Keynesian over Input-Output Multiplier Model in Economic Impact Analysis: Purdue's International Capacity Building Projects, 1951-2011

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Abstract
Keynesian multiplier model is applied to evaluate historical regional economic impact of Purdue international institutional capacity building projects that ran from 1960 to 2011. Input-output model is applied to the most recent projects, from 2007 to 2011, to compare the results of Keynesian technique since the two models are closely related even though conceptually different.

Keynesian multiplier shows that there was a significant return for every dollar spent in Indiana during the 60-year project period. About $26 million has been injected in Indiana's economy and the total economic impact of that injection is about $36 million. Input-output model results are within the range of the Keynesian multiplier. Out of $2.9 million spent in Indiana economy from 2007 to 2011 through Purdue Afghanistan Project (PAP), input-output model yielded an impact of $4.6 million while the Keynesian multiplier gave $4.1 million.

JEL: O18, O22, R11, R15
Keywords: Keynesian model, Input-output model, Regional economic impacts.

CHAPTER 1. Introduction

1.1 Background

The changing financial climate in many public institutions of higher education has seen university administrators seek concrete economic justifications for their budget requests from State legislatures (Zumeta 2003). As such, institutions of higher learning are now required to shift from their old style of self-regulation to one that is more predetermined and closely monitored by the States (Alexander, 2000). In the new arrangement, universities are required to be more accountable, more efficient, and more productive in the use of publicly generated resources. Moreover, universities are expected to be both short-term and long-term maximizers of economic returns in addition to being seen as engines of economic development that prepare an increased percentage of the population to be productive members of the high tech workforce (Alexander, 2000).

In implementing the new requirements, university administrators are now reevaluating all programs with a view of streamlining those activities that may be viewed as inefficient and productive as per State requirements. International rograms share resources with the host institutions.

Purdue University has a long tradition of engagement in international capacity building projects that date back to the 1950s. Purdue's International Capacity building projects involve bilateral agreements with communities and institutions in developing countries mostly in South America, Asia and Africa. The projects are aimed at strengthening skills, competencies and abilities of people in those communities so that they can achieve measurable and sustainable productivity levels. Seven projects that Purdue has been involved with are:

- Federal University of Vicosa Agricultural Project (UFV) that ran from 1951-1973
- National Cheng Kung University engineering project (NCKU) from 1953-1962
- Niger Cereals Research Project (NCRP) 1982-1988
- Niger Applied Agricultural Research (NAARP) from 1988-1993
- Burkina Faso's Agricultural and Training Support (ARTS) from 1990-1994
- Malaysia Polytechnic Development Project (MUCIA) from 1995-1999
- Purdue Afghanistan Program (PAP) from 2007-ongoing

Table 1.1 shows the projects summaries including the recipient countries, period of implementation, objectives, activities and total funding estimates. The information was derived from the projects bulletins, briefs and reports that was available online and at university archives (Fernandez, 1991; Purdue University, 1962; 1989; 1992; 1999; 2011).

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Table 1.1 Summaries of Purdue's International Engagements from 1951 to 2013

Project	**Country**	**Time**	**Objective/s**	**Activities**	**Funding* (US$ 000)**
Federal University of Vicosa Agricultural Project (UFV)	Brazil	1951-1973	Strengthen and expand school activities, and improve professionals and teaching competencies of staff	Double undergraduates students, start Masters program, train students and staff on agricultural research and extension	8,769
National Cheng Kung University (NCKU) project	Taiwan	1953-1962	Develop a first-rate college of engineering	Offer consultancy on administration and teaching, train 32 professors, improve physical plant and laboratories, library and refine curricula and teaching methods	8,000
Niger Cereals Research (NCRP) Project	Niger	1983-1988	Institution capacity building program to help in agricultural research to make the country food self-sufficient	Train scientific manpower in Niger and US, mobilize resources to enhance interdisciplinary research, conduct problem-oriented research	9,154
Niger Applied Agricultural Research (NAARP) Project	Niger	1988-1992	Institution capacity building program to help in agricultural research to make the country food self-sufficient as per NCRP project	Organization development, develop research-extension linkages, train personnel on agriculture research and extension; 29 researchers on long-term and 246 researchers and technical personnel on short term basis	19,999
Agricultural Research and Training Support (ARTS) project	Burkina Faso	1990-1994	Institution capacity building	Support scientific research activities, develop linkages between research, extension and outreach programs, short-term training in Burkina Faso and US by Purdue Staff	4,261
Malaysia Polytechnic Project (MUCIA)	Malaysia	1995-1999	Train high level manpower for three Malaysian polytechniques	Train Professors in Malaysia, develop laboratories and libraries, refine curricula and teaching methods in civil, electrical and mechanical engineering, textiles manufacturing and automated packaging.	20,700
Purdue Afghanistan Program (PAP) includes 8 projects	Afghanistan	2007-ongoing	Rebuild physical infrastructure for faculties and Veterinary Science at Kabul University	Provide long term and short term training of students and staff in Afghanistan and US, refine curricula and teaching methods in agriculture, education and engineering, offer consultancy services, develop laboratories, library and learning materials	24,000

Sources. (Fernandez, 1991; Purdue University, 1962; 1989; 1992; 1999; 2011).
* Currency is in nominal rates

The projects have mostly been funded by USAID and other donors and total about $75 million over the entire period. Out of that amount, around $50 million has been transferred to international recipient institutions while $24 million has been used locally in Indiana (See Table A 1).

1.2 Introduction to Purdue International Engagement[1]

International engagement is a priority for the Purdue University International Programs in Agriculture (IPIA). While this global engagement offers Purdue the opportunity to assist others while positioning their faculty and staff to gain important experience in working with diverse cultures and institutions, it also injects funding back to the local Indiana economy (e.g. local job growth). Engagement measures of the collaborative relationships between the Purdue University and its international partner institutions is not in the scope of this pape.

1.3 Objective

This report therefore seeks to quantify the Indiana state economic benefits of seven major international programs hosted at six sites that Purdue has engaged in over the last 60 years. Each project expenditure values and decomposition are presented. As a first step, this study will nominally aggregate the local injection of each project investment and then quantify the benefits that have accrued to the State of Indiana. An economic impact study will inform university administrators and state legislatures the local economic impact of such university engagement with international public educational and research institutions.

[1] The information about Purdue International Engagement is from the official website: https://ag.purdue.edu/ipia/Pages/engagement.aspx

CHAPTER 2. LITERATURE REVIEW

Chapter 2 will review literature (aministrative project reports) for each of the Purdue international institutional capacity building project expenditures. It then provides the background information on the international programs under study and their expenditures in the Indiana statewide economy. Expenditures are decomposed in terms of their immediate local return in nominal terms. Calculations of these estimates will also be presented.

2.1 Two Types of Economy-Wide Models

Keynesian multiplier, economic base and input-output models have been used to estimate the economy-wide effects that an initial change has on a particular economy (e.g., Florax, 1992; Michael et al., 1992; Faggian and Biagi, 2003; Carroll and Smith, 2006). These models are based on the idea than an initial change in economic activity results in diminishing rounds of new spending as leakages occur through savings or spending outside the local economy. When there are more leakages, the size of the associated multipliers is smaller. In this study we will concentrate on the two most popular models to evaluate the economic impact of Purdue's international capacity building projects analysis: The Keynesian and input-output multipliers models. As will be seen in the model derivation, all models are interconnected by common variables and the multipliers are relatively equal but not substitutes (ten Raa, 2005). In choosing the multiplier one is always guided by several factors that include but not limited to availability of data and the time period that the project was implemented.

Keynesian multipliers are also known as “macro-economic multipliers” because they are based on behavioral assumptions related to how individuals adjust their saving and consumption decisions when there is an initial change (shock) affecting their income (Michael et al., 1992; Bess and Ambargis, 2011). The Keynesian multiplier was popular from the 1950s through the 1980s but it was dominated by the input-output technique that allowed for both internal and external regional linkages amongst sectors (Faggian and Biagi, 2003). Input-output models estimate economic impacts from perturbations (shocks) of trade flow patterns of goods and services within the economy (Leontief, 1986). The shocks from purchases of individual sectors are used to make the predictions about an industry’s total economic impact.

Input-output analysis requires huge amounts of resources to gather and regularly update specific information at a high level of spatial disaggregation that are essential in the formulation of input-output tables (Bess and Ambargis, 2011; Faggian and Biagi, 2003). Moreover, input-output analysis uses a “single year” to develop total requirements table but purchases usually reflect a longer term relationships. Technical coefficients in input-output analysis tend to be unstable, i.e., coefficients get “out of date” because technology changes, prices change and demand changes over time. As such, input-output analysis is best when applied to the projects that are conducted within the period of formulation of input and output tables while Keynesian multiplier model is more suited for projects that date back in time. As it will be seen below the input-output and Keynesian multiplier models are closely related even though conceptually different.

