The Economic Impact of Federal Funds on a Local Community in Hawaii

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Background

The Pacific Area Climate Modeling and Analysis Network (PACMAN), a collaborative project between the University of Hawai`i and the University of Alaska, is designed to develop cyberinfrastructure and local community capability to monitor, understand, mitigate and adapt to Pacific-wide climate change scenarios. PACMAN is a three-year (September 1, 2009 to August 31, 2012) Experimental Program to Stimulate Competitive Research (EPSCoR) award funded by the National Science Foundation under the American Recovery and Reinvestment Act of 2009 (ARRA).

As an ARRA project, one of the goals of PACMAN is to demonstrate an impact on a local community (the Kahalu`u/Keauhou community) located near Kona, Hawai`i. The multi-faceted evaluation of PACMAN focused on addressing a number of evaluation questions, ranging from cyberinfrastructure development to community capacity building. A copy of the full evaluation report is available from the authors. [2] For this paper, however, we focus exclusively on assessing the economic impact of project funds on a small community on the island of Hawai`i.

Evaluation Research Question

The federally-funded NSF project is expected to contribute to the local employment by providing salaries for Kohala Center (TKC) personnel, to the rental market by procuring office space, to educational services by sponsoring educational outreach programs, to the travel industry by researchers travelling between islands, and to various local industries through its purchases of project materials. The focus here is on documenting the financial "worth" or "value" of those investments. The evaluation question was:

> *In what ways, and to what extent has PACMAN impacted the economic development of the Kahalu'u/Keauhou community in Hawaii?*

Method

To assess the project's impact on the local economy, the UH evaluators used an Input-Output (I-O) model developed by the Hawai`i Department of Business, Economic Development and

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[2] EPSCoR Track 2, Pacific Area Climate Modeling and Analysis Network (PACMAN) Year 2 Evaluation Report. Craig Dorman, Ph.D; Judith K. Inazu, Ph.D; Debbie Gundaya, M.A., June 2011

Tourism (DBEDT). I-O models are accounting representations for the structure of an economy describing the flow of economic transactions to and from industries and institutions. The models are based on the latest available and estimated economic data. The DBEDT updates the I-O models every five years. The models are in turn reliant on the U.S. Census Bureau's economic census which is conducted every five years. Hence, by using the models and multipliers, we are assuming that there have been no significant changes in the structure of the local economy between the year when the model was developed and the year for which we are estimating the impact of our project.

By tracking each sector's backward linkages to the other sectors of the economy, I-O models can calculate economic multipliers, which can be used to estimate the effect of expenditures on various sectors in the economy.[3] A sector's demand multiplier measures the volume of economic activity related to a dollar of expenditure in that sector (e.g., a multiplier of 2.25 in the educational services sectors means that a dollar of spending in that sector generates $2.25 worth of economic activities).

Table 1 shows the demand multipliers for the county of Hawai`i based on two models: the inter-county model (column 1) and the county model (column 2). The inter-county model considered the inter-linkages between economic activities across different counties in the State, e.g., how economic activities in the Big Island (Hawai`i county) affects and is affected by expenditures or economic activities in Honolulu county. The county model is limited to economic activities within Hawai`i County. We used both models to have a range of estimates of PACMAN's economic impact on Hawai'i county's economy. Due to consideration of how economic activities between counties are related, and hence how financial infusion in one county can create positive effect on other counties, the inter-county model's multipliers are higher than the county model multipliers. Thus, we can think of the county model multipliers as the lower bound and the inter-county model multipliers as the upper bound when estimating a range of possible economic impacts based on PACMAN activities.

The multipliers shown in Table 1 illustrate the dollar change in output in industries that result from a $1 change in final demand in that industry. For example, a $1 expenditure in transportation (includes airfare of UH researchers from Honolulu to the Big Island) results in economic activities ranging from $1.54 (based on the county model) to $1.94 (based on the inter-county model).

