COMPARATIVE ECONOMIC CONTRIBUTION ANALYSIS OF THE SAN ANTONIO ZOO AND THE DALLAS ZOO

A Thesis

by

JESSICA KAYLA LOVE

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Chair of Committee,	Rebekka Dudensing
Committee Members,	Michael Schuett
	James Mjelde
Head of Department,	C. Parr Rosson, III

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ABSTRACT

Most economic contribution studies for zoos run the Impact Analyses for PLANning (IMPLAN) model sector for museums, historical sites, zoos, and parks (Sector 493) without customizing it to a specific zoo. This research considers the question of how zoos' allocations of expenditures and revenues change the default economic multipliers and compares a modified zoo IMPLAN sector to a default zoo IMPLAN sector. This study compares and contrasts the economic contributions of the San Antonio Zoo and the Dallas Zoo to the local and state economies using both multipliers calculated from zoo-specific cost functions and default multipliers. The IMPLAN input-output model was modified with data gathered through correspondence with the Chief Financial Officers and ran using the analysis-by-parts method. Locally, the default IMPLAN zoo sector under-estimated the Dallas Zoo and over-estimated San Antonio output multipliers. Statewide, the default Texas IMPLAN zoo sector saw the San Antonio and Dallas zoos as providing equal contributions to output when, again, it over-estimated San Antonio and under-estimated Dallas. Higher wages relative to revenue at the San Antonio Zoo were associated with smaller output multipliers. Customization of the IMPLAN production function and the percent shares of goods and services purchased locally showed a substantial difference relative to default specifications. This study provides a blue print for specifying zoo-specific information in an IMPLAN analysis-by-parts model.

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NOMENCLATURE

SA	San Antonio
H1	Hypothesis one
HA1	Alternate hypothesis one
H2	Hypothesis two
HA2	Alternate hypothesis two
IMPLAN	Impact Analyses for PLANning (input-output model)

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CHAPTER I

INTRODUCTION

Thousands of visitors and employees participate in the operations and economic contributions of zoos every day (San Diego County Taxpayers Association 2014; Erkkila 2012; CSL International 2014; Bureau of Business Research 2011; Coons Advisors 2007; Fuller 2011; Department of Business and Economic Development 2011; RCGA 2008). The Association of Zoos and Aquariums (AZA) found the direct spending of $3.482 billion by U.S. zoos and aquariums contributed a total of $10.2 billion to U.S. GDP (Fuller 2011). Direct spending generated from these institutions contributed $3.2 billion in new personal earnings to the benefit of workers residing in the U.S. and supported 85,820 jobs across all sectors of the U. S. economy. Direct zoo spending benefits the local economy when purchases occur locally; that money multiplies as it circulates though the economy giving multipliers to different types of spending. Including multiplier effects, AZA-accredited zoos and aquariums contributed $16 billion in output and 142,436 jobs to the U.S. economy (Fuller 2011).

Most zoos are non-profit entities that rely on ticket sales, donations and other sales to support 365 days a year of animal care and conservation. Zoos often research their own economic contribution as a way to promoting their zoo to investors, but they tend to use stock methods and multipliers. A review of zoo studies found no references adjusting data or adapting of the models used to calculate contribution.

This study considers the methods and effects of customizing economic contribution multipliers to reflect actual zoo expenditures. To this end, the study compares and contrasts the economic contributions of the San Antonio Zoo and the Dallas Zoo at the local and state level using both multipliers calculated from the zoo-specific cost functions and default multipliers. This study used the input-output (I-O) model, Impact Analyses for PLANning (IMPLAN), to estimate economic contribution. Most studies run the IMPLAN model sector for museums, historical sites, zoos, and parks (Sector 493) without customizing it to the specific zoo. This study modifies the IMPLAN zoo sector by specifying zoo-specific costs and shares of products or services bought locally. This research considers the question how zoos' allocations of expenditures and revenues change the default economic multipliers and compares a modified zoo IMPLAN sector to a default zoo IMPLAN sector.

The objectives of this study are:

(1) To capture the economic contribution of each zoo's expenditures.

(2) To compare and contrast each zoo's allocation of resources to determine how the differences between these zoos play out in the economy.

(3) To observe the difference between the default IMPLAN zoo sector and the modified IMPLAN sector.

The first objective was a descriptive necessity to this study; the second and third objective lend to the respective hypotheses:

- H1: Modifying the default IMPLAN commodity expenditures relative to the reported zoo-specific expenditures, will show a measurable difference

in the results of outputs and multipliers between zoos and between the default and the modified models.

- HA1: Modifying the default IMPLAN commodity expenditures relative to the reported zoo-specific expenditures, will not affect the results in any measurable difference from the default IMPLAN output and multipliers.
- H2: Changing the regional purchasing coefficients from the default IMPLAN percentages to the reported zoo-specific percentages, will reflect a notable difference between the default IMPLAN and the zoo-specific IMPLAN models, because of a variance in contribution to the local economy through different allocation of resources and different percentages of commodities bought locally.
- HA2: The zoo-specific percentages of commodities bought locally will not differ from the default IMPLAN sector percentages and therefore show no notable variance in the local contribution from changing the regional purchasing coefficients.

This research is important because zoos can use zoo-specific results to more reasonably measure their economic contributions. This may help them more effectively secure infrastructure and to request support from government or private funders. In the long run, inaccurate economic impact estimates are detrimental to effective decision-making and the reliability of impact studies, even if (or perhaps especially if) models over-estimate economic contributions (Crompton 2006, Swenson 2006). This study also

provides future researchers with a template to modify the IMPLAN sector to make the study more specific, to individual zoo expenditure patterns.

The San Antonio and Dallas zoos provide a good comparison. Both have 1 million visitors annually and revenues around $25 million; at the state level, IMPLAN would estimate the same multiplier for both zoos. However, they have different expenditure patterns, which would be expected to results in different multipliers, not only at the local level but at the state level as well.

In summary, zoos are non-profit profit entities that rely on contributions from the government or private funders, donations, memberships, and visitors for effective allocation of revenues and expenditures. Millions of people visit zoos annually, and every dollar spent at the zoo can spread throughout the economy in paying for things such as utilities, labor, and feed. The Association of Zoos and Aquariums has shown that zoos provide multiplier effects in the economy (Fuller 2011). Several individual zoos have found it helpful to conduct their own economic contribution study to show how the zoo benefits the local economy. This study used IMPLAN and a modified zoo sector in IMPLAN to compare and contrast the economic contribution of the San Antonio Zoo and the Dallas Zoo at the local and state level and determine how their allocation of resources and expenditures play out in the economy.

To clarify, this study was based solely on expenditures and revenues within the zoos' operations; as opposed to other economic contribution studies conducted that included a tourism aspect in their final economic multiplier. A tourism aspect would include such things as surveying the zoos' patrons and seeing where else in the economy

they spend their money. The travel research program in Texas takes into account such tourism indicators as travel volume and behavior, hotels, and economic impact to screen the health of the Texas travel industry and to recognize tendencies that will sway Texas tourism programs and services (Dean Runyan Associates 2015). This study based on operations (revenues and expenditures on commodities in the economy) will complement other tourism studies.

The paper proceeds with a review of literature related to economic impacts in general and zoo impacts specifically in Chapter II. The data and methods are described in Chapter III. Chapter IV presents results and compares the customized zoo and default multipliers. Chapter V concludes with summary observations and recommendations for future research.

CHAPTER II

LITERATURE REVIEW

Fundamentals of Input-Output Analysis

Credit for input-output analysis goes to Wassily Leontief, who published his "Quantitative Input-Output Relations in the Economic System of the United States" in The Review of Economics and Statistics in August 1936 (Miernyk 1965). Leontief's central achievements were in outlining the structure of economic systems; his studies encompassed the component parts of an economy, the way they fit together and how they influence one another. Leontief created an analytical model that can be applied to any kind of economic system during any stage of its development.

