in the production of their respective commodities. Land and capital are ultimately owned by households, and the returns to land and capital are then distributed to the households that own them. Because capital is such an important component of the commercial fishing sector, we will discuss its distribution further.

Jobs and Wages

The number of jobs and wages in the community comes from the U.S. Census Bureau. The number of jobs by industry is available from the local employment dynamics (LED) data series. This data includes all jobs by workers covered under unemployment insurance laws. The number of jobs for self-employed workers in the community is estimated proportionately to the county-level nonemployer statistics. The estimated total number of jobs is then distributed proportionately to each industry based on the LED covered jobs.

Wages are from the quarterly workforce indicators (QWI), which are part of the LED series. QWI reports average monthly wages by industry for covered employees at the county level. The average monthly wage is annualized and multiplied by the number of workers in the industry to calculate labor income for each industry in the community.

Exports

Because this SAM is used to perform an export base model analysis of resource dependency, the calculation of exports out of the community is of vital important to the results. Exports were calculated as the residual of domestic supply of a commodity minus the domestic demand for domestic production. The amount of domestic demand accounted for by domestic production can be calculated in numerous ways. The spreadsheet tool developed here was modified from Schwarm and Cutler (2003) and allows for multiple methods to be used. The proportion of domestic demand that is accounted for by domestic production cannot exceed the supply-demand pooling ratio. In other words, a community cannot demand more local production than is actually produced locally. However a local community may still import a commodity that it produces in excess locally (cross-hauling) because of factors such as product differentiation, tastes, and preferences. Therefore, the proportion of local demand accounted for by local production must have an upper bound of the supply-demand pooling ratio, but is likely to be less than that ratio.

Community Marine Resource Dependency

A dependency index can be constructed from these SAMs, and this index represents the percentage of the total GRP or total employment in the community that is accounted for by the export base sales of a given industry (Waters, Holland, and Weber 1999). The dependency indices are equivalent to the percentage of the total economic activity (whether measured in terms of GRP or employment) that is generated by the economic base activity (exports) of a given sector. A community where the economic base activity of marine resource industries is responsible for supporting a large proportion of the economic activity of the other sectors in the economy would have a high marine resource dependency score. The employment-based economic base dependency indexes and ranks are presented in the far right column of tables 2 and 4 for Westport and Newport, respectively.

We suggest that this is a better method for assessing community dependency on marine resource industries than previous measures used by NOAA Fisheries. The methodology outlined here could easily be extended to any community in the nation and could be used to assess the dependency in that community on any sector.

Results and Discussion

Westport, Washington and Newport, Oregon provide an interesting framework to investigate the role of marine resources in a regional economic context. In a gross measure of the GRP for Grays Harbor County, Washington (the county where Westport is located), commercial fishing and fish processing together only account for 1.2% of the county's GRP. However, these sectors represent just over 18% of the gross GRP in the city of Westport and from an economic base perspective, commercial fishing and seafood processing account for almost 23% of the city of Westport's GRP. When ship building is included in the definition of a marine resource dependent industry, then marine resources are estimated to account for 35% of the gross GRP in the city and over 43% of the economic base contribution to GRP, giving Westport a marine resource GRP dependency score of 43 (table 2). When these measures are taken into account, a picture of Westport emerges as a port where marine resources play an integral part in the community's economy in terms of the percentage of economic activity that is attributable to marine resources. When looking at a gross measure of GRP at the county level, the region may seem minimally connected to marine resources. However, at the community level and from an economic base perspective, marine resource industries are the largest segment of Westport's economy.

Traditional industrial sectors such as commercial fishing, seafood processing, and shipbuilding, however, are not the only value associated with marine resources. Just like a forest provides more than timber, the ocean provides recreation, beauty, ecosystem services, and other values to communities. Marine resources also play an important role in Westport's tourism industry. According to the SAM generated here, tourism (defined here as the sales of hotels, restaurants, recreation services, and retail to people from outside the city) accounts for 20% of the city's base GRP. If this were combined with the other marine resource industries, the total reaches nearly 60% of the city's $34.25 million in GRP. The government sector constitutes the next largest sector in the economy in terms of base contribution, accounting for 17% of total GRP, followed by transfer and nonlabor income from households at 6%. The precise extent to which the quantity and quality of a community's marine resources are responsible for generating tourism is an important topic for further research.