Keynesian multiplier model was chosen for impact analysis in this study because most projects date back to the 1950s. However, given that the projects ran from 1951-2011, input and output model was also applied to the most recent international engagement, Purdue Afghanistan Program (PAP) that ran from 2007 to 2011 for comparison purposes. Both models are described in detail below.

2.2 University Impacts in a Space-Time Setting

When taken as a production unit, a university contributes immensely to its surrounding community. The benefits come from the production process or from the externalities in production as well as consumption, where consumption includes the amenities that a university might consume in a region. University expenditure impacts are the effects related to the outlay by the university, faculty, staff, students and visitors to the university. Expenditure leads to an autonomous reinforcing process. That is, expenditure impacts leads to an increase in regional income that may lead to growing demand for goods and services.

2.3 Project Expenditure Impacts

The project expenditure impacts are the effects related to the outlay by the university and staff and include direct, indirect and induced effects (e.g., Lewis, 1988; Michael et al., 1992; Carroll and Smith, 2006). The direct impacts include the purchases of resources (labor, goods, and services) from the project funds. The indirect and induced impacts occur through business-to-business purchases resulting from the project's interactions with its suppliers and the change in household demand as those employees of the project and suppliers' employees earn dollars for consumer spending. The indirect and the induced portions show how the initial (direct) expenditures get multiplied through the economy (Michael et al., 1992, Carroll and Smith, 2006; Bess and Ambargis, 2011).

Local economic impacts accruing from international projects are similar to those of other national projects albeit the above highlighted differences. An economic impact study that provides such comprehensive information, will inform university administrators and the state legislatures on the minimal[2] usefulness of such international capacity building projects to the local economy and jobs growth.

[2] Other benefits including regional technological and bilateral trade enhancement between local and recipient countries are not considered in this study.

2.4 Project Expenditures

The following overview of the major projects decomposes each of their total project funding by first removing what is transferred to host countries then considering the remainder as expenditures in Indiana. The funding that remains in-state is finally divvied into University Consumption (i.e. Salaries & Wages) and University Investment. The University Consumption item assumes that all project salaries were deposited - and eventually spent in Indiana.

Further assumptions are made in lieu of some projects' additional budget details. The following salary calculations assume that all project wages received were deposited and eventually spent in Indiana. However, because some salaries were received overseas or were earned by non-Indiana residents, they were not, necessarily, spent entirely in Indiana. For the case that the literature only identifies the number of total project hours worked by Purdue employees, it is assumed that the ratio of total salaries to Indiana salaries was the same as the ratio of total hours worked to Indiana hours worked. I.e., sufficient data to account for each project's variable levels of income no longer exists. If a project has an expenditure item not specified, the average value of the coreresponding item for the other projects is multiplied by the total project funding. For lack of a better method, these assumptions are deemed reasonable.

2.4.1 Vicosa (UFV) (1951-73)

Purdue University was chosen through the Foreign Assistance Act of 1950 to help provide assistance to developing countries. The next year, Purdue International Programs in Agriculture (IPIA) was funded by the Institute of Interamerican Affairs (IIAA) and the Brazilian government for its first long-term institution building program. Purdue initially sent two

agricultural faculty to the Rural University of Minas Gerais, UREMG. This school was federalized during this project to become the Universidade Federal de Vicosa (UFV).

The project maintained its agricultural focus but shifted from a more general Brazilian higher education focus in 1952 to a focus on the state of Minas Gerais in 1958 when the project saw greater funding from the International Cooperation Administration (ICA) (Peterson, 1969). Brazilian university assistance expanded into its final stage in 1963 when USAID (then ICA) funded the Ohio State University, University of Wisconsin, and University of Arizona to begin projects at different Brazilian universities while increasing Purdue's funding. This final plan stipulated that the program was to perform three tasks for the UREMG: strengthen and expand the school's activities by coordinating the program of agricultural teaching, research and extension at the UREMG; help improve the professional and technical competence of its staff; and double the school's number of undergraduate students while developing a Master's program by the time the project period completed (Fernandez, 1991).

This final plan also included a 1966-73 scholarship program that supported 245 UFV Faculty to study as US graduate students; such that 90 completed degrees at Purdue (33 MS; 57 PhD) from 1968 until the project's end (Peterson, 1969). The funding for this scholarship program is considered as a direct addition to the university consumption line item of the second table (Table 1A). This yields a change in the expenditure timeline's fund distribution for the project's final years (Fernandez, 1990). University F & A includes other costs. Similar to previous budgets for the UFV project, the 1964-73 scholarship program expenditure was evenly divvied between University consumption and Wages and salaries (Peterson, 1969).

Table 2.1 Expenditures of Federal University of Vicosa Agricultural Project (UFV) 1951-1973

Type of Expenditure	**Value ($)**
Total Project Funding	8,769,000.00
Transfers to host countries	6,140,535.35
Expenditures in Indiana	2,628,464.65
University Consumption (Salaries & Wages)	915,251.15
University Investments	1,713,213.50

2.4.2 Purdue-Formosa Engineering Project (NCKU) (1953-1962)

The Purdue-Formosa Engineering Project (NCKU) was a nine-year cooperative program designed to develop a first-rate college of engineering in Taiwan (historically called Formosa). The host institution, now called the National Cheng Kung University, began this project as a war-impoverished school of 800 students and ended as a well-staffed and equipped university of 3,500 students, including 2,500 engineering students. Since the end of this project, NCKU has been self-sustaining. The successful development of the Chinese engineering school was organized by a contract carried out between Taiwan College of Engineering (now known as National Cheng Kung University) and Purdue University (Purdue News Service, 1962). This was financially supported by Taiwan's federal government and the USAID.

As part of the project, Purdue chemical engineering professor R. Norris Shreve and a team of 16 colleagues served as consultants with administrators and faculty; 32 NCKU professors, in turn, studied at Purdue (Purdue Engineering, 2009); this included engineering students selected from the top 12 percent of Taiwan’s competitive entrance examinations (Purdue News Service, 1962).

While Purdue incurred no direct financial cost in the program, 16 Purdue professors and consultants were furnished as advisors to the Cheng Kung engineering department. Education at both campuses included education on the modernization of the physical plant and laboratories, library and textbook facilities, modern engineering curricula, and teaching methods to insure mutually beneficial cooperation between the university and its local industries.

The Taiwanese government invested approximately $5 million for the project and the USAID invested approximately $3 million into NCKU over the 9-year duration of the project in order to modernize the entire campus (Purdue thanked, 2009). Due to the lack of financial data remaining for this project, Tables 2A and 2B were formed by applying the other projects' expenditure decompositions.

Table 2.2 Project Expenditures – NCKU (1953-62)

Type of Expenditure	**Value ($)**
Total Project Funding	8,000,000.00
Transfers to host countries	4,000,000.00
Expenditures in Indiana	4,000,000.00
University Consumption (Salaries & Wages)	1,392,830.00
University Investments	2,607,213.50

2.4.3 Niger (NCRP) (1982-88) and (NAARP) (1988-92)

In 1974 the Government of Niger (GON) established its agricultural research agency, Institut national de Recherches Agronomiques du Nige*r* (INRAN). In response to the research constraints faced by INRAN, Purdue University and Alabama A&M University initiated an institution-building program, the Niger Cereals Research Project (NCRP), with funding from the USAID (NCRP Admin Report, 1989). The Niger Applied Agricultural Research Program succeeded this program in 1988 to build on the progress made during the preceding five years (NAARP Admin Report, 1992).

NCRP was conducted under a host country contract with the GON that gave top priority to food self-sufficiency in its long-run development plan. In the short term, this was conceived as producing enough food grains (sorghum, millet, cowpeas) during years of normal rainfall to meet the needs of the population. In the long term, this was conceived as being able to accumulate enough surplus stocks during good years to overcome deficits experienced in bad years. At the beginning of the project, INRAN problems included: a shortage of trained scientific manpower; difficulties in effectively mobilizing its available resources; insufficient interdisciplinary, problem-oriented research on agricultural problems of high priority; and their research was not yet focused on site-specific agricultural production constraints (NCRP Admin Report, 1989).

The NCRP involved use of a long- and short-term expatriate staff of research and farming personnel. The team was divided between INRAN's two major research stations, Kolo and Tarna. The NCRP technical assistance team conducted collaborative research and directly guided activities that contributed to attainment of the institution building objectives. During the life of the project, 26.0 person-years of long-term assistance aided INRAN in pursuing its mission. In addition, 233.8 person-weeks, or 4.4 person-years, of short term assistance complemented the long-term team and assisted in training and research in a variety of disciplines.

The first Nigerien expenditure decomposition is focused on the NCRP. The source budget states how much is spent at funding and host institutions. The salaries item was computed based on the ratio of total purdue to total project hours (NCRP Admin Report, 1988). All staff were assumed to receive the same salary per hour. Transfers equal subcontractor expenses. Faculty and staff wages were assumed to be completely spent in their home state. University F & A is equal to the 'Other costs' of the source. Vehicles-Freight are considered to be purchased strictly overseas. Equipment expenditures are considered to be purchased from Purdue. Wages and salaries equals the Purdue salaries expenditure of the source budget. Supplies equals the Purdue equipment expenditure plus half the remaining university consumption. This half represents the services expenditure.