> "As he himself noted, input-output analysis is above all an analytical tool. It can be used in the analysis of a variety of economic problems and as a guide for the implementation of various kinds of economic policies" (Miernyk 1965).

An out-of-print volume from the National Bureau of Economic Research titled, *Input-Output Analysis: An Appraisal* that was published in 1955 says that "Input-output economics can be regarded as a vast collection of data describing our economic system, and/or as an analytical technique for explaining and predicting the behavior of our economic system" (Christ 1955, p.137). In this article, Carl Christ from The John's Hopkins University discusses the theory, assumptions, and errors behind input-output analysis (I-O analysis). Overall Carl Christ explains how I-O analysis provides a "picture of the production function of the entire economy, and that its results can serve as first

approximations from which to start making corrections where special information permits or experience demands" (Christ 1955, p.169).

Miller and Blair (2009) discuss the foundations and extensions of input-output (I-O) analysis and point out that the number of industries may widely vary between models and studies. "For instance, an industrial sector title might read 'manufactured products,' or that same sector might be broken down into many different specific products" (Miller and Blair 2009, p.2). A larger number of sectors allow researchers to more precisely identify economic activity and adapt models to fit more specific production functions.

Miller and Blair (2009) go on to explain how I-O analysis has become more prominent after the availability of computers. Miller notes that input-output analysis is routinely applied in national economic analysis by the U.S. Department of Commerce, and in regional economic planning and analysis by states, industry, and the research community. I-O has also been extended to include framework of employment, industrial production, and other economic activity such as international and interregional flow of products and services, in addition to accounting for energy consumption and pollution associated with inner industry activity (Miller and Blair 2009, p.2).

The input-output analysis described up this point concerns the process of simply examining associations within an economy, between industries and between industries and consumers. It was designed to capture all monetary dealings for consumption in a set period of time. Modern I-O models provide impact analysis by applying a final demand change to the predictive economic input-output model and then observing the variations

in the economy. The final demand change was a table that consists of purchases of goods and services for final consumption (MIG Inc. 1999).

IMPLAN was originally developed by the U.S. Forest Service in cooperation with the Federal Emergency Management Agency and the U.S. Department of the Interior's Bureau of Land Management to assist in land and resource management planning (Mulkey 2002). An input-output (I-O) model is built around quantifying the interactions between sectors within an economy. A basic I-O model uses a matrix or transactions table that incorporates the entirety of economic activity in a region occurring over a general period of time, generally a calendar year. Seller and purchaser are represented in the transaction matrix by sectors including: agriculture, manufacturing, services, consumption, investment, government purchases, exports, imports, and value added (Davis 2001).

The transactions table is then turned into a matrix of direct requirements (the A matrix) by dividing the purchases and sales by total input or output. The A matrix specifies the value of indirect purchases in each sector resulting from a $1 change in final demand in a given sector. The A matrix was then subtracted from an identity matrix and inverted. The I-A matrix provides the multipliers for the I-O analysis. The I-A matrix can be validated by multiplying by a final demand matrix that was made from the consumption, investment, government purchases, imports, and exports. The product of this multiplication of the two matrices should equal the total output and input of the original transaction matrix.

IMPLAN is comprised of multipliers that break down economic stimuli into three components: direct effects, indirect effects, and induced effects (MIG Inc. 1999). Direct effects signify initial expenditures specified as direct final demand changes. Indirect effects are the effects of businesses purchasing from businesses. Induced effects are the influences made on all local industries caused by expenditures of new household income made by the previous two effects (MIG Inc. 1999).

Minnesota IMPLAN Group's analysis guide book (MIG Inc. 1999) points out that input-output modeling operate under many assumptions: constant return to scale, no supply constraints, fixed commodity input structure, homogenous sector output, and fixed industry technology assumption. Davis (2001) addresses some of the principal assumptions of the I-O model. Davis (2001) states that in general the most crucial assumption is that of fixed direct purchases, where the proportions purchased in each sector from all other sectors are assumed to be unchanging over the period of analysis. The rigidity among sector purchases could potentially adversely affect the accuracy of coefficients from the model because fixed patterns of inputs imply unchanged technology and no scale efficiencies. Linearity is also a major assumption that states all inputs in a specific division are assumed proportionate to the output of the division.

Davis (2001) goes on to evaluate the model stating that compared to the economic base and income-expenditure analysis, the I-O model provides significant advantages in that it explicitly recognizes sources of economic growth and decline in exports, personal consumption, capital formation, and government spending. The I-O model also disaggregates each of these exogenous factors among each sector of the

model (Davis 2001). Thus, analysts can identify how individual sectors are affected by a final demand shock. In summary, “The input-output model is most relevant to the more diversified economies of metropolitan regions” (Davis 2001, p.66).

Impacts and contributions depend on the size and structural linkages in the economy. Larger regions and economies with more industries and output (e.g., a multi-county metropolitan area versus a single county or a state versus a county) provide more opportunities for businesses and households to make purchases within the region, resulting in larger multipliers. Similarly, stronger local linkages (and thus fewer leakages) in similarly sized economies also result in larger multipliers.

IMPLAN calculates economic impacts through intricate algorithms, but to make the model more user-friendly the specification of their production function or the regional purchase coefficients was allowed in order to find the contribution or impact of an entity or industry. Gross absorption coefficients make up the production function, and percentage of shares of a commodity purchased locally make up the regional purchase coefficients (RPC). Lazarus, Platas and Mores (2002) discussed whether the production function or the RPC was the weakest link in IMPLAN. The study suggests that the production function changes are more important than the RPC (Lazarus, Platas, and Morse 2002). Another article looks into IMPLAN’s methods and modeling and discusses the importance of operational variables and expresses that greater consideration needs to be given to the adjusting of the production function variables (Liu and Warner 2009). In addition, Dudensing, Robinson, and Hanselka (2016) adapting the IMPLAN cotton sector represent regional production budgets, find that modifying the

cotton sectors' wages, proprietors income, and other property income accounts for the majority of the change in the multipliers.

Studies on impact analysis differ from those on contribution analysis. Impact analysis is a study on a change in the economy more often from a new business or new event. Contribution analysis is a study on existing businesses. Many zoo studies, especially ones done yearly, are titled economic impact studies when in fact they should be titled economic contribution because the studies are done to see how the existing zoo has impacted the economy that year. Many of these zoos have operated for decades; thus their operations are hardly new activity.

Previous Studies of Zoos

Several economic impact studies of zoos have been published in recent years. These studies generally consider the impacts of zoo operations, construction, and/or visitor expenditures. The studies have been conducted at the city, state, and national level and are often used to promote the importance of zoos to the economy and/or to justify public spending on zoos.

For example, a 2014 publication described the 2012 economic and fiscal impact of the San Diego Zoo Global (San Diego County Taxpayers Association 2014). The methodology behind this study was discussed in detail in an appendix. According to this study:

> "The IMPLAN model includes datasets that account for the specific trade flow relationships between different industries within a specified geographic area. In addition, the model includes functions for creating customized industry spending patterns. This allows for economic impact results to more closely match the actual supplier relationships and operational characteristics for a particular business operation. For this analysis, detailed operational data

> from San Diego Zoo Global was compiled to match the IMPLAN model to the spending patterns for these operations" (San Diego County Taxpayers Association 2014, p.18).