The engagement in marine resource industries is even more pronounced when measuring in terms of employment (table 3). From a gross employment perspective, commercial fishing and seafood processing accounts for less than 3% of the total employment in Grays Harbor County. However, these industries make up 17% of Westport's gross employment, and 21% of the city's employment can be traced to the new dollars generated by exports of these industries. The economic base activity of ship building is responsible for generating an additional 150 jobs in the city. If this were to be combined with the other marine resource sectors, then fishing, seafood processing, and ship building would be responsible for 45% of the total employment in Westport. This gives Westport an employment dependency score of 45 (table 3).

Tourism's base activity is responsible for generating 11.5% to the total jobs in Westport. If commercial fishing, seafood processing, ship building, and tourism were all included as dependent on marine resources, they would be responsible for almost 60% of Westport's total employment.

Land-based natural resources (agriculture and forestry) accounted for 11% of jobs. The next largest generator of jobs is the transfer payments and non-labor income from households (7%). This is interesting because this sector does not directly employ any people; all of its contribution to employment is from the indirect and induced component. This household income sector represents nonlabor transfer payments to households from retirement accounts, other dividends, interest, rent, and government transfer payments. This non-labor income is an increasingly important source of base income in many rural natural amenity-rich communities in the western U.S. (Lorah 2000; Deller *et al.* 2001).

Marine resource industries play a different role in the economy of Newport, Oregon. Newport is the single largest port on the West Coast in terms of total commercial fish landings; however, when looking at the structure of the city's economy, a picture emerges of a community that is far less dependent on marine resources for their economic base. Commercial fishing and seafood processing accounted for less than 2% of the gross GRP in Lincoln County, Oregon, the county in which Newport is located. At the community level for Newport, commercial fishing and fish processing accounted for just over 6% of the city's gross GRP. In terms of base contribution, commercial fishing and seafood processing accounted for just under 10% of GRP and ship building is a negligible industry in Newport, accounting for just 0.27% of base GRP. The marine resource GRP dependency score for Newport is then 10.1, much lower than the 43 score found in Westport (table 4).

The economic base GRP contribution of fishing and seafood processing in Newport did not increase as sharply relative to the gross measure of GRP as it did in Westport. This indicates that the fishing and seafood processing complex does not represent a disproportionately high proportion of the community's export income. Newport is a much more diversified economy with numerous sources of export income. Therefore, while commercial fishing and seafood processing are important sectors in the economy, the community is far less dependent on these industries than is Westport.

The economic base contributions of the tourism sectors (retail sales, hotels, restaurants, and recreational services sold to consumers from outside the region) play an extremely large role in the Newport economy. These sectors are responsible for over 31% of the total GRP generated in Newport, making this complex the single biggest base industry in the community. The extent to which the quality of marine resources plays a role in the tourism of coastal communities represents an avenue for further quantitative research. Other major components of Newport's economic base include professional services (primarily from the operations of a regional medical center) at almost 30% and household non-labor income at 8%.

In terms of employment, fishing and seafood processing represent 4.4% of gross employment and 7.4% of base employment in Newport. The employment dependency score for marine resources in Newport is 7.6 (table 5). The fact that the "gross" and "base" measures of economic activity deviate in terms of employment and not in terms of GRP indicate that the fishing and seafood processing complex is labor intensive and generates relatively low earning jobs in the community.