Table 2.3 A Project Expenditures – NCRP (1982-88)

Type of Expenditure	Value ($)
Total Project Funding	9,153,856.35
Transfers to host countries	5,779,744.89
Expenditures in Indiana	3,374,111.46
University Consumption (Salaries & Wages)	732,308.51
University Investments	2,641,802.95

NAARP comprised three major components: organizational development, strengthening of research programs, and development of strong research-extension linkages (NAARP Final Report, 1992). USAID supported 29 person-years of long-term technical assistance focused on agricultural and social economics, research management, research extension, crop breeding, and the agronomy of dryland cereals and irrigation. Short-term technical assistance of thirty-six person-months were provided for the following disciplines: computer science/data management, agricultural machinery repair, planning and updating training, marketing and interim and final evaluations. As well, 210-person-months was provided for short-term training to upgrade the skills of INRAN's technicians and laboratory assistants. This training succeeded in the advanced professional training (MS and Ph.D.) for 21 INRAN personnel. The staff maintained their focus in the two major research stations, Kolo and Tarna.

Table 2.3 B Project Expenditures – NAARP (1988-92)

Type of Expenditure	**Value ($)**
Total Project Funding	19,999,000.00
Transfers to host countries	15,006,000.00
Expenditures in Indiana	4,993,000.00
University Consumption (Salaries & Wages)	2,083,846.15
University Investments	2,909,153.85

2.4.4 Burkina Faso (ARTS) (1990-94)

Purdue signed a contract with USAID in 1990 as the primary contractor of the Agricultural Research and Training Support (ARTS) institution building project in Burkina Faso to support scientists from the Burkina Faso Institute of Agricultural Studies and Research (INERA)'s Production Systems Research Program (RSP) to better serve the needs of Burkina's rural poor, particularly in the management of fragile its agricultural lands. The ARTS project was funded by USAID to direct the Institute of Agricultural Studies and Research (INERA) of Burkina Faso, West Africa. Purdue University was the primary contractor for the technical assistance (TA) portion of this project. WINROCK International was a subcontractor for a portion of the project. The technical assistance was focused on INERA's Production Systems Program (RSP).

The general objectives of the ARTS Project were to improve the capabilities of farming systems research teams to collect farm level data, process it, analyze it and make recommendations based on it, and to develop organizational linkages between the farming systems unit and other ministries and agencies involved in agriculture and related policy making (USAID, 1989). This project was built on 20 years of Purdue experience in farming systems research in the Sahel, including the SAFGRAD/Farming Systems Unit from 1979 to 1986 in Burkina Faso, and a 10-year effort (1983—1992) at the National Agronomic Research Institute of Niger (INRAN).

U.S. based Purdue University staff were closely involved in short-term training and research collaboration. Purdue Agricultural faculty supplied 299-person days of short-term training in Burkina Faso and 60-person days in the U.S. About two-thirds of the 53.5 person weeks of short-term technical assistance under the project were supplied by Purdue staff. Due to the multidisciplinary nature of the RSP work, Purdue staff were supported by researchers in other INERA programs were involved in the ARTS project activities.

Values for these calculations are based on the expenditures table published in Purdue University's and Winrock International's administrative report. These expenditures were categorized into the following types of expenses. Salaries is the sum of salaries & wages, fringe benefits, and allowances. Its Purdue expenditure was found by multiplying by the ratio of staff time employed by Purdue (ARTS, 1994). Equipment is composed of supplies, non-expendable equipment, and other direct costs. These were all considered to be purchased from Purdue (ARTS, 1994). Purdue expenditure of University F & A was estimated by reviewing the source report (ARTS, 1994). Travel equals the travel amount budgeted. Travel expense that was local Purdue travel is currently under estimation (ARTS, 1994). Transfers equal the total expenditures from Winrock and Florida sub-contracts and what leaked away from travel, salaries. Supplies equals the Purdue equipment expenditure plus half of Purdue University F & A. Services equals equipment plus half of Purdue University F & A.

Table 2.4 Project Expenditures – ARTS (1990-94)

Type of Expenditure	**Value ($)**
Total Project Funding	4,261,341.00
Transfers to host countries	3,026,594.00
Expenditures in Indiana	1,234,747.00
University Consumption (Salaries & Wages)	573,589.90
University Investments	661,157.10

2.4.5 Malaysia Polytechnic Project (MUCIA) (1995-99)

For this project, Purdue International Programs and the School of Technology were funded $20.7 million over five years to prepare the faculty of three new polytechnic colleges in Malaysia. The central goal for Purdue's involvement was to increase the quality and quantity of high-level technical manpower in Malaysia by managing the Malaysia Polytechnic Project on behalf of the Midwest Universities Consortium for International Activities (MUCIA, 1995).

Malaysia's rapid economic growth preceding this project fueled a demand for technically trained manpower in Malaysia. Thus the government of Malaysia's main goal of the program was to increase the number of students graduating from the existing polytechnic system in the country. Polytechnics are educational institutions that provide instruction in various scientific and technical subjects. The Malaysian polytechnics offer a three-year degree.

Faculty from Purdue and other universities involved in the project, particularly those in the consortium, spent at least one year in Malaysia, teaching classes to future faculty members of the new polytechnic colleges and advising the Malaysian faculty about curriculum and laboratory development. The program graduated more than 900 Malaysians to become faculty of the new schools. Disciplines included in the project are civil, electrical and mechanical engineering and a variety of specialties such as textile manufacturing and automated packaging.

Two other university consortia joining Purdue and MUCIA to supply faculty for the project are the Consortium for International Development and the Universities of the North of England Consortium for International Activities. No subcontractors external to the government of Malaysia, MUCIA, or Purdue University existed in this project.

The total funding for this project contract was annually disaggregated based on the semi-annual project expenditure tables between June 1995 and June 1997. Weighted sums were calculated to summarize the varying levels of different expenditures across the time of this project. The averages for this sample were then applied to the total project for the expenditure decomposition table.

Ringitt to USD conversion based on the average annual exchange rates between June 1995 and 1997 (Oanda, 2013). Purdue expenditure is based on the average of the local salaries expenditures of the June 1995 to June 1997 semi-annual project budgets. Salaries equals the sum of fringe benefits, wage related overhead, and allowances. University F & A is home office, indirect on out of pocket, and wage related overhead. Travel equals the travel and transportation reported on the expenditure budget. Transfers equals the amount that leaked away in the Malaysia Polytechnic budget. Supplies equals University F & A. Services equal Purdue travel expenditure plus half of Purdue University F&A.

Table 2.5 Projected Expenditures – MUCIA (1995-99)

Type of Expenditure	**Value ($)**
Total Project Funding	20,700,000.00
Transfers to host countries	13,629,860.89
Expenditures in Indiana	7,070,139.11
University Consumption (Salaries & Wages)	2,639, 826.14
University Investments	4,430,276.97

2.4.6 Afghanistan (PAP) (2007-11)

Purdue University involvement in Afghanistan began in 2002 shortly after the fall of the Taliban government. In 2002, Professor Kevin McNamara received funding from USDA and USAID to rebuild the physical infrastructure for the faculties of Agriculture and Veterinary Science at Kabul University until 2006. He initiated a graduate degree training program in India for young agricultural Kabul faculty. In March 2007 Purdue signed a contract with USAID for the Advancing Afghan Agriculture Alliance (PAP). USAID provided core funding of $7 million for the Alliance. A further $2.2 million was funded by USAID for the Afghan Merit Scholars program, $5 million was provided by other U.S government sources, and $3 million from non-U.S. government sources (A4 Final Report).

A4 worked most closely with Kabul University and three regional universities in northern Afghanistan: Herat University, Balkh University near Mazar-e-Sharif, and Nangarhar University near Jalalabad while other Afghan universities benefited from PAP long- and short-term training activities. To implement PAP activities Purdue University stationed seven international staff in Afghanistan; six served in Kabul and one in Herat. Purdue established subcontracts with three NGOs to implement PAP activities in the three regional universities. These NGOs are: Catholic Relie Services (CRS) in Herat, Joint Development Associates (JDA) at Balkh University and International Foundation for Hope (IFHOPE), mainly at Nangarhar University. Each NGO had one international employee stationed at its partner university. The U.S. universities involved were: University of California-Davis, Kansas State University, and Cornell University. Purdue faculty and staff provided 41 weeks of short-term technical assistance in support of PAP. The other U.S. universities provided 69 weeks of short-term technical assistance. Consultants engaged by Purdue provided 87 weeks of service in Afghanistan (A4 Final Report).

The PAP expenditure items were were calculated by multiplying its total project funding by the average of the previous project ratios.