A key result of this study was that through operations and related activity through the region, the San Diego Zoo Global had an economic output of $875.8 million. The data source came from estimated visitor spending from a survey conducted for the San Diego Tourism Authority by CIC Research. The information regarding operations was provided by San Diego Zoo Global. The authors of this report considered the economic activity, estimated based on operations, contingent upon visitors from outside of the County of San Diego because the study includes sales tax revenue.

The Bureau of Business Research (2011) used IMPLAN to find the economic and fiscal contribution of Omaha's Henry Doorly Zoo at the city and state level. The total economic contribution was estimated using, on-site spending, zoo construction projects, and off site spending. They summed the direct spending contribution and the multiplier effect to find the total economic contribution.

In 2010, the total economic impact on the City of Omaha was $93.82 million in input including a $33.54 million labor income component. The impact on the state of Nebraska was slightly lower because visitors to the Zoo from cities such as Lincoln, Nebraska, may bring new spending to the City of Omaha, but not to the state because they are in-state residents. In 2010, the estimated economic impact of Omaha's Henry Doorly Zoo on the State of Nebraska was $77.47 million including $25.4 million labor income.

The Detroit Zoological Society retained the services of Conventions Sports and Leisure (CSL) to analyze the economic impacts of the zoo operations. CSL calculated the direct spending to include zoo patron spending (restaurants, fuel, lodging, retail, and other) and zoo operations and vendors (capital projects, utilities, maintenance, supplies, and salaries). All of these resulted in $60.6 million in direct spending. IMPLAN economic impact multipliers were used to estimate measure induced and indirect spending. Based on 2013 audited financial reports, $100.2 million in economic impact was generated from zoo operations, vendors, and visitors (CSL International 2014).

The Maryland Department of Business and Economic Development (2011) conducted a research study that estimated the economic and fiscal impacts of the Maryland Zoo's annual operations. The estimates are based on the zoo's operating expenditures and capital improvements budget for 2009-20101. Spending by visitors was also considered as a source of economic activity that adds to businesses in the state. Only out-of-state visitor spending was included in their impact estimates. Researchers found the Maryland Zoo directly generates $23.8 million in direct spending, $9.8 million in employee income, and about 330 full-time jobs. Secondary impacts of the zoo reported as nearly $19.4 million in sales, $4.7 in income and about 180 full-time jobs. Statewide economic impact which sums the direct and secondary impacts was estimated to be $43.1 million in gross sales. The economic and fiscal impact was estimated by the zoo's operating expenditures and capital budget. The secondary impacts of the zoo on other Maryland industries and institutions were estimated using IMPLAN which

describes the inter-industry flow of goods and services within and outside of the Maryland economy (Department of Business and Economic Development 2011)

The St. Louis Regional Chamber and Growth Association (RCGA) worked with the Metropolitan Zoological Park and Museum District to estimate the economic impact of the zoo museum district's institutions on the regional economy, including: St. Louis Art Museum, St. Louis Zoological Park, Missouri Botanical Garden, St. Louis Science Center, and the Missouri History Museum. The five institutions and the zoo museum district provided operation expenditures for 2007 which totaled $167 million in direct spending $190 million in indirect and induced spending, bringing the total output impact of operations to $357 million. Capital improvements and out-of-town visitor spending were also studied and added to the operation expenditures to produce a total regional economic impact of $549 million. All impacts were calculated using IMPLAN Professional for Windows, version 2.0 which used the geographical area: St. Louis, MO-IL Metropolitan Statistical Area (RCGA 2008).

Erkkila (2012) found that the Minnesota Zoos' annual operations and visitor spending in the area generated $142.2 million in gross output, 1,738 jobs, and $79.1 million in value-added to the local metropolitan economy (Erkkila 2012). Direct impacts of their operation's goods and services sales and purchases, indirect of their intermediate sales of buying inputs for their productive use, and induced impacts from increased household income from employee expenditures on the local economy were all taken into consideration when generating the economic impact from annual operations to their region. According to Erkkila (2012), in many industries the products sold or services

rendered are from outside from the region being appraised. Economic effects from sales to visitors of those goods do not accrue to the region's economy and must be deducted from the impact analysis Therefore in this study the information was updated because about 60-70% of spending by tourists ends up as final demand within a local area. This study's model took that into consideration and reflected those adjustments in the impacts (Erkkila 2012).

A study on the Columbus Zoo in Powell, Ohio was done in 2006 estimating the total level of economic activity (Coons Advisors 2007). The estimates used to calculate this were: financial and other records from the zoo, estimates of consumer and business behavior surveys, and regional economic impact multipliers derived by the Bureau of Economic Analysis of the U.S. Department of Commerce using input-output tables. Calculated expenses for operations which excluded salaries and wages estimated to $58.7 million in total economic activity of the central Ohio area. Separate impacts of capital improvements, employee spending, and visitor spending were also calculated. The most recent version of the Regional Industrial Multiplier System (RIMS), RIMS II, was used in this study (U.S. U.S. Bureau of Economic Analysis 2013).

RIMS II is comprised of five final-demand multipliers: output, earning, employment/direct-effect, earnings, and employment. Final-demand and direct-effect multipliers provide alternative means of measuring economic impacts depending on the availability of data (Coons Advisors 2007). Impacts calculated with RIMS final-demand multipliers will differ from those calculated with direct-effect multipliers. Direct-effect multipliers more closely reflect regional economic patterns, while final demand

multipliers are based on overarching national economic relationships adapted to regional economies' capacity constraints (Coons Advisors 2007).

Fuller (2011) calculated the economic impacts of the annual spending of all Association of Zoos and Aquariums (AZA) accredited zoos and aquariums at the state and national level (Fuller 2011). "The direct outlays by U.S. AZA-accredited zoos and aquariums of $3.482 billion contributed a total of $10.2 billion to U.S. GDP reflecting an aggregate output multiplier of 2.94" (Fuller 2011, p.1). To put this figure in perspective the AZA accredited zoos and aquariums contributed $10.2 billion in GDP out of a total $16.7 trillion in U.S. GDP. Overall, this study demonstrated the contribution of all AZA accredited zoos and aquariums to the economy at a state and national level. The collective direct and indirect values reported in this study were estimated by the application of multipliers calculated for each state and for the U.S. by the Bureau of Economic Analysis of the U.S. Department of Commerce employing its Regional Input-Output Model (RIMS II) (Fuller 2011).

Findings on each state in the study by Fuller (2011) were reported. Total economic impacts of the outlays by U.S AZA member zoos and aquariums for 2010 were reported in terms of total output, personal earnings and jobs supported. Texas was reported to have $884.19 million in total output, $312.04 million in personal earnings, and 8,998 supported jobs (Fuller 2011).

To summarize, of the eight studies covered in this review, six used the input-output model IMPLAN; the other two used RIMS II. Economic contributions using IMPLAN range from $23.8 million from Maryland to $875.8 million from San Diego.

Economic contributions using RIMS II range from $58.7 million from the Columbus Zoo to $3.482 billion nationwide from a U.S. study of all AZA accredited zoos and aquariums.

The studies date from 2006 to 2014; it was only in 2011 that a national study was done to show the benefit of zoos and aquariums on the economy. Most studies base their findings off some combination of spending on operations, vendors, and/ or patrons. Uniquely, the 2008 study on the RCGA used the IMPLAN zoo sector to the full extent by estimating the whole museum district in St. Louis. In addition the only zoo study that took into consideration the amount of spending by tourists in a local area was the study in 2012 using IMPLAN on the Minnesota Zoo. Reliance on operations data rather than visitor expenditures was appropriate considering most zoo visitors do not solely or primarily visit a location to see the zoo but rather enjoy an array of activities. Thus attributing all visitor spending to the zoo would over-estimate the true economic contribution (Crompton 2010; Jeong, Crompton, and Dudensing 2015).