Table 2. Westport, WA; GRP Contribution

	Gross GRP ($ Mill.)	Percent of Gross GRP	Base GRP Contrib. ($ Mill.)	Direct	Indirect & Induced	Base GRP Dependency (% of Base Contrib.)
Agriculture and Forestry	2.51	7.33	3.06	2.50	0.56	8.94
Fishing	5.65	16.50	6.20	5.07	1.13	18.10
Construction and Utilities	0.98	2.86	0.24	0.22	0.02	0.69
Other Manufacturing	0.96	2.80	0.11	0.09	0.02	0.32
Seafood Processing	0.52	1.52	1.58	0.52	1.06	4.61
Shipbuilding	5.91	17.26	7.00	5.91	1.09	20.43
Trade and Transport	4.37	12.76	2.26	2.04	0.22	6.61
Real Estate	0.60	1.75	0.36	0.31	0.04	1.04
Recreation	1.07	3.12	1.18	0.98	0.20	3.45
Hotel and Food Services	3.36	9.81	3.19	2.75	0.44	9.31
Professional Services	1.16	3.39	0.49	0.39	0.11	1.44
Other Services	1.24	3.62	0.60	0.57	0.03	1.77
Labor (Commuters)	0.00	0.00	0.04	0.00	0.04	0.13
Households	2.36	6.89	2.13	0.00	2.13	6.21
Government	3.56	10.39	5.81	5.80	0.01	16.96
Total	34.25	100.00	34.25	27.16	7.09	100

Table 3. Westport, WA; Employment Contribution

	Gross Employ-ment	Percent of Gross Employ-ment	Base Employ-ment Contrib.	Direct	Indirect & Induced	Base Employment Depend. (% of Base Contrib.)
Agriculture and Forestry	60	9.52	68	60	8	10.74
Fishing	85	13.49	92	76	16	14.61
Construction and Utilities	4	0.63	1	1	0	0.14
Seafood Processing	23	3.65	39	23	16	6.22
Shipbuilding	136	21.59	150	136	14	23.86
Trade and Transport	87	13.81	50	47	4	8.01
Real Estate	14	2.22	8	7	1	1.27
Recreation	24	3.81	12	10	2	1.83
Hotel and Food Services	8	1.27	10	7	3	1.64
Professional Services	124	19.68	108	101	7	17.19
Other Services	39	6.19	17	17	1	2.72
Labor (Commuters)	0	0.00	1	0	1	0.15
Households	0	0.00	47	0	47	7.44
Government	26	4.13	26	26	0	4.16
Total	630	100.00	630	511	119	100

Table 4. Newport, OR; GRP Contribution

	Gross GRP ($ Mill.)	Percent of Gross GRP	Base GRP Contrib. ($ Mill.)	Direct	Indirect & Induced	Base GRP Dependency (% of Base Contrib.)
Agriculture and Forestry	1.26	0.54	1.28	1.09	0.19	0.54
Fishing	12.16	5.17	13.91	10.05	3.86	5.92
Construction and Utilities	17.67	7.52	17.11	12.18	4.92	7.28
Other Manufacturing	11.20	4.77	14.97	11.17	3.80	6.37
Seafood Processing	2.94	1.25	9.16	2.88	6.29	3.90
Shipbuilding	0.49	0.21	0.63	0.48	0.16	0.27
Trade and Transport	37.10	15.79	29.37	22.97	6.40	12.50
Real Estate	11.26	4.79	1.65	1.23	0.41	0.70
Recreation	5.95	2.53	8.04	4.38	3.66	3.42
Hotel and Food Services	31.53	13.42	35.62	27.52	8.09	15.15
Professional Services	79.88	33.99	69.46	53.58	15.89	29.56
Other Services	16.21	6.90	12.54	8.89	3.65	5.34
Labor (Commuters)	0.00	0.00	1.75	0.00	1.75	0.74
Households	7.40	3.15	18.77	0.00	18.77	7.99
Government	0.00	0.00	0.77	0.00	0.47	0.33
Total	235.03	100.00	235.03	156.43	78.30	100

Table 5. Newport, OR; Employment Contribution

	Gross Employ-ment	Percent of Gross Employ-ment	Base Employ-ment Contrib.	Direct	Indirect & Induced	Base Employment Depend. (% of Base Contrib.)
Agriculture and Forestry	34	0.46	34	29	5	0.47
Fishing	205	2.78	278	170	108	3.76
Mining	27	0.37	17	15	2	0.24
Construction and Utilities	433	5.86	464	315	149	6.29
Other Manufacturing	192	2.60	297	192	106	4.03
Seafood Processing	120	1.62	270	118	152	3.65
Shipbuilding	13	0.18	17	13	4	0.23
Trade and Transport	1,282	17.36	990	818	173	13.41
Real Estate	229	3.10	37	25	12	0.51
Recreation	193	2.61	242	142	100	3.28
Hotel and Food Services	1,372	18.58	1,413	1,198	216	19.13
Professional Services	2,082	28.19	1,693	1,241	453	22.93
Other Services	655	8.87	475	375	100	6.43
Labor (Commuters)	0	0.00	51	0	51	0.69
Households	0	0.00	542	0	542	7.34
Government	549	7.43	564	549	15	7.63
Total	7,386	100.00	7,386	5,198	2,188	