Table 2.6 Projected Expenditures – PAP (2007-11)

Type of Expenditure	**Value ($)**
Total Project Funding	7,000,000.00
Transfers to host countries	4,609,131.70
Expenditures in Indiana	2,390,868.30
University Consumption (Salaries & Wages)	864,190.64
University Investments	1,526,677.66

CHAPTER 3. METHODOLOGY

This chapter describes the data and assumptions utilized in this analysis to calculate the economic impact on Indiana's economy from the seven major Purdue international institutional capacity building projects from the 1950s to 2011 listed above.

3.1 Study Area

Indiana State was chosen as the study area for both model applications. Data availability of the model variables, spatial location of employees and students and intended audience of this study were all considered before choosing the study area. While counties would have better showed the impact of expenditures, lack of data at lower spatial aggregations for the variables in the Keynesian model made it difficult to consider counties. The location that Purdue employees and student reside and spend their expenditures was also considered before choosing the study area. According to central place theory, consumers tend to minimize the distance that they travel while looking for functions that provide their demands and such they are likely to visit the nearest central places that provide those functions, i.e., counties and cities across Indiana (Openshaw and Veneris, 2003). The last factor that we considered was the audience of the study. Since Purdue is partly state supported possible audience would be state legislators that make decisions about funding (Carroll and Smith, 2006).

3.2 Regional Keynesian Model

Regional multipliers are similar, at a regional level, to the national Keynesian multiplier model, and the model that we use in this study is adopted from Florax (1992) and is given as,

$$Y = C + I + G + X - M - T_i \qquad 1)$$

Where,

$$C = C_a + cY_d \quad 2)$$
$$Y_d = Y + T_d + U - Y_a^o \quad 3)$$
$$T_d = t_d Y \quad 4)$$
$$U = U_a + uY \quad 5)$$
$$I = I_a \quad 6)$$
$$G = G_a \quad 7)$$
$$X = X_a \quad 8)$$
$$M = M_a + mY \quad 9)$$
$$T_i = t_i C \quad 10)$$

Where,

Y	$Gross\ domestic\ product$
Y_d	$Disposable\ income\ of\ consumption\ of\ households$
Y^o	$Disposable\ income\ of\ other\ sectors$
C	$Private\ consumption$
I	$Private\ Investment$
G	$Government\ Spending$
T_d	$Direct\ taxes\ and\ social\ insuarance\ constributions$
T_i	$Indirect\ taxes$
U	$Transfer\ payments$
X	$Exports; and$
M	$Imports$

Subscripts a denotes autonomous factors, and parameters are in lower case.

Substituting equations (2-10) into identity equation (1) gives the closed form solution (11),

$$Y = \frac{(1-t_i)C_a + c(1-t_i)(U_a - Y_a^o) + I_a + G_a + X_a - M_a}{1 - c(1-t_i(1-t_d+u)+u-t_d)+m} \quad 11)$$

The multiplier for private consumption k_c is given by,

$$k_c = \frac{(1-t_i)}{1 - c(1-t_i(1-t_d+u)+u-t_d)+m} \quad 12)$$

The multiplier for private investment k_i is given by,

$$k_i = \frac{1}{1 - c(1-t_i(1-t_d+u)+u-t_d)+m} \quad 13)$$

The multipliers are aggregate multipliers unlike the input-output multipliers that are usually disaggregated by sectors. The aggregate multiplier of the Keynesian model has the advantage of drawing a picture of regional macro-economic characteristics, which is vital for regional policies (Faggian and Biagi, 2003).

3.3 Input-Output Model.

An input-output model illustrates an economy in equilibrium, where the gross output of each industry is equal to the gross inputs to the industry (Miller and Blair, 2009, p.2). The gross output of an industry includes both inter-industry sales and sales to final demand while the gross inputs of an industry includes the purchase of goods and services, labor, investment, and profit. The input-output model provides a means of examining relationships within an economy both amongst different sectors and between sectors and final consumers such as households and government (Miller and Blair, 2009, p.2). The model allows one to examine the impact on the entire economy due to a change in one or several economic activities through multiplier effects.

At the core of input-output analysis, is a matrix of technical coefficients called Leontief input matrix[3]. Leontief input matrix is a transaction table that diagrams the flows (exchanges of goods) among sectors and final demand of the economy. For industry output vector, x the input-output model is given as,

$$x = (I - A)^{-1} f \qquad 14)$$

Where $(I - A)^{-1}$ is the Leontief inverse and f is a vector of final demand. Changes in final demand such as an increase in export demand or a new construction project perturbs the equilibrium in Leontief input matrix leading to iterative rounds of local spending before a new equilibrium is attained (ten Raa, 2005, p. 14).

[3] The production under Leontief systems assumes fixed factor proportions and operates under constant returns to scale (Miller and Blair, 209. P. 17)

A software that has been widely used to capture the impact of changes in final demand in an input-output framework is IMPLAN (IMpact analysis for PLANning). IMPLAN is designed by IMPLAN Group (MIG Inc., 2008). IMPLAN examines forward and backward linkages that are present in any regional economy and it is therefore able to make the primary economic forecasts (MIG Inc., 2008). The model measures the total annual economic activity that results from interindustry transactions in the economy through the multiplier effects. IMPLAN is designed with over 400 sectors[4] that represent an individual industry (MIG Inc., 2008).

The State of Indiana State has 408 industries that are engaged in active interindustry transactions and IMPLAN formed a 408 by 408 Leontief input matrix that showed all transactions between the individual sectors in dollar values. The transactions are the dollar values that each industry sells to (and purchases from) other industries in the economy of Indiana. It measures the amount of final consumption by the residents of Indiana, as well as how much each industry exports from the area. The model database is data collected at the county level in 2008, which are obtained from the IMPLAN Group (MIG Inc., 2008) and the Bureau of Economic Analysis-BEA (U.S. Department of Commerce, 2003). The BEA collects extensive data on these regional trade flows and reports this annually (U.S. Department of Commerce, 2003). In this study, we used IMPLAN's social accounting matrix (SAM) multipliers, which include the direct, indirect, and the induced effects (MIG Inc., 2008).

[4] Most IMPLAN sectors are defined by North American Industry Classification System (NAICS) codes; however, construction is based on Census structure types rather than NAICs codes (MIG Inc., 2008)

3.2.3 The link Between Input-Output and Keynesian Multiplier

Input-output analysis gives production income multiplier from the "roundabout" of production process[5] while the Keynesian multiplier gives the consumption income effect[6] from shocks in final demand (Bess and Ambargis, 2011; Miller and Blair, 2009. p.14; ten Raa, 2005. p. 25). In Keynesian multiplier, the factor inputs are aggregated and directly mapped into the national output and therefore production income multipliers are not detected (ten Raa, 2005. p. 27). The feedback effect of say income shock is mostly felt through the propensity to consume and save (investment). If final demand is increased, output goes up too but disproportionally because sectors demand for material inputs is different. As such, the two models are not expected to yield equivalent economic impact due to that disproportional increment in material demand from final demand shock (ten Raa, 2005. p. 25).

[5] "Roundaboutness" in production implies that sectors use each other's output as inputs (ten Raa, 2005. p. 25)
[6] Demand-pull multiplier effect is another name given to consumption income effect. i.e., the output increases per unit of final demand increase.

The Keynesian multiplier and input-output model are linked by price of a commodity through the total income effect multiplier (ten Raa, 2005. p. 27). Production income multipliers equals price of a commodity, which is equal to the component of income generated by the direct and indirect requirements of an additional unit of the final demand. The total income effect is the product of the production and consumption income multipliers that is caused by an increase in final demand. The Keynesian multiplier is incorporated into the input-output model through modelling of consumption income effect in microeconomic context. This is attained by disaggregating the propensity to consume component of the Keynesian multiplier into a commodity vector and inserting that vector in the output sector in the input-output table (interindustry transaction table). This gives an augmented Leontief inverse matrix[7] which has two components, one the original Leontief inverse and two, the new term consisting of the Keynesian multiplier effect of an increase in the final demand on non-household demand (like investment spending) due to the initial household demand shock. The two models therefore reinforce each other through consumption and but they are conceptually different. Under special a circumstance that involves the value propensity to consume, the two models might be equivalent (ten Raa, 2005. p. 30).

3.2.4 Estimation of Regional Keynesian Multiplier

The regional data analogous to the national data is often difficult to get and most regional studies have used non-survey[8] techniques to convert the national data to regional data (e.g, Bess and Ambargis, 2011; Florax, 1992; Greig, 1971). The main difference between the regional data to the national data comes from interregional linkages because external flows are more important to a region than to nation (lsard, 1960). Linkages in Keynesian multiplier are usually investigated using interregional trade multipliers and therefore regional imports and exports are the most important distinguishing variables in the two models. The other regional spillover effects of increased public expenditure, consumption or investments are often assumed to be captured through imports and exports (e.g., Faggian and Biaggi, 2003). The regional exports are assumed to be fixed in our model (see equation 8) but imports are not. The regional imports will be discussed under the data section below.

[8] Non-survey techniques are techniques applied to national data to obtain regional estimates

CHAPTER 3. DATA

The data used to generate the Keynesian multiplier model is discussed first followed by the data for the input-output model.