All studies found that zoos were advantageous to either the local or state economy or both. However, none of the studies using IMPLAN modified the default zoo, museum, and historical site sector to more closely represent the purchasing pattern of the relevant zoo. This was unnecessary in the RCGA museum district study because they looked at the whole sector not just a zoo, but whether the default sectors accurately reflected the zoos in the other studies was a question not asked in the literature.

CHAPTER III

METHODS

This study compares and contrasts the economic contributions of the San Antonio Zoo and the Dallas Zoo to the local and state economies using both multipliers calculated from zoo-specific cost functions and default multipliers. Economic contribution analysis is similar to impact analysis but considers existing endeavors rather than new activity. Both are based on final demand spending. The IMPLAN input-output model was modified with data specific to each zoo. Differences in the expenditure patterns and outcomes of the default zoo IMPLAN sector and the modified zoo IMPLAN sector were observed.

The default zoo IMPLAN sector 493 of 2014 data includes museums, historical sites, zoos, and parks. The modified zoo IMPLAN sector included specific revenue and expenditure details for each zoo, including each zoos' local purchases of inputs. The individualized information was gathered through the correspondence with the Chief Financial Officers of the San Antonio and Dallas zoos using the questionnaires in Appendix A. The revenue and expenses questionnaires were formulated by observing each commodity within the IMPLAN zoo sector and deciding which sectors, if modified, would likely differentiate zoos from museums, historical sites, and parks. The questionnaires also allowed the zoos to note additional expenditures they considered unique and inquired about what percentage of each commodity was purchased locally. Clarifications were made during follow-up phone calls and emails.

The revenues section of the questionnaire, provided in Appendix A, was listed first and was an essential piece of information to estimate the zoos' economic contribution and compare modified and default IMPLAN sectors. Total number of visitors was included because I-O models respond to direct economic activity so comparing visitation was useful in identifying common patterns among zoo revenue and spending relationships. Memberships were included with ticket sales because those with a membership would most likely visit the zoo multiple times and wouldn't pay for a ticket each time. Revenue from other amenities such as a restaurant and gift shop were also considered to fully account for the direct effects of zoo revenue.

In the expenditure section of the questionnaire, percent purchased locally defined as the share of each expenditure category produced from within the zoo's home county and all adjacent counties. Labor costs were listed because zoos' employee compensation from contracted professional consultants or temporary agencies may differ from those of museums, historical sites, and parks. The commodities hay for feed, processed feed, produce for animals, and meats for animals were listed because these agriculture products would logically be in high demand at a zoo, and the share purchased locally was also important because if more feed purchased from the local economy the local multiplier effect was larger. Veterinary services (excluding zoo staff salary) and veterinary supplies listed in the zoo IMPLAN sector would be specific for a zoo. Landscaping, waste management, utilities, water, maintenance, and construction are expenditures that are constantly ongoing and will differ between each zoo and between zoos and museums. Similarly, the remainders of the expenditures on the questionnaire

were believed to elicit more reasonable results if such expenditures were specific for each zoo.

The questionnaire was returned with information from 2014 revenue and expenditure reports for each zoo (Appendix B). The zoo-specific expenditures then had to be calculated into a coefficient for IMPLAN. Thus, all individual expenditures were divided by the total of all expenditures to show each as pennies on the dollar. When zoos reported expenditures at a higher level of aggregation than required by IMPLAN the aggregated expense was allocated with in IMPLAN according to the ratio of sectors comprising the expense. For example, zoos reported an expense for utilities but IMPLAN notes nine electric power sectors, so the utilities expense was allocated proportionally amount relative sectors by weighted average.

After calculating pennies on the dollar for each zoo's expenditures shown in Appendix B, several steps were taken in IMPLAN. First, the IMPLAN model was built for the metropolitan area and then the state area. Next, for the specific area, under the customize tab and study area tab for sector 493; the value added properties such as proprietor income, employee compensation, and other property income were customized to reflect the shares reported. This study left tax shares the same because taxes weren't reported by the zoos, although some indirect business taxes are paid. After these properties were changed the model was re-run to establish the rate of value added to intermediate expenditures. Then, again under the customize tab for sector 493, the absorption coefficients (input purchase coefficient) were changed to match the zoo-specific data. Most were left un-fixed and allowed to rebalance freely and the model was

run again. This re-running of the model set the production relationship. These absorption coefficients were copied to an Excel activity template provided by IMPLAN. Then a new model with default settings was created, and, under “analysis and set-up activities”, the model in the template was imported from Excel. Finally, to complete the analysis by parts modeling approach, a “new activity” with zoo-specific labor income was run in IMPLAN to model wages. Detailed explanations of these steps are provided in the next section.

Step-by-Step IMPLAN Model Modification

From the IMPLAN home screen (Figure 1) new model was selected in the left hand control panel (Figure 2).

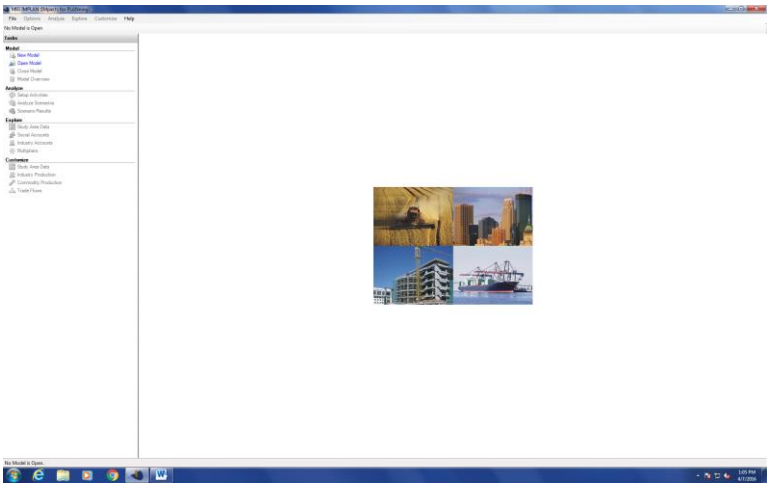


Figure 1. **Home screen**

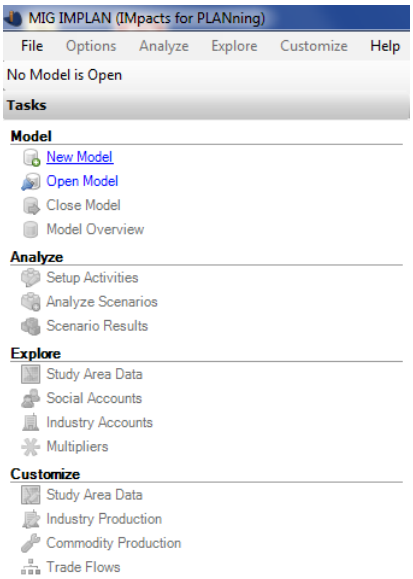


Figure 2. IMPLAN control panel

The model was named and saved (Figure 3).