Conclusions

In terms of gross employment or GRP, marine resource industries are not major contributors at the state or even county level anywhere in California, Oregon, or Washington. However, this measure of economic dependence masks the importance of marine resource industries from an economic base perspective and at a community level. Communities such as Westport, Washington are heavily dependent on marine resource industries, even though the larger Grays Harbor County may not be. Newport, Oregon is an example of a community that, although it is the largest single port on the contiguous West Coast in terms of commercial landings, is far less dependent on marine resource industries due to a more diversified economy.

We believe that using an index comprised of either the percent of total employment or the percent of total GRP that can be traced to the economic base (export) activities of marine resource industries is the most appropriate measure of economic dependency for use in policy analysis. Using gross measures of economic activity will underestimate the importance of these sectors to the community, while not using the percentage of total base contribution will overstate the importance of marine resource industries in highly diversified economies like Newport, Oregon or Seattle, Washington.

The social accounting and export base dependency methodology demonstrated here represent a way to quantify marine resource dependency at a specific community level that is grounded in regional economic theory. This methodology gives a dependency score that is presented in terms of the percent of total employment or GRP that each sector is responsible for generating and has the added benefit of being tractable, and the results are understandable by non-experts in the field.

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Appendix: Data Sources and a Guide to Using the Spreadsheet Tool

The infrastructure of the model is drawn from two studies. The SAM structure is based on Schwarm and Cutler's *Building Small City and Town SAMS and CGE Models*. Some of the data sources have been changed to take advantage of new datasets that became available since that paper's 2003 publication. The export dependent employment calculations are based on Waters, Weber, and Holland's 1999 paper, *The Role of Agriculture in Oregon's Economic Base: Findings from a Social Accounting Matrix.* The user should probably be familiar with these papers before attempting to build a Small Community SAM Model. The Small Community SAM Model was created using Microsoft Office Excel 2003 and has not been tested using any other versions of Excel. The spreadsheet model is available upon request from the authors and is assumed to be the starting point for the description below.

To build a small community model, open the Small Community SAM Model Excel file. The best way to build a new model is to enter the new community's values directly into the example model. Replace the sample values in the cells that are shaded gray according to the instructions in this guide. This helps prevent Excel from generating #REF errors in the model.

Dollar values in most of the worksheets are shown in millions. For example, $2,567,689 is shown as 2.568 in most cells. Values entered by the user should be in this same format. Exceptions are the 'Average Wage-Industry' values in row 17 of the WAGE worksheet and average household expenditure figures from the Consumer Expenditure Survey in the SYNTI and HOUSEHOLD worksheets, which should be entered as whole dollars. The model will automatically adjust these values into millions.

The CxA Matrix worksheet combines information from the BEA's Benchmark Make and Use tables or this step can be greatly expedited by using an IMPLAN model to obtain the study area's gross absorption coefficients. Subtracting the sum of the study area's value-added totals creates the commodity by activity use matrix portion of the SAM. The IMPLAN absorption coefficients are entered by the user. These values could alternatively be obtained from the publically available national input-output accounts. Value-added totals are automatically imported from the SAM. The value-added totals are then used to estimate the dollar values for the use matrix. The CxA Matrix is automatically exported to the SAM.

This worksheet is also where the user enters the names of the industries in the study area. The model allows for up to 21 profit maximizing sectors (industries). Once the titles are entered for each of the 21 industries, the titles are automatically exported throughout the rest of the model. There is also a row/column for federal, state, and local government commodities/industries and a column for owner-occupied dwellings, both of which are part of the IMPLAN gross absorption report.

The AxC Matrix worksheet combines information from the IMPLAN regional make matrix and the SAM industry activity totals to create the activity by commodity make matrix portion of the SAM. The IMPLAN regional make matrix values are entered by the user. Industry activity totals are automatically imported from the SAM. These values are scaled to fit the model's industry output, and the adjusted AxC Matrix is automatically exported to the SAM.