3.1 Data for Keynesian Multiplier Model

Data for this study are national and regional data for the US and Indiana. The national data for the US, 1950-2012, are taken directly from the Bureau of Economic Analysis (BEA) website (http://www.bea.gov/national/). Indiana's regional data, from 1963-2012 are also taken directly from BEA website. The missing data (1950-1962) was interpolated linearly based on average annual growth rate. A detailed description of the variables used in estimating the multipliers (Equations 12 and 13 in our model) is given below. The descriptions and definitions are from the U.S Bureau of Economic Analysis (U.S. Department of commerce, 2007).

3.1.1 Regional Income (Y)

This study used GDP as the measure of income in the region as suggested by Faggian and Biagi (2003). GDP measures the value of final goods and services produced in the United States in a given period of time (U.S. Department of commerce, 2007). Faggian and Biagi (2003) noted that since 1977, the basic aggregate in the national account system has been recommended by the UN as the fundamental measure of the "economic capacity" of an economy. The authors also note that GDP is usually preferred because its value is more practical than the disposable income measure that has also been used by some studies.

3.1.2 Direct and Indirect Taxes ($\boldsymbol{T_d}$&$\boldsymbol{T_i}$)

The chosen tax rates were based on the effects of taxes on final income of the regions (Faggian and Biagi, 2003). Direct taxation reduces disposable income while indirect taxation affects consumption (The respective average propensities of direct and indirect taxation are estimated using national data).

3.1.3 Disposable Personal Income ($\boldsymbol{Y_d}$)

Disposable personal income is the net of regional income less the direct tax and non-tax payments (U.S. Department of commerce, 2007). It is the income available to persons for spending or saving.

3.1.4 Personal Consumption Expenditures ($\boldsymbol{C}$)

Personal consumption expenditures (PCE) is goods and services purchased by persons resident in the United States (U.S. Department of commerce, 2007). PCE consists mainly of purchases of new goods and of services by individuals from businesses, non-profit institutions (including compensation of employees), net purchases of used goods by individuals and non-profit institutions, and purchases abroad of goods and services by U.S. residents. PCE also includes purchases for certain goods and services provided by government agencies-primarily tuition payments for higher education, charges for medical care, and charges for water and sanitary services. Finally, PCE includes imputed purchases that keep PCE invariant to changes in the way that certain activities are carried out-for example, whether housing is rented or owned, whether financial services are explicitly charged, or whether employees are paid in cash or in kind (U.S. Department of commerce, 2007).

3.1.5 Current Transfer Payments ($\boldsymbol{U}$)

Current transfer payments are net transfer payments to persons and net transfer payments to the rest of the world (U.S. Department of commerce, 2007). The latter consists of U.S. government military and non-military grants in cash and non-military grants in kind to foreign governments and of U.S. government transfers, mainly retirement benefits, to former residents of the United States.

3.1.6 Regional Imports ($\boldsymbol{M}$)

Since regions are unlikely to be self-contained economies like in most nations' economies, imports include both purchases from abroad and other regions (i.e., regional foreign and domestic imports). However, the availability of regional data is very scarce and various studies have suggested use of non-survey methodologies to transform information from the national accounts to the inter-regional case. Regional foreign imports are assumed to be proportional to the national foreign imports (Alward and Despotakis, 1988).

To estimate the domestic regional imports, we adopt the 2008 regional imports data for Indiana contained in IMPLAN software model. IMPLAN uses regional purchase coefficients (RPC) to create the multipliers for each commodity and to estimate the direct impact leakage. The RPC are defined as the proportion of the regional demand for that sector's output that is fulfilled from regional production (Alward and Despotakis, 1998; Miller and Blair, 2009. p. 357). RPC are also known as regional supply portions since they operate uniformly across the input-output table rows, in a similar fashion to the location quotients[9] (LQ)-based methods (Miller and Blair, 2009. p. 357). Domestic imports are directly related to LQs which do not change significantly over time due to relatively sluggish mobility of capital (e.g., Taylor, 1996).

RPC are derived from regional trade flows through non-survey techniques. If, say a commodity "Wheat" has a RPC of 0.6, then 60% of the demand by local wheat processors, wholesalers, and other wheat consumers are met by local wheat producers. Conversely, 40% (1.0-RPC) of the demand for wheat is satisfied by foreign and domestic imports (Alward and Despotakis, 1998). Indiana regional imports were calculated from an average of about 200 sectors that had a significant RPC and hence multiplier. The average regional imports derived from IMPLANs trade flows of 2008 was 0.49 (or about 50%). The domestic imports were calculated as the net of regional imports and the regional foreign imports in 2008 (i.e., regional imports (0.5) less regional foreign imports (0.2) [10] equals regional domestic imports (0.3)). The estimated value of 2008 was taken as the proportion of domestic imports for the entire project period, 1950 to 2011 and this was added to the foreign imports to give the regional imports.

[9] Location Quotients (LQ) measures the ability of regional industry i to supply the demands placed upon it by other industries (final demand) in that region (Miller and Blair, 2009. P. 349).
[10] Foreign imports in 2008 were calculated from BEA data at 0.2

3.2 Data for Input-Output Analysis

The data for IMPLAN analysis came from audited financial reports of the eight projects under PAP and students spending from 2007 to 2011 (see annual expenditure spreadsheet in appendix A). Other inter-industry data used in the input-output analysis are as described above and are contained in IMPLAN software (MIG Inc. (2008).

CHAPTER 4 RESULTS

Results of the Keynesian multiplier model are presented and discussed first followed by those of input and output model. Results of both models are then compared last.

4.1 Keynesian Multiplier by the Marginal Propensities Method (MPM)

The marginal propensities to consume, import and to receive transfer payments were calculated in blocks of 10-year period (decades) starting from 1950 to 2011. Regressions analysis to equations (2), (5) and (9) were then carried out using the above described data from national account and regional adjusted regional imports data for each variables in the Keynesian model. The average direct tax and the average indirect tax propensities were calculated as ratios between direct tax and national income and indirect tax and national consumption respectively. These correspond to equations (4) and (10) in the Keynesian multiplier model. The annual propensities were used to calculate the multipliers for private consumption and private investments based on equations (12) and 13) of the Keynesian multiplier model. Results of the multipliers are presented in Figure 4.1.

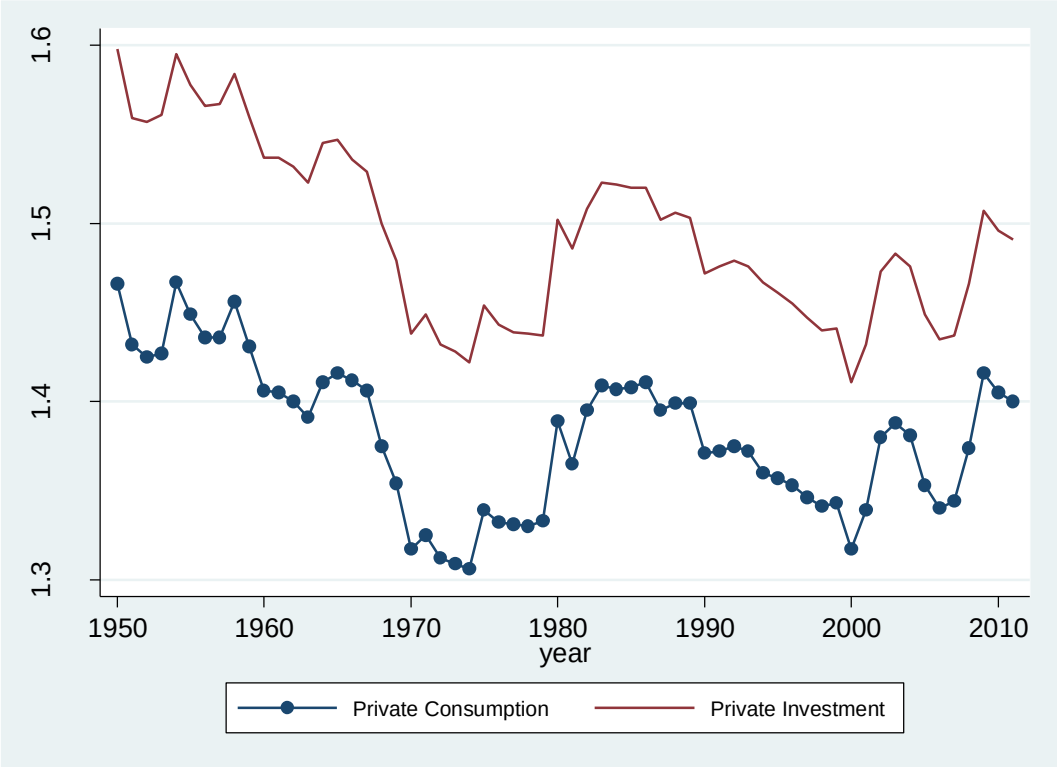

Figure 4.1 Indiana's multipliers for private consumption and investments from 1950 to 2011

Figure 4.1 shows similar patterns for both multipliers in the projects period. The similar pattern is expected because the multipliers are proportional to each other (see equations 12 and 13 in the Keynesian model). Results shows that the regional multiplier for private investments is slightly higher than that of private consumption. The multipliers decrease from slightly above 1.5 in the 1950s to around 1.3 in the 1970s before rising again slightly to below 1.5 in the 2000-2011 period. These multipliers are within the range of Indiana IMPLAN multipliers for Indiana found by Broomhall (1993) and MIG Inc. (2008) which ranged from 1.2 to 2.4 depending on the sector.