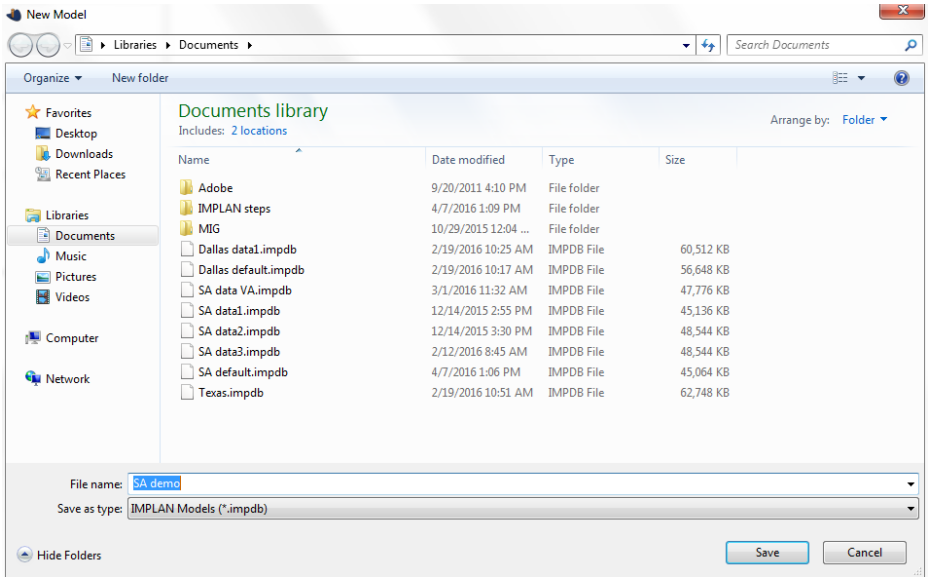


Figure 3. Save model screen

For each zoo, the counties in the metropolitan statistical area were selected by holding the control key and clicking each county (Figure 4). Counties were added to the model by clicking the Select Data File button. With the Build through Multipliers box checked, pressing the Continue button resulted in IMPLAN constructing the model.

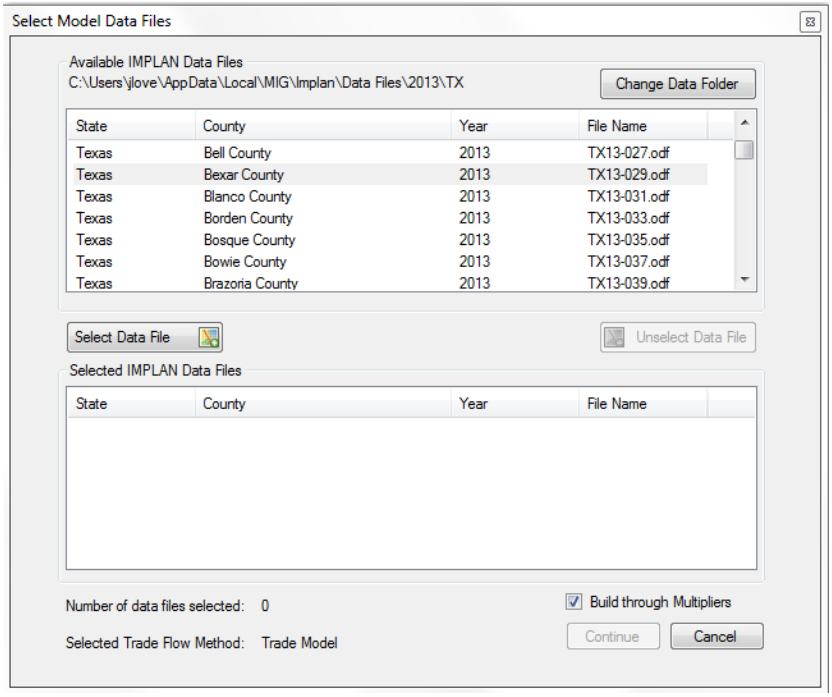


Figure 4. Geography selection

When the model was built, a message appeared at the bottom of the home screen indicating the model was complete (Figure 5). Analyze, Explore and Customize options became active (blue) in the control panel (Figure 6). Clicking Setup Activities under the Analyze section brought up the activities and scenarios screen (Figure 7).