The worksheet consists of three matrices. The first matrix contains the raw values from the IMPLAN regional make matrix, and each row is summed in column Y. The second matrix automatically calculates make coefficients based on the IMPLAN values. Each coefficient represents the share of the row industry's output that produces the column's commodity. The third matrix calculates the adjusted make values. Row 94 imports industry output totals from the SAM, which are then multiplied by the coefficients in the corresponding row of the second matrix. This ensures that local commodity supply is equal to local activity output. Each cell contains the value of the commodity in its column that is produced by the industry in its row.

The WAGE worksheet contains the total number of workers, grouped by industry and wage range, as well as the labor income earned by each group. Worker groups include wage earners and the self-employed. The user can decide whether to use a worker headcount or full-time equivalencies (FTEs), depending on available data. The choice between headcount and FTE will affect the interpretation of the model's output of employment. Labor income should include both earned wages and proprietor income.

Labor income by industry and wage group is exported directly into the SAM. Average per-worker labor income by labor group is reported in column AA. These values are exported automatically into SYNTI to be used as part of the workers per-household income estimating iterations. Average wages per worker by industry are reported in row 17 as a summary statistic, but have no effect on model calculations. Social Security taxes are calculated in rows 20-23. These are the employer's share of Social Security payroll tax and are exported automatically into the SAM.

The WAGE worksheet also estimates the number workers by commuting characteristics in rows 27-34. 'In-Commuters' are people who work inside the study area but live elsewhere. 'Local Workers' are study area residents who work in the study area. Working Residents' are study area residents who work, whether inside or outside the study area. 'Out-Commuters' are local residents who work outside of the study area. The 'Out-Commuters' are used in SYNTI to estimate labor income earned by households from household members working outside the study area.

The number of workers by 2-digit industry at the small community level is available from the U.S. Census Bureau's Local Employment Dynamics "OnTheMap" Version 2.0, Labor Shed Area Profile Report. This dataset only includes workers who are covered by unemployment insurance laws. The number of unemployment insurance jobs is amended by U.S. Census Bureau's Nonemployer Statistics data.

The number of workers who commute to or from the study area is calculated using OnTheMap's Commute Shed Report, which shows the number and percent of the study area's residents that are employed inside of the study area. The percent of residents who are out-commuters is the percent of residents' jobs listed as being outside of the area. The number of in-commuters is equal to the total number of jobs, minus the number of residents' jobs that are listed as being inside the study area. Wage data is from the U.S. Census Bureau's Quarterly Workforce Indicators (QWI) dataset, which has average monthly wages by county available at the industry level.

The LAND spreadsheet contains the property value of real estate in the study area by industry and household group. These values are used to calculate industry payments to land, capital, and property taxes in the SAM. The spreadsheet also calculates returns to household from land and capital and housing stocks payments to land and capital.

Rows 25-48 contain a capital trade flow coefficient matrix that is based on Bureau of Economic Analysis (BEA) *Capital Flows in the U.S. Economy, 1997*. The matrix premultiplies the values that industry activities pay to capital and calculates the values of investment that comes from each industry. This step links the investment that comes from industry commodities to the capital that is used by industry activity. The flow coefficients are generic and infrequently updated by the BEA, so they are included as an integral part of the model. Building and land values are from the local county assessor office.

The SYNTI spreadsheet imputes the number of workers by income range into the appropriate household by income level groups. Averages of non-labor income and tax expenditures by household income are combined with household expenditures from the HOUSEHOLD spreadsheet to estimate the amount of household labor income required for all households in each income group. The estimation process takes place in D1:I6. Total expenditures by household groups and land and capital income are automatically imported from HOUSEHOLD. Income and tax expenditure averages by household group are entered by the user. The total estimated earned income required is total household expenditures, minus non-wage income and land and capital income, plus tax expenditures. The estimates for total retirement income and its share of total income are displayed in D15:I16. The estimates are used to estimate the number of retired households in each income group.

Rows 20 to 32 contain the iterations that place the number of workers by income into the appropriate households by income. The user enters these figures in the grey shaded cells in each household's iteration box. The number of workers is multiplied by the labor group's average wage to estimate total wage income by household income level and labor income level. These values are automatically exported to the SAM cells AW59:AZ64.