4.2 Economic Impact Based on Keynesian Multiplier Model

The economic impacts of international projects in Indiana were attributed to Purdue University spending on employee compensation and investments (capital improvements and investments spending) (e.g., Carroll and Smith, 2006). The expenditure spending was derived from the projects audited financial accounts and it is equal to Facilitation and Administrative (F&A) charges[11] less taxes. The bulk of F&A revenues for public universities like Purdue are mostly used for employees' compensation and capital investments and operations spending (Purdue, 2010). Given that we did not have itemized expenditures for the F&A revenues, we used the expenditure proportions in IMPLAN's industry 392, institution for State/Local Government Education[12], to partition the revenues into employee compensation (consumption),

[11] Purdue University on-campus and off-campus F&A cost rates for sponsored programs are 36% and 26% respectively (Purdue, 2010).

[12] This section partitions institutional spending pattern into annual operating expenditures (i.e. what is requires to operate the college, mostly employee compensation) from impacts from capital improvement and other operation spending such as construction (MIG Inc., 2008).

capital improvement and investments spending and taxes (MIG Inc., 2008). (See appendis for consumption, investments and taxes expenditures proportions).

IMPLAN's Industry 392, contains the average expenditures of all public universities-from elementary through colleges (MIG Inc., 2008). In this modelling, the university is assumed to "purchase" labor, other operating expenditures and capital goods from various industries within IMPLAN. These industries form the partitions. We recognize that these expenditure proportions might differ by the type and level of public institution, but we take the expenditure averages as the best estimates for partitioning outlays F&A revenues given the data limitation. However, we compared our partition estimates to those found in one of the available audited financial report, Purdue-Vicosa project (Fernandez, 1991). Our estimate for employee compensation was higher than the proportion in the report (compare 87% to over 60%) but our capital investment estimate was slightly lower than that in the report (i.e., 7% to 10%)[13].

Purdue University spending on employee compensation and investments (capital improvements and investments spending) were taken as the direct effects of Purdue university spending (e.g., Greig, 1971). The indirect and induced effects are estimated as multiplier effects, simply as the product of each expenditure category and the respective multiplier. i.e., the university consumption was multiplied by the multiplier for private consumption while the investments were multiplied by the multiplier for private investments. Results show that there was a significant economic impact for every dollar spent in Indiana in all projects period. On average, every project dollar spent in Indiana generates about one dollar and forty cents to the Indiana economy.

[13] Taxes and other benefits constitutes the remainder of the total percentage (100%)

4.3 Employment Impact Based on the Keynesian Multiplier Model

The number of jobs that were supported by the economic impacts were calculated based on a conservative approach using the average wage rate. The number of jobs that were supported by the projects were calculated as the ratio between the projects annual total economic impacts and the average wage rate for Indiana from the 1950s to 2011. There was high variability in the number of jobs that were supported during the projects period. The highest number of jobs that were supported annually was 163 while the lowest is zero. On average around 36 local jobs are supported annually because of Purdue's engagement in international capacity building projects.

4.4 Economic Impacts Based the Input-Output Model

This section considered the expenditures of the most recent International program that Purdue has been engaged with (from 2007 to 2011) because we used version 3.0 of IMPLAN software that contains 2008 data. (See 2007 to 2011 data in annual expenditure spreadsheet in appendix A.) The economic impact that were attributed to the projects came from outlays of the

consumption and investments proportions of F&A charges and students stipend spending that came from external sources[14].

Expenditure data shows that about $2.8 million was collected as F&A charges from 2007 to 2011. Out of that amount, about $2.4 million was used as employees' compensation[15] and around $0.18 million was used for capital investments and operation spending at the university while another $0.19 million was used for taxes and other benefits. The partitioned expenditures from F&A and the student stipend spending were then used to evaluate the total impacts of the projects that ran from 2007 to 2011. Results of the impacts of each spending categories is presented in Table 2. These are separately reported in columns as employee spending impact, capital investments and operation spending Impact and students spending impacts.

[14] The students attended Purdue but their funding came from a project that was not managed by Purdue
[15] Employee compensation includes salaries and benefits

4.4.1 Employee Spending Impact

The Employee spending generated the largest impact of the projects. Out of $2.4 million paid as employee compensation, we subtracted 17% in taxes and other deductions to get a net of $2.0 million disposable income available for consumption on various household spending categories (U.S. Department of Labor, 2011). The deductions were guided by the bureau of labor statistics (BLS) consumer expenditure guidelines for Mid-West (U.S. Department of Labor, 2011). The economic impact associated with this expenditure was then evaluated based on an average university employee household spending pattern. The average employee compensation was calculated as the ratio of total university employee compensation to the number of employees and this yielded $46,000. This average employee compensation fell in IMPLAN's inbuilt household spending pattern[16] of $35, 000 to $50,000 annual income and was subsequently used to calculate the total impact of employee spending during the 2007 to 2011 project period. The local purchase percentage (LPP) was set to 100% because it was assumed that the bulk of employee spending was spent in Indiana State.

[16] IMPLAN's inbuilt household spending pattern allocated household income into various household consumption categories based on bureau of labor statistics consumer expenditure surveys.

Table 2 shows the direct[17], indirect, induced and total impacts of employee spending in Indiana between 2007 and 2011. The SAM multipliers were calculated as the ratio of total effect to direct effect. These multipliers are about 1.57 and are within Broomhall (1993) and MIG Inc. (2008) multipliers that range from 1.2 to 2.4. The direct spending in Indiana was about $2.0 million from 2007 to 2011. This direct spending generated about $0.58 million in indirect spending as businesses (intermediate suppliers) transacted with other businesses to meet the new demand. The induced spending generated from employees of intermediate suppliers and university spending was about $0.55 million. The total impact of employee spending was the summation of the direct, indirect and induced effect and this was about $3.10 million from 2007 to 2011.

The 5 most impacted industries were; 438 (Employment and payroll only), 361 (Imputed rental activity for owner-occupied dwellings), 394 (Offices of physicians, dentists, and other health practitioners), 413 (Food services and drinking places) and 360 (Real estate establishments). In terms of jobs, employee spending supported a total of 25 jobs from 2007 to 2011. However, the impact of jobs did not necessarily follow the order of magnitude of output impact due to industries specificity (labor input requirements). The 5 most impacted industries in terms of employment were; 438 (Employment and payroll only), 413 (Food services and drinking places), 394 (Offices of physicians, dentists, and other health practitioners), 397 (Private hospitals) and 360 (Real estate establishments).

[17] The direct spending that was used to calculate the economic impact does not include the leakages

4.4.2 Capital Investments and Operation Spending Impact

To evaluate the impact of the combined capital improvement and operational spending we first deleted the employee and payroll amount from IMPLAN inbuilt institution spending pattern for public universities since this was evaluated under employee spending. Because we did not know the proportion of university investments spending that was available locally we used IMPLAN to get the estimates of local purchases before evaluating the impact to the local economy. This was attained by setting LPP to the social accounting matrix (MIG Inc., 2008).

Table 2 shows the direct, indirect, induced and total impact of projects spending on capital investments and operations spending. The direct impact of capital improvements and operation was about $0.18 million from 2007 to 2011. This direct spending generated an addition of $0.05 million in indirect spending of the university purchase of intermediates and value added. The employees of other sectors spending generated an induced effect of $0.06 million. The total economic impact was about $0.29 million between 2007 and 2011 and the SAM multiplier was calculated at 1.63. The 5 most impacted sectors were, 351 (Telecommunications), 369 (Architectural, engineering, and related services), 319 (Wholesale trade businesses), 389 (Other support services) and 390 (Waste management and remediation services). The number of jobs supported by this amount of spending during the project period, 2007 to 2011, was about 2.

4.4.3 Students Spending Impact

The economic impact in this category was attributed to spending of stipend by about 12 graduate students who were affiliated to PAP from 2008 to 2010. These students received monthly stipend from an "external donor" and used that amount to support their living at Purdue University. As such, no taxes and other benefits were deducted from the amount that they received. The estimated total stipend for the program was $0.8 million and this was distributed equally in the 3-year study period, 2008 to 2010. The economic impact was calculated according to the bureau of labor statistics expenditure survey shares for household earning between $15,000-$25,000 annual incomes because the paid students stipends fall in that income category.