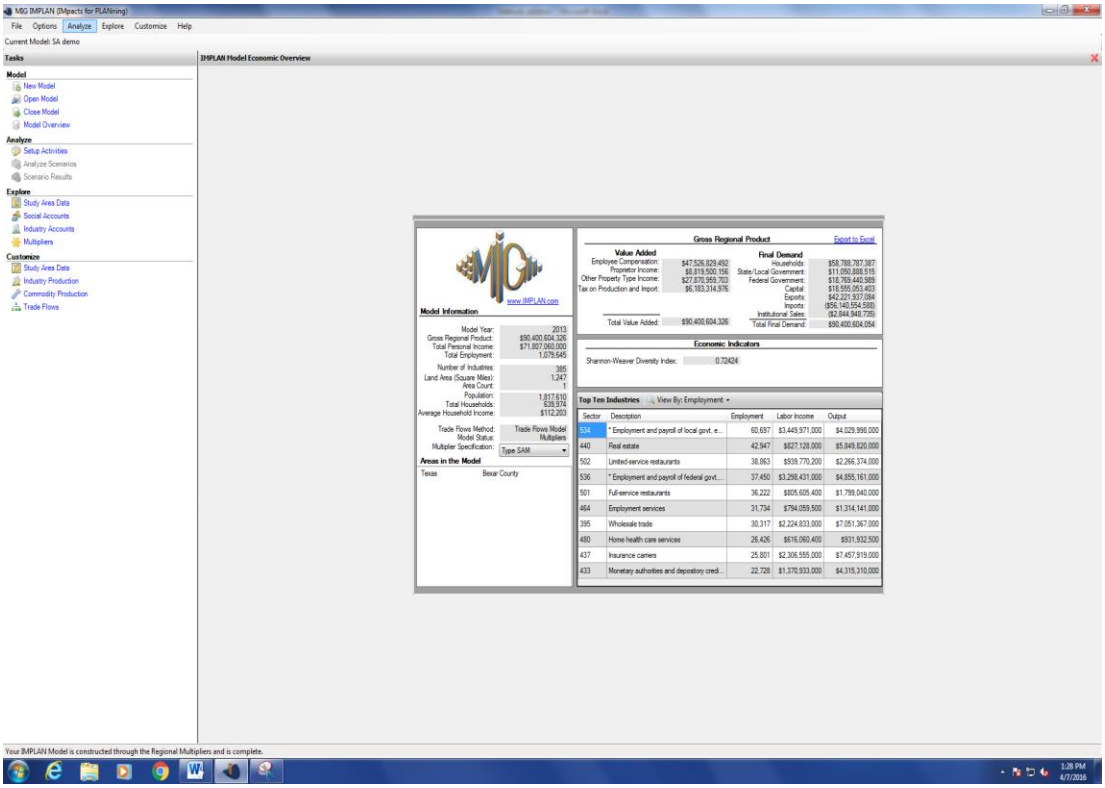


Figure 5. Model ready home screen with IMPLAN control panel at left

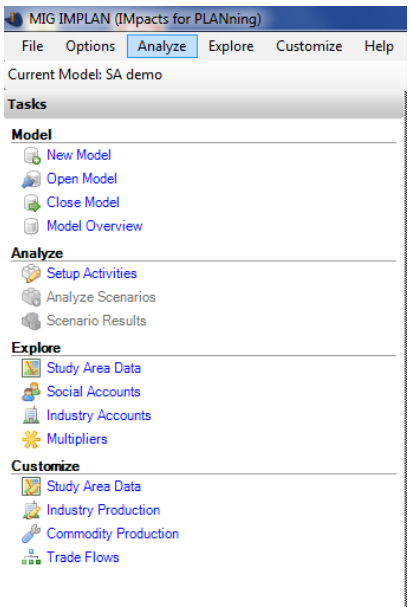


Figure 6. IMPLAN control panel with analyze and customize options

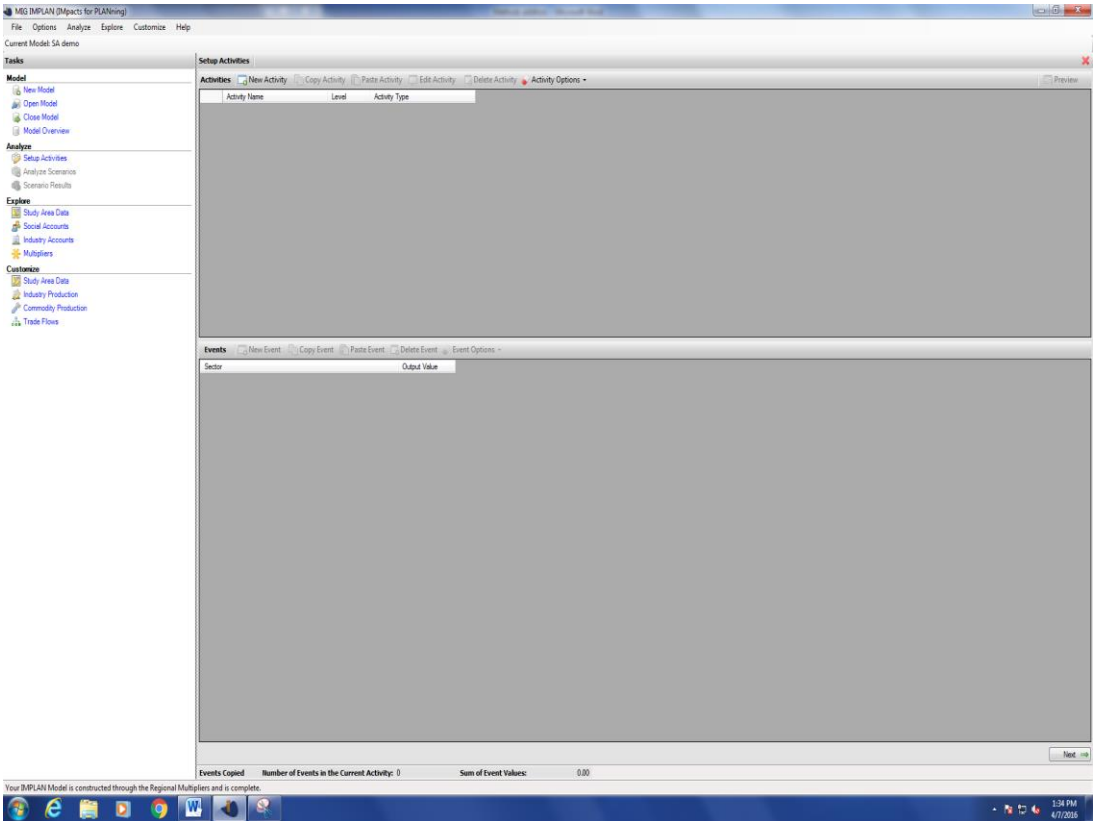


Figure 7. Activities and scenarios screen

Clicking the new activity button (Figure 7) at the top right of the Activities area brought up the add new activity screen (Figure 8) where industry change was selected as the type of new activity and the model was named. Each model was named intuitively in reference to what the model was calculating as to make it easier to find the appropriate file at a later date. For example, the activity level was left at 1.000, because the total zoo revenue would be entered at the next step.

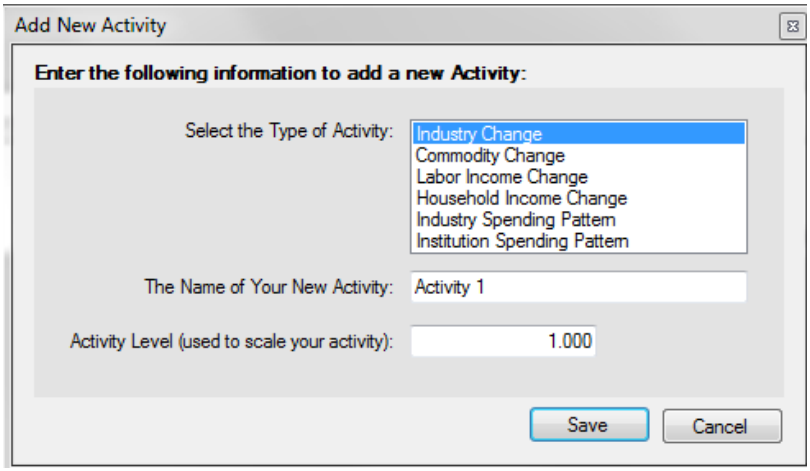


Figure 8. Add new activity screen

After clicking Save on the new activity screen, the events section of the setup activities screen became active (Figure 9). For the default model, sector 493 was selected from the sector drop down box and zoo revenue was entered into the industry sales box. The other cells auto filled and were left at their default auto fill levels. IMPLAN year could be changed to the match the study year if necessary.

Once the activity and event information were entered, clicking the next button or clicking analyze scenarios in the analyze section of the control panel brought up the analysis screen (Figure 10).