The SYNTI spreadsheet also estimates the wages for workers who live in the study area but earn income outside the study area. The number of out-commuters by labor income group is imported from the WAGE spreadsheet and shown in cells D36:G36. They are distributed among household income groups based on the distribution of workers by wage group and household group in the household iterations above. The number of workers in each cell is multiplied by average wage by income group to calculate the estimates. The estimates for out-commuter labor income are automatically generated in cells I37:L42 and exported to SAM cells BC59:BF64.

Another function of the SYNTI spreadsheet is to estimate the amount of retirement income that is from outside the study area. This is accomplished by multiplying the estimated number of households per group by the CES average Social Security and retirement income per household. Average household expenditures are from the Bureau of Labor Statistics' Consumer Expenditure Survey (CES).

The HOUSEHOLD spreadsheet estimates the total value of each commodity that each household group purchases. The values are based on IMPLAN estimates and are adjusted using estimates of housing expenditures, property taxes, housing maintenance costs, and average expenditures. The purchases for the average household in each group are multiplied by the estimated number of households per household group to arrive at the total purchases estimate. This spreadsheet also estimates personal income tax expenditures (PIT), household savings (INVEST), property taxes paid by household groups to the city (CNPRP), and other taxes paid by household groups to the city (CYORV).

Another function of the HOUSEHOLD spreadsheet is to estimate housing stock payments for mortgage interest payments and housing stock maintenance spending. Household consumption expenditures are from the IMPLAN Household Commodity Demand report. IMPLAN uses the BEA Benchmark I-O Study and the BLS Consumer Expenditure Survey (CES) to create this report. IMPLAN data is used because of the convenient aggregation feature of the software.

Housing expenditures, property tax, maintenance and insurance, CES average expenditures, and state and federal personal income tax expenditures by household income level are taken directly from Table 2 of the CES.

Number of households by housing stock and household income group is estimated by the user. There are no reliable sources of this data, but the user can make estimates based on 2000 Census data and county assessor's office records. Federal Reserve Board savings rates and interest rates' proportion of housing payments are repeated from Schwarm and Cutler (2003).

The GOVT spreadsheet contains information about revenue sources and expenditures from the city's annual detailed budget. City expenditures are divided into four 'departments,' protective services (PROSER); parks, recreation, and libraries (CTY P,R,&L); infrastructure (CTY INFRA); and other (CTY OTHER). Capital expenditures are placed into the investment category (CTY INVEST) regardless of department making the investment. City revenue by source is entered by the user, and the spreadsheet automatically allocates these expenditures for use in other spreadsheets.

State and federal expenditures are estimated by removing the city expenditures from the IMPLAN provided federal non-defense, federal defense, and state non-education spending categories. Revenue sources that are not directly attributable to certain industries are considered other revenue sources (CITY ORV) and are distributed proportionately across all industries.

Data for this table were obtained from the respective city governments. The budget accounts need to be adjusted for margins and allocated according to the industry sectors in the model.

The social accounting matrix (SAM) worksheet brings in the information from the other spreadsheets and lays it out into tableau form. To complete the SAM, information about trade calculations are entered by the user, which is one source of trade data used by the SAM. The trade calculations represent the fraction of local demand supplied by local industries. This can be in the form of supply/demand pooling, regional purchase coefficients (RPC), or any other source of trade data exogenous to the model.

The worksheet imputes additional trade values in the model in the process of balancing the SAM. The row totals in column BU and the column totals in row 73 are automatically adjusted to create the final Rest of World (ROW) totals in column BT and the final ROW totals in row 72. The SAM self balances if the data in the other worksheets are reasonably correct and have been entered correctly without errors.

The SAM spreadsheet also calculates employee per output and employee per value-added ratios, which are used in the EMP IMP worksheet to calculate the employment that is dependent on exports.

IMPLAN creates both Supply/Demand Pooling and RPCs for each industry that are both possible sources of trade calculation ratios. The model creates its own supply/demand pooling ratios for each industry as well. Ultimately, it is up to the user to decide which trade calculation ratio is appropriate for each industry.