Table 2 shows the impact of student's stipend spending to the local economy during the three years. A total of $0.75 million was spent directly by the students in Indiana over the three-year period. This direct spending generated around $0.21 million and $0.20 million in indirect and induced effects respectively. The total impact in Indiana from student spending was around $1.16 million and the SAM multiplier was calculated at 1.55. The 5 most impacted sectors were; 361 (Imputed rental activity for owner-occupied dwellings), 360 (Real estate establishments), 397 (Private hospitals), 394 (Offices of physicians, dentists, and other health practitioners) and 413 (Food services and drinking places). This level of consumption supported around 3 jobs annually over the three-year period.

4.5 Co-Impact from Keynesian Multiplier and Input-Output Models

In this section, we compare results of the private investment and private consumption multipliers for both models from 2007 to 2011 when PAP was implemented. We then compare the total economic and employment impacts of expenditures associated with PAP using those multipliers. Because, input-output model had two consumption categories, employee and student stipend spending, we first aggregated both impacts and calculated the mean consumption multiplier. The multipliers generated by input-output models are slightly higher than those generated by the Keynesian multiplier. The private consumption multiplier from input-output model was 1.57 while the multiplier generated by Keynesian model is 1.39. Similarly the private investment multiplier from input-output model was 1.63 while the multiplier generated by Keynesian model was 1.48. The different multipliers are directly attributed to the dissimilar conceptual approaches used in generating them. In Keynesian multiplier model, the production multiplier (from the rounds of spending by producers) are not detected because the factor inputs are aggregated and directly mapped into the national output while in the input-output model the production are detected (ten Raa, 2005. p. 27). The higher level of sector disaggregation in the input-output model is attributed to the slightly higher multipliers.

The economic impacts generated from the input-output models are also expected to be slightly higher than those generated by the Keynesian multiplier model because of the higher values of in the input-output multipliers. Out of $2.9 million spent in Indiana economy from 2007 to 2011 through PAP, input-output model yielded an impact of $4.6 million while the Keynesian multiplier yields $4.1 million.

4.6 Employment Impact from Keynesian Multiplier and Input-Output Models

The employment impacts generated from Keynesian multiplier model are higher than those generated in the input-output model. Results from the Keynesian multiplier model show that on average about 20 jobs were supported annually from economic impacts associated with PAP from 2007 to 2011 while input-output model shows that around 8 employees were supported annually during the same period.

The differences in employment impacts are attributed to the methodology used in calculating the employment numbers. In the Keynesian multiplier, an average wage rate is used to calculate the number of employees supported by the economic impact while production employment multiplier is used in the input-output model. Production employment multiplier measures the employment requirements for units of final demand increases resulting from intermediate demand pull (ten Raa, 2005. p. 30). This implies that if sectors that are affected by the expenditures are labor-intensive, then the score on production employment multiplier and hence employment numbers will be low as it is seen in the input-output model results (ten Raa, 2005. p. 31). From these results and inference, we can also conclude that the average wage rate used to calculate employment numbers in the Keynesian multiplier model is lower than the average wage rate of the sectors that are affected by the changes in final demand from PAP expenditures.

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CHAPTER 5 CONCLUSION

This study applied Keynesian multiplier model to estimate the economic impact of Purdue international institutional capacity building projects on Indiana's economy from the 1950s to 2011. Input-output multiplier models was also used for the most recent project, Purdue Afghanistan Project-PAP (2007 to 2011) to compare the Keynesian multiplier results since the two models are closely related even though conceptually different. The projects include: Federal University of Vicosa Agricultural Project (Vicosa) in Brazil that ran from 1951-1973, National Cheng Kung University engineering project (NCKU) in Taiwan, 1953-1962, Niger Cereals Research Project (NCRP), 1982-1988 and 1988-1993 under Niger Applied Agricultural Research (NAARP), Burkina Faso's Agricultural Research and Training Support (ARTS) from 1990-1994, Malaysia Polytechnic Development Project (MUCIA) from 1995-1999, and the Purdue Afghanistan Program (PAP) from 2007-ongoing. These projects were funded by the United States Agency for International Development (USAID) and other donors. The projects directly injected money into the Indiana economy through wages and salaries paid to Purdue faculty and staff, graduate student stipends and tuition and through purchases of capital goods, including the supply of local goods and services in Indiana. The seven projects injected around $26 million into Indiana's economy during the 60 year project period, 1951 to 2011.

The estimated regional multipliers from the two models show slight variations for investment spending and consumption spending. The multiplier from the input-output model are slightly higher than those from the Keynesian multiplier model. The Keynesian multipliers shows variation in the entire project period. The private consumption multiplier ranges from a minimum of 1.3 in the 1970s to a maximum of nearly 1.5 in the 1950s while the private investment multiplier ranges from a minimum of slightly above 1.4 in the 1970s to a maximum of nearly 1.6 in the 1950s. The input-output generated multipliers are slightly higher than those of Keynesian multiplier and both average about 1.6 in the considered project period, 2007 to 2011. The differences in the multipliers is directly attributed to the conceptual differences in the models. For example, Keynesian multiplier is generated from aggregated factor inputs while input-output multiplier is generated from disaggregated factor inputs and this is likely to give higher impacts.

Results of the Keynesian multiplier show that there was a significant return for every dollar spent in Indiana in all the project periods. Over the 60 year project period, over $26 million has been injected in Indiana's economy and the total economic impact of that injection is about $36 million. This implies that on average, every project dollar spent in Indiana generates about one dollar and forty cents in Indiana's economy. Results of the impact from input-output model seem to agree with the Keynesian results albeit slight higher values for the considered program, PAP. Out of $2.9 million spent in Indiana's economy from 2007 to 2011 through PAP, input and output model yielded an economic impact of $4.6 million while the Keynesian multiplier model yields $4.1million as economic impact.

Employment support from the expenditure patterns from the projects was projected based on average compensation wage rates in the Keynesian multiplier case and from the production employment multiplier in the input-output analysis. The number of jobs that were supported by the PAP expenditures were calculated as the ratio between the projects total annual economic impact and annual average wage rate for Indiana from the 1950s to 2011 in the Keynesian case. The mean number of local jobs that were supported annually by the economic impact was around 36. The highest number of local jobs that was supported by these impacts was 163 while the lowest was zero. During the PAP project period, 2007 to 2011, the Keynesian multiplier model shows that around 20 jobs were supported annually from 2007 to 2011 while the input-output model shows that around 8 jobs were supported annually in the same period. The differences in employment impacts is attributed to the methodology used to calculate the employment numbers.

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APPENDIX

Table A 1 Expenditure Decomposition (Nominal $)

Project	Years	Total Incoming Funds	Transfers	Funds Available	Wages and Salaries	University Consumption	Supplies	Services
UFV	1951-1973	8,769,000.00	(3,672,000.00)	5,097,000.00	2,421,075.00	2,675,925.00	1,337,962.50	1,337,962.50
NCKU	1953-1962	8,000,000.00	(4,000,000.00)	4,000,000.00	2,330,449.28	1,669,550.72	834,775.36	834,775.36
NCRP	1982-1988	9,153,856.35	(5,779,744.89)	3,374,111.46	732,308.51	2,641,802.95	2,007,440.70	634,362.25
NAARP	1988-1993	19,999,000.00	(12,627,368.60)	7,371,631.40	1,599,920.00	5,771,711.42	4,385,780.71	1,385,930.71
ARTS	1988-1993	4,261,341.00	(2,608,184.90)	1,653,156.10	724,985.42	928,170.68	584,894.34	343,276.34
MUCIA	1990-1994	20,700,000.00	(1,364,130.00)	19,335,870.00	16,387,552.23	2,948,317.77	1,099,632.49	1,848,685.28
PAP	1995-1999	7,000,000.00	(2,459,597.45)	908,080.51	3,082,794.18	1,457,608.37	799,395.05	658,213.32