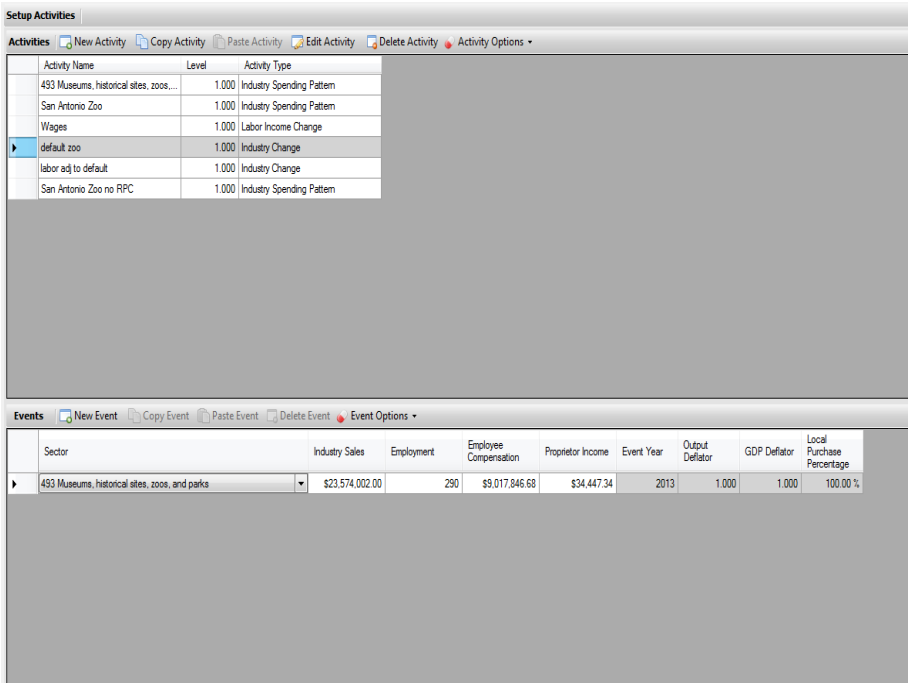


Figure 9. Default scenario screen

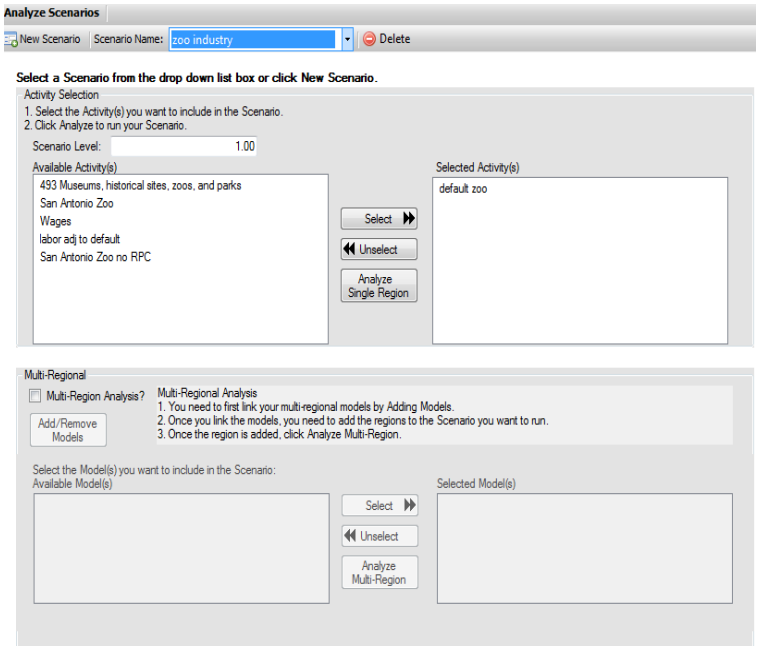


Figure 10. Analyze scenarios screen

Clicking the new scenario button on the analyze scenario screen (Figure 10) pulled up a new scenario dialog box (Figure 11). Each scenario was named intuitively as to how the model was modified so that when viewing the model on the results screen it is easier to identify. The activity level was left at 1.000 in the default model.

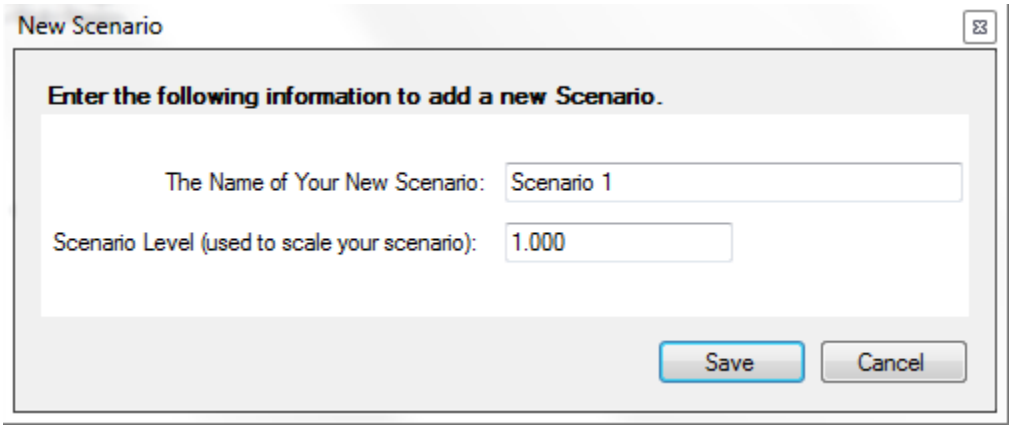


Figure 11. New scenario screen

The appropriate activity was selected from the list of available activities by highlighting the activity name and clicking the select button. For the default, “default zoo” was selected, and analyzed single region was clicked. After IMPLAN calculated outcomes, a dialogue box popped up asking if the used wanted to view results. Results are discussed in the next chapter. However for the sake of completeness a results screen is shown in Figure 12.

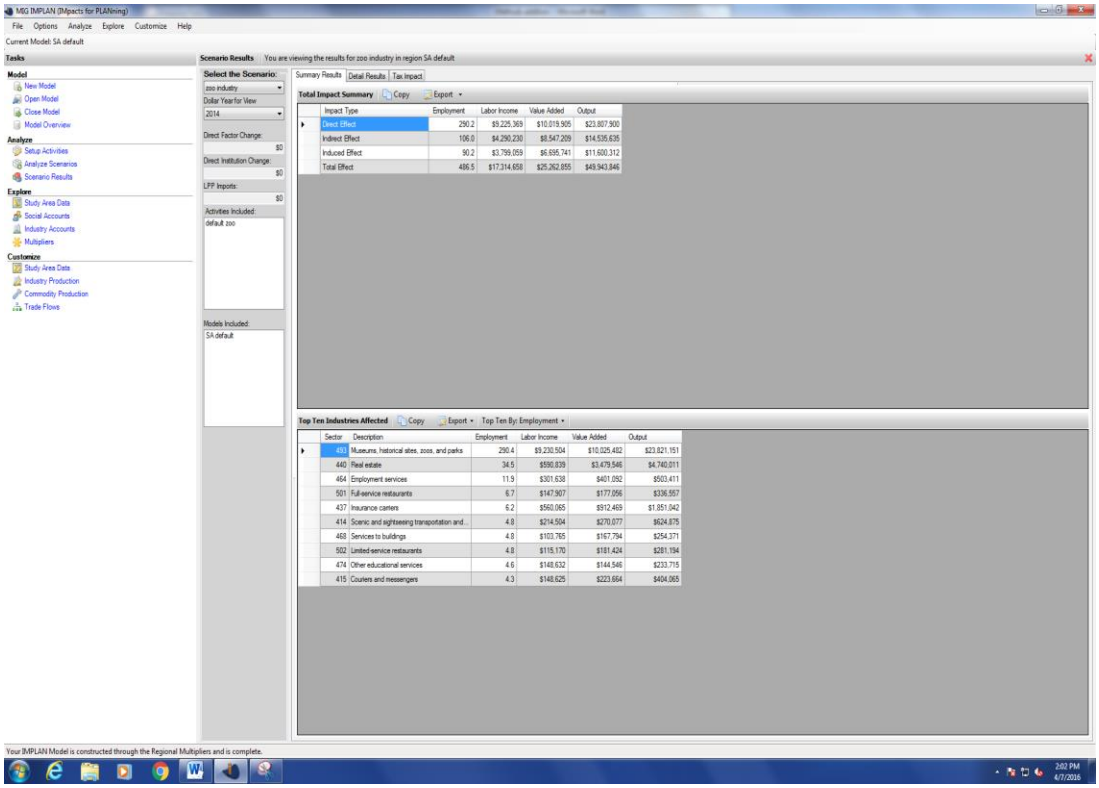


Figure 12. Results screen

The next step in customizing the IMPLAN model to more closely match the San Antonio zoo was to change the underestimated direct labor income from the zoo. However even though the labor costs were customized in the one-step process the actual direct employment numbers were not adjusted. The labor adjusted default model was set up as described in Figures 7-11 except that labor income was changed from the auto fill default to match the zoo's actual labor expenditures as shown in Figure 13. The red warning signals appear when a user changes one of the auto fill values.