We looked at the detailed annual expenditures of the project that went to the local community (Hawai'i County) and categorized each item by the industry classification identified in the Hawai`i I-O model. For example, funds given to TKC for research and community outreach fall

[3] The discussion on Input-Output modeling is derived from The DBEDT Inter-County Input-Output Study (2005). The report can be downloaded from http://hawaii.gov/dbedt/info/economic/data_reports/2005_Intercounty_I-O/. DBEDT develops I-O models and calculates economic multipliers for the state, county and inter-county models. The inter-county I-O considers linkages between counties. The models are generated every five years using the latest available and estimated economic data from the U.S. Census Bureau, the State of Hawai`i Data Book, and the Bureau of Economic Analysis. For 2010, the latest and currently available I-O model is the 2005 model which is based on the 2002 Economic Census.

under professional services, while researchers' airfare from Honolulu to Hawai`i are considered contributions to the transportation sector.[4]

Results

Table 2 shows the breakdown of PACMAN expenditures in Hawai`i County for Year 1. A total of $120,560 was spent by the project in Hawai`i County. The majority (87%) of PACMAN economic activities occurred in the professional services sector, which has an economic multiplier of 2.24 (Table 2). The transportation and accommodation sectors received six percent and four percent of PACMAN expenditures, respectively.

Table 1. Final Demand (Type II) Output Multipliers for Inter-County and County Models, 2005

Sector	Inter-County Model**	County Model***
Transportation	1.94	1.54
Information	1.80	1.54
Utilities	1.87	1.27
Retail trade	1.81	1.57
Real estate and rentals	1.65	1.47
Professional services	2.24	1.83
Accommodation	1.96	1.67

Note: Output multipliers show the total dollar change in output of all row industries that results from a $1 change in final demand in the corresponding industry.
**Inter-County Level multiplier for Hawai`i County calculated using the economic inter-linkages between counties
*** County Level multiplier for the Hawai`i County, limited to the local (county) economy

Using the DBEDT multipliers (Table 1), we derived the overall economic impact of PACMAN activities (Table 3). We used Type II multipliers, which consider the direct impact of the initial spending to each sector and the indirect impact generated by the linkages of the various sectors among each other. [5]

Table 2. PACMAN expenditures in Hawai`i County, Year 1

Sector	Expenditure	%
Transportation	$ 6,932.92	5.8 %
Information	$ 427.50	0.4 %
Utilities	$ 126.28	0.1 %
Retail trade	$ 1,703.23	1.4 %
Real estate and rentals	$ 1,766.47	1.5%

[4] To isolate PACMAN economic activities in the Hawai`i County for the transportation sector, we used 50% of the total transportation cost for transactions going to/from another island to Hawai`i.

[5] There are two types of multipliers: Type I and Type II. Type I includes the direct or initial spending, and the indirect spending that is generated from businesses buying and selling to each other. Type II includes Type I (direct and indirect) and the household spending (induced effect) based on income earned from the direct and indirect effects. We recommend using Type II multipliers for they capture a broader notion of the linkages in the economy that we are trying to quantify. Since they include the induced effect to the household sector, they trace the impact of economic activities to a broader portion of the community.

Professional services	$ 105,259.40	87.3%
Accommodation	$ 4,344.37	3.6%
TOTAL	$ 120,560.17	100%

Using the multipliers, we estimate that the $120,560.17 in PACMAN expenditures in Hawai‘i county generated economic activities between $216,646.00 (using the county model) and $264,364.79 (using the inter-county model). Thus, on average, every dollar of PACMAN funding spent on the Big Island resulted in about $2 worth of economic activities. [6]

Table 3. Economic Impact of PACMAN Expenditures in Hawai‘i County, Year 1[a]

Sector	**Inter-County Model****	**County Model*****
Transportation	$ 13,440.19	$ 10,676.69
Information	$ 770.36	$ 658.35
Utilities	$ 235.57	$ 160.38
Retail trade	$ 3,081.64	$ 2,674.07
Real estate and rentals	$ 2,992.92	$ 2,596.71
Professional services	$ 235,389.17	$ 192,624.70
Accommodation	$ 8,524.94	$ 7,255.10
Total	$ 264,364.79	$ 216,646.00
Total economic impact/PACMAN expenditures	**2.19**	**1.80**

[a] Using Type II Multipliers

** Inter-County Level multiplier for Hawai`i county calculated using the economic inter-linkages between counties

***County Level multipliers for the Hawai`i county, limited to the local (county) economy

Discussion

Externally-funded community capacity-building projects infuse funds into a community to improve the infrastructure, provide expertise, develop leadership, and so on. The project is generally evaluated by focusing on impacts on community capacity, and rarely have the economic benefits of those funds been assessed. More recently, there has been increasing interest in also documenting the financial “worth” or “value” of those investments. Economic approaches, such as cost-benefit analyses, are of particular interest to funders and funding agencies, who, in addition to the social, psychological impact of those dollars, are also demanding information on whether the benefit has been worth the investment.