Table A 2 International Projects Expenditures Breakdown from 1950 to 2011

Year	Total Funds	Trans*	Funds in Indiana	Cons**	Invst+	Taxes	Year	Total Funds	Trans	Funds in Indiana	Cons	Invst	Taxes
			US$(000)							US$(000)			
1950	0.0	0.0	0.0	0.0	0.0	0.0	1982	0.0	0.0	0.0	0.0	0.0	0.0
1951	26.2	18.3	7.9	6.9	0.5	0.5	1983	656.2	414.3	241.9	210.6	15.4	15.4
1952	26.2	18.3	7.9	6.9	0.5	0.5	1984	1006.7	635.6	371.1	323.1	23.6	23.6
1953	26.2	18.3	7.9	6.9	0.5	0.5	1985	1769.6	1117.3	652.3	567.9	41.4	41.4
1954	26.2	18.3	7.9	6.9	0.5	0.5	1986	2176.7	1374.4	802.3	698.5	50.9	50.9
1955	26.2	18.3	7.9	6.9	0.5	0.5	1987	2517.7	1589.7	928.0	808.0	58.9	58.9
1956	26.2	18.3	7.9	6.9	0.5	0.5	1988	5026.7	3173.9	1852.9	1613.1	117.7	117.7
1957	26.2	18.3	7.9	6.9	0.5	0.5	1989	3999.8	2525.5	1474.3	1283.5	93.6	93.6
1958	26.2	18.3	7.9	6.9	0.5	0.5	1990	4852.1	3047.1	1805.0	1571.4	114.6	114.6
1959	26.2	18.3	7.9	6.9	0.5	0.5	1991	4852.1	3047.1	1805.0	1571.4	114.6	114.6
1960	26.2	18.3	7.9	6.9	0.5	0.5	1992	4852.1	3047.1	1805.0	1571.4	114.6	114.6
1961	1149.2	644.1	505.1	439.7	32.1	32.1	1993	852.3	521.6	330.6	287.8	21.0	21.0
1962	1149.2	644.1	505.1	439.7	32.1	32.1	1994	852.3	521.6	330.6	287.8	21.0	21.0
1963	1149.2	644.1	505.1	439.7	32.1	32.1	1995	2271.2	1548.7	722.5	629.0	45.9	45.9
1964	879.1	614.5	264.6	230.3	16.8	16.8	1996	4064.0	2771.2	1292.9	1125.6	82.1	82.1
1965	752.9	526.3	226.6	197.2	14.4	14.4	1997	5739.0	3913.3	1825.7	1589.5	115.9	115.9
1966	714.1	499.2	214.9	187.1	13.6	13.6	1998	4312.9	2940.8	1372.0	1194.5	87.1	87.1
1967	714.1	499.2	214.9	187.1	13.6	13.6	1999	4312.9	2940.8	1372.0	1194.5	87.1	87.1
1968	714.1	499.2	214.9	187.1	13.6	13.6	2000	0.0	0.0	0.0	0.0	0.0	0.0
1969	828.0	578.8	249.2	216.9	15.8	15.8	2001	0.0	0.0	0.0	0.0	0.0	0.0
1970	714.1	499.2	214.9	187.1	13.6	13.6	2002	0.0	0.0	0.0	0.0	0.0	0.0
1971	714.1	499.2	214.9	187.1	13.6	13.6	2003	0.0	0.0	0.0	0.0	0.0	0.0
1972	714.1	499.2	214.9	187.1	13.6	13.6	2004	0.0	0.0	0.0	0.0	0.0	0.0
1973	714.1	499.2	214.9	187.1	13.6	13.6	2005	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	2006	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	2007	647.8	453.5	194.3	129.8	11.7	52.9
1976	0.0	0.0	0.0	0.0	0.0	0.0	2008	1330.2	931.1	665.7	517.0	24.6	124.1
1977	0.0	0.0	0.0	0.0	0.0	0.0	2009	2099.6	1469.7	896.5	689.2	39.7	167.6
1978	0.0	0.0	0.0	0.0	0.0	0.0	2010	2343.6	1640.5	969.8	756.6	45.5	167.6
1979	0.0	0.0	0.0	0.0	0.0	0.0	2011	2895.5	2026.9	868.7	632.4	57.7	178.6
1980	0.0	0.0	0.0	0.0	0.0	0.0							
1981	0.0	0.0	0.0	0.0	0.0	0.0	**Total**	**74,600**	**48,982**	**26,418**	**22,595**	**1,628**	**2,140**

***Trans=Transfers to recipient countries, **Cons=Consumption in Indiana, +Invst=Investment in Indiana**

Table A 3: Economic Impact of Employee, Capital Investments and Operational and Student Spending, from 2007 to 2011.

		Employee Impact*				**Capital investments impact**				**Student spending impact**			
Year	**Impact Type**	**Jobs**	**Labor Income**	**Value Added**	**Output**	**Jobs**	**Labor Income**	**Value Added**	**Output**	**Jobs**	**Labor Income**	**Value Added**	**Output**
2007	Direct Effect	1.1	36,619	67,196	129,769	0.1	3,956	6,035	11,670				
	Indirect Effect	0.3	12,173	20,468	37,372	0	1,165	1,885	3,510				
	Induced Effect	0.3	11,264	21,045	36,092	0	1,186	2,217	3,802				
	Total Effect	1.7	60,056	108,708	203,232	0.2	6,307	10,137	18,982				
2008	Direct Effect	2.3	76,698	140,740	272,143	0.2	8,285	12,640	24,562	1.9	67,146	127,660	244,894
	Indirect Effect	0.6	25,497	42,869	78,697	0.1	2,440	3,949	7,404	0.5	22,162	37,648	68,894
	Induced Effect	0.7	23,592	44,078	75,698	0.1	2,484	4,643	7,974	0.6	20,627	38,541	66,189
	Total Effect	3.5	125,787	227,687	426,538	0.3	13,209	21,232	39,941	3	109,936	203,848	379,977
2009	Direct Effect	3.6	122,877	225,476	438,861	0.3	13,274	20,251	39,749	1.9	68,154	129,574	250,328
	Indirect Effect	1	40,848	68,679	127,417	0.1	3,908	6,326	12,007	0.5	22,495	38,212	70,706
	Induced Effect	1.1	37,796	70,616	122,081	0.1	3,980	7,439	12,860	0.6	20,937	39,119	67,628
	Total Effect	5.6	201,521	364,772	688,359	0.5	21,162	34,016	64,616	3	111,585	206,905	388,662
2010	Direct Effect	4	140,427	257,681	500,674	0.3	15,170	23,143	45,504	1.9	69,777	132,659	255,970
	Indirect Effect	1.1	46,682	78,489	145,934	0.1	4,467	7,230	13,773	0.5	23,030	39,122	72,584
	Induced Effect	1.2	43,194	80,702	139,283	0.1	4,549	8,501	14,672	0.6	21,435	40,051	69,122
	Total Effect	6.3	230,304	416,872	785,891	0.6	24,185	38,874	73,949	3	114,242	211,832	397,676
2011	Direct Effect	4.9	177,531	325,764	632,421	0.4	19,178	29,258	57,673				
	Indirect Effect	1.3	59,017	99,227	185,042	0.1	5,647	9,140	17,490				
	Induced Effect	1.5	54,607	102,026	175,941	0.2	5,750	10,748	18,533				
	Total Effect	7.7	291,154	527,016	993,404	0.7	30,575	49,146	93,697				

*All impact values are in US ($) but jobs are in numbe

Table A 4 Economic Spending Impact, from 2007 to 2011

		Employee Impact*				**Capital investments impact**				**Student spending impact**			
Year	**Impact Type**	**Jobs**	**Labor Income**	**Value Added**	**Output**	**Jobs**	**Labor Income**	**Value Added**	**Output**	**Jobs**	**Labor Income**	**Value Added**	**Output**
2007	Direct Effect	1.1	36,619	67,196	129,769	0.1	3,956	6,035	11,670				
	Indirect Effect	0.3	12,173	20,468	37,372	0	1,165	1,885	3,510				
	Induced Effect	0.3	11,264	21,045	36,092	0	1,186	2,217	3,802				
	Total Effect	1.7	60,056	108,708	203,232	0.2	6,307	10,137	18,982				
2008	Direct Effect	2.3	76,698	140,740	272,143	0.2	8,285	12,640	24,562	1.9	67,146	127,660	244,894
	Indirect Effect	0.6	25,497	42,869	78,697	0.1	2,440	3,949	7,404	0.5	22,162	37,648	68,894
	Induced Effect	0.7	23,592	44,078	75,698	0.1	2,484	4,643	7,974	0.6	20,627	38,541	66,189
	Total Effect	3.5	125,787	227,687	426,538	0.3	13,209	21,232	39,941	3	109,936	203,848	379,977
2009	Direct Effect	3.6	122,877	225,476	438,861	0.3	13,274	20,251	39,749	1.9	68,154	129,574	250,328
	Indirect Effect	1	40,848	68,679	127,417	0.1	3,908	6,326	12,007	0.5	22,495	38,212	70,706
	Induced Effect	1.1	37,796	70,616	122,081	0.1	3,980	7,439	12,860	0.6	20,937	39,119	67,628
	Total Effect	5.6	201,521	364,772	688,359	0.5	21,162	34,016	64,616	3	111,585	206,905	388,662
2010	Direct Effect	4	140,427	257,681	500,674	0.3	15,170	23,143	45,504	1.9	69,777	132,659	255,970
	Indirect Effect	1.1	46,682	78,489	145,934	0.1	4,467	7,230	13,773	0.5	23,030	39,122	72,584
	Induced Effect	1.2	43,194	80,702	139,283	0.1	4,549	8,501	14,672	0.6	21,435	40,051	69,122
	Total Effect	6.3	230,304	416,872	785,891	0.6	24,185	38,874	73,949	3	114,242	211,832	397,676
2011	Direct Effect	4.9	177,531	325,764	632,421	0.4	19,178	29,258	57,673				
	Indirect Effect	1.3	59,017	99,227	185,042	0.1	5,647	9,140	17,490				
	Induced Effect	1.5	54,607	102,026	175,941	0.2	5,750	10,748	18,533				
	Total Effect	7.7	291,154	527,016	993,404	0.7	30,575	49,146	93,697				