A method for documenting the economic impact of project funds, using an Input-Output model developed by state economists, tracks the flow of financial transactions to and from economic sectors (e.g., transportation, agriculture). Each sector is assigned a multiplier (based on census

[6] It is important to keep in mind that while straightforward, using I-O models and multipliers for economic impact analyses also requires caution. I-O multipliers are derived using the following limiting assumptions: (i) the relationships between industries and final demand sectors are linear, which implies fixed prices and no substitution among different inputs; (ii) the direct purchase coefficients are assumed to be fixed, reflecting the average input-output relationship in each industry as opposed to a marginal unit of production; (iii) consumption is a simple linear function of household income; and (iv) the effect of induced state and local government spending and capital investment are assumed to be zero.

data and previous research), which reflects the impact of each dollar spent in that sector. Results of these analyses show that each dollar invested by the project resulted in a two-fold increase in economic benefit to the community. This method provides an approach for documenting the economic "value-added" of project funds that is often neglected in evaluation studies. The resulting quantitative indicator (i.e., the multiplier) can be viewed as an indirect, unintended "value-added" component of that investment, i.e., by enriching the community's economy. Using an Input-Output model developed and verified by external parties provides accountability to funders and demonstrates a type of impact that is not often examined in capacity-building projects.

Appendix
Economic Impact Analysis

We employ quantitative analytical tools to assess the project's impact on the local economy. In particular, we use a county-level economic model to measure how the project's expenditures in the various local sectors have generated benefits for the county's economy. The assessment uses a county-level Input-Output (I-O) model developed by the Hawai`i Department of Business, Economic Development and Tourism (DBEDT).

I-O models are accounting representations for the structure of an economy describing the flow of economic transactions to and from industries and institutions. Through tracking each sector's backward linkages to the other sectors of the economy (e.g., the food sector's purchases from the agriculture and transportation industries), I-O models can calculate economic multipliers, which can in turn be used to estimate the effect of policies to the various sectors in the economy.[7]

For the State of Hawai`i, the DBEDT develops I-O models and calculates economic multipliers for the state, county and inter-county models. [8] The models are generated every five years using the latest available and estimated economic data from the U.S. Census Bureau, the State of Hawai`i Data Book, and the Bureau of Economic Analysis.[9] We use the latest DBEDT model each year. For 2010, the latest and currently available I-O model is the 2005 model which is based on the 2002 Economic Census. For 2011 and 2012, we will use the 2010 I-O model, which will be based on the 2007 Economic Census data (check the DBEDT website for updates).

The latest available output multipliers are presented in Table 1 below. There are two types of multipliers: Type I and Type II. Type I includes the direct or initial spending, and the indirect spending that is generated from businesses buying and selling to each other. Type II includes Type I (direct and indirect) and the household spending (induced effect) based on income earned from the direct and indirect effects. We recommend using Type II multipliers for they capture a broader notion of the linkages in the economy that we are trying to quantify. Since they include

[7] The discussion on Input-Output modeling is derived from The DBEDT Inter-County Input-Output Study (2005). The report can be downloaded from http://hawaii.gov/dbedt/info/economic/data_reports/2005_Intercounty_I-O/
[8] The inter-county I-O considers the linkages between counties.
[9] The DBEDT updates the county-level I-O models every five years.

the induced effect to the household sector, they trace the impact of economic activities to a broader portion of the community.

Estimating the Impact of PACMAN in Hawai'i County

The estimation of the economic impact of PACMAN (EPSCoR Track II) activities in the local economy of Hawai'i county can be done in the following basic steps: (1) allocating the detailed annual expenditures of the project at the county level (Hawai'i county) among the industries identified in the Hawai`i I-O model, and (2) multiplying the vector of expenditures generated in step (1) by the appropriate multipliers to estimate the total economic impacts on output, earnings and jobs.

Data Requirements

To calculate the economic impact of PACMAN using the I-O method, we need expenditure data by sector and county.

Step-by-Step Process

1. Isolate expenditures incurred in the Big Island.
2. Classify the expenditures according to the 20 sectors in Table 1. Below are the common expenditures in year 1.
    a. For retail purchases, only purchases made in the Big Island are considered. If purchases are made online from elsewhere, they are not considered since the resources do not directly go to the local economy.
    b. For transportation to and from the Big Island (e.g., airfare from O‘ahu to BI), count 50% of the total transportation expense. Mileage reimbursement and Fedex are classified as transportation expense.
    c. Retail expenditures include parking fee, gas, supplies, and tools.
    d. Salaries of TKC Consultants, image use fees and other consulting fees are classified as professional services.
    e. Cable and internet expenditures are classified under “Information”
    f. Rent is classified under real estate and rental
    g. Electricity is classified as utilities
    h. Hotel expenses are classified as accommodation
    i. If an expenditure does not fall under any of the above common sectors, consult the North American Industry Classification System (An excel file and a pdf definition file will be uploaded to the portal for reference).
3. Add up all the expenditures for each sector and make a corresponding Table (2).
4. Multiply each cell in Table 2 with the corresponding sector multiplier from Table 1 (Use Type II multipliers for Inter-County and County Models).
5. Export the result into Table 3 (Economic Impact of PACMAN Expenditures).
6. Add up the total economic impact (sum of all sectors economic impact).
7. To get the ratio of total economic impact to PACMAN expenditures, Use total economic impact in (6)/total PACMAN expenditures.

Some Caveats

It is important to keep in mind that while straightforward, using I-O models and multipliers for economic impact analyses also requires caution. I-O multipliers are derived using the following limiting assumptions: (i) the relationships between industries and final demand sectors are linear, which implies fixed prices and no substitution among different inputs; (ii) the direct purchase coefficients are assumed to be fixed, reflecting the average input-output relationship in each industry as opposed to a marginal unit of production; (iii) consumption is a simple linear function of household income; and (iv) the effect of induced state and local government spending and capital investment are assumed to be zero.

Finally, the models are based on the latest available and estimated economic data. The DBEDT updates the I-O models every five years. The models are in turn reliant on the U.S. Census Bureau's economic census which is conducted every five years. There is a lag between the census years and the DBEDT publication—the latest available I-O model is for 2005, which is based on 2002 census data. The next scheduled DBEDT release will be the 2010 model which will be based on 2007 census data. Hence, by using the models and multipliers, we will be assuming that there had been no significant changes in the structure of the local economy between the year when the model was developed and the year for which we are estimating the impact of our project.

Table 1. Final Demand Output Multipliers for the State, Inter-County and County I-O Models, 2005
(Hawai'i County)

	State*	Inter-County model**	County model***
Type 1			
Agriculture	1.43	1.46	1.33
Construction	1.42	1.42	1.27
Food processing	1.57	1.58	1.38
Other manufacturing	1.32	1.34	1.19
Transportation	1.56	1.46	1.23
Information	1.25	1.33	1.23
Utilities	1.59	1.61	1.13
Wholesale trade	1.28	1.29	1.18
Retail trade	1.34	1.34	1.26
Finance and insurance	1.49	1.68	1.41
Real estate and rentals	1.40	1.40	1.31
Professional services	1.42	1.42	1.28
Business services	1.38	1.35	1.23
Educational services	1.47	1.48	1.34
Health services	1.42	1.30	1.20
Arts, entertainment, and recreation	1.27	1.27	1.19
Accommodation	1.42	1.43	1.31
Eating and drinking places	1.51	1.51	1.32
Other services	1.46	1.45	1.32
Government	1.05	1.09	1.06
Type II			
Agriculture	1.97	2.01	1.70
Construction	1.96	1.98	1.63
Food processing	1.98	2.04	1.67
Other manufacturing	1.61	1.95	1.60
Transportation	2.05	1.94	1.54
Information	1.66	1.80	1.54
Utilities	1.88	1.87	1.27
Wholesale trade	1.77	1.84	1.55
Retail trade	1.83	1.81	1.57
Finance and insurance	1.96	2.41	1.86
Real estate and rentals	1.61	1.65	1.47
Professional services	2.13	2.24	1.83
Business services	2.11	2.08	1.72
Educational services	2.19	2.25	1.86
Health services	2.08	2.15	1.80
Arts, entertainment, and recreation	1.92	1.93	1.64
Accommodation	1.98	1.96	1.67
Eating and drinking places	2.04	2.03	1.65
Other services	2.06	2.11	1.76
Government	1.79	1.80	1.57

Note: Output multipliers shows the total dollar change in output in all row industries that results from a $1 change in final demand in the corresponding industry.

*State - multiplier for the State of Hawai'i
**Inter-County Level - multiplier of Hawai'i county, calculated using the economic interlinkages between counties
***County Level- multiplier fo the Hawai'i county, limited to the local (county) economy

Source: The 2005 Hwaii Inter-County Input-Output Study (February 2009)
State of Hawai'i Research and Economic Analysis Division, Department of Business, Economic Development and Tourism