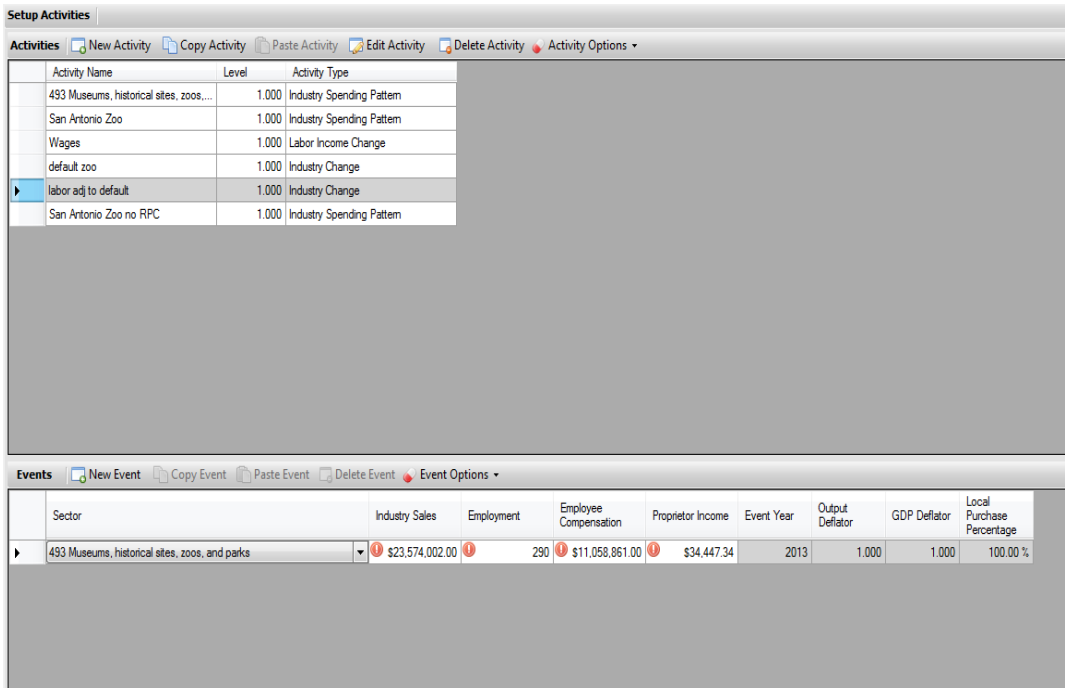


Figure 13. Labor adjustment setup activities screen

Because the fully customized models were run using the analysis by parts method, the default with labor adjustment was run using analysis by parts to compare the models while using consistent methods. From the setup activities screen in Figure 7, the sector 493 industry spending pattern was imported. From the setup activities screen and the activity options drop down, import and then industry spending pattern was selected (Figure 14). Sector 493 was selected from the import an industry spending pattern screen and Import was clicked (Figure 15).

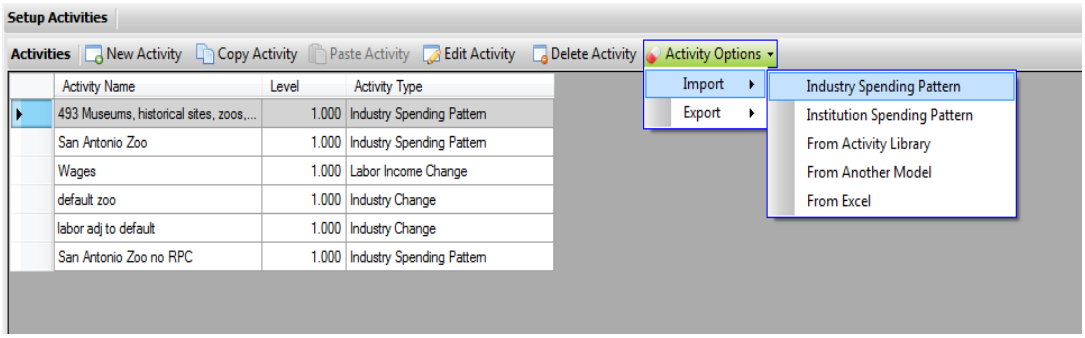


Figure 14. Importing for analysis by parts

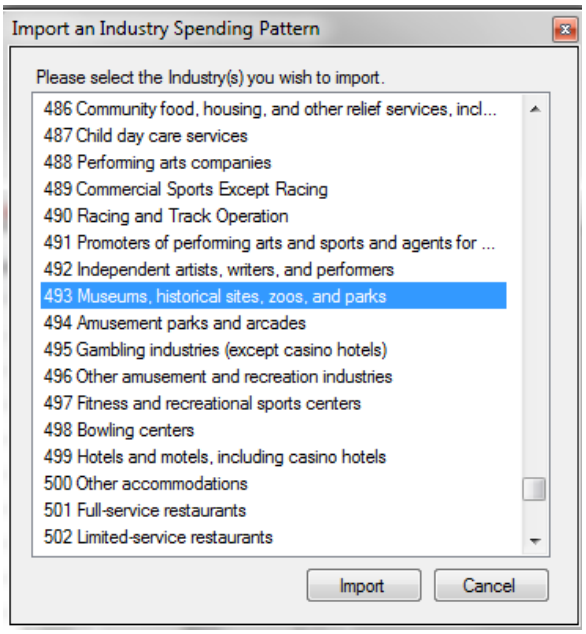


Figure 15. Import industry spending pattern selection

The sector 493 spending pattern (Figure 16) totals 58 cents per dollar of direct output. This value included only purchased inputs; labor income proprietor income, other property income and indirect business taxes, must be modeled as separate activities as separate activities when running analysis by parts. Labor income was added to the

model by creating a new activity on the screen in Figure 7; in this case labor income change was selected from the screen in Figure 8.

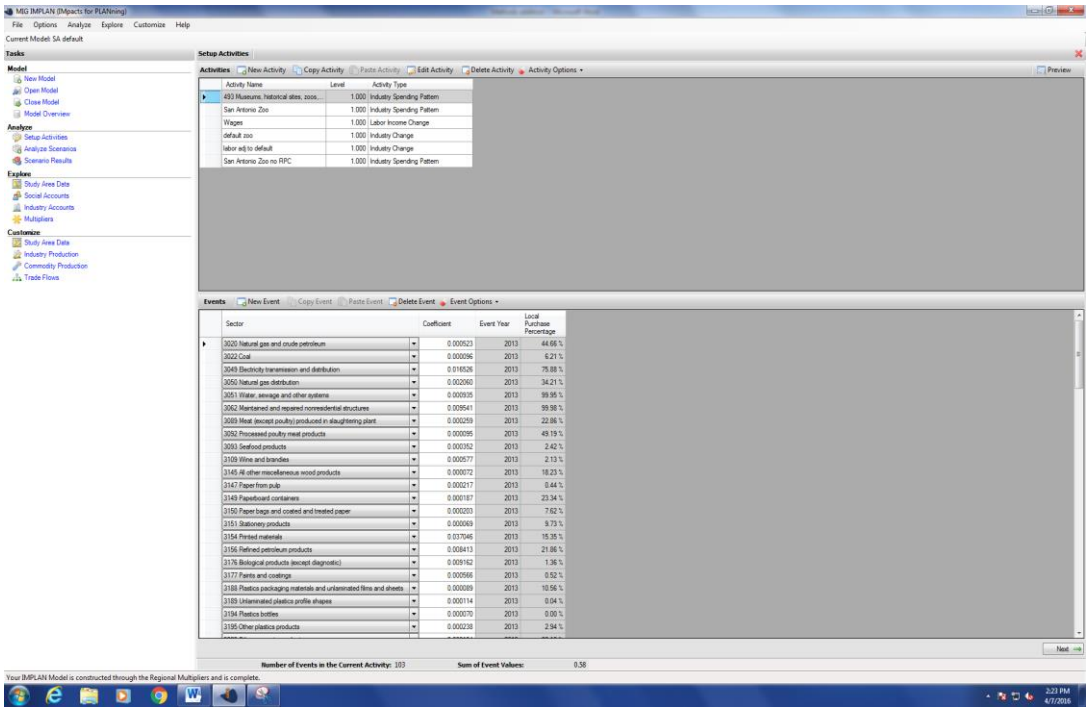


Figure 16. Sector 493 spending pattern

Clicking New Event in the events section of the setup activities screen, employee compensation was selected from the drop down box, and the zoo's labor costs were entered as the Labor Income Value (Figure 17). Clicking the next button or clicking analyze scenarios in the analyze section of the control panel brought up the analysis screen. The industry spending patterns and wage model were run separately as described in Figures 10 and 11. The two components of analysis by parts were run

separately to gain a clear understanding of both the industry spending pattern and wages independently. In the results, the outcomes of these two models are summed. Analyses that are only interested in the aggregate result could include both the industry spending pattern and wage activities in the same scenario, which would achieve the same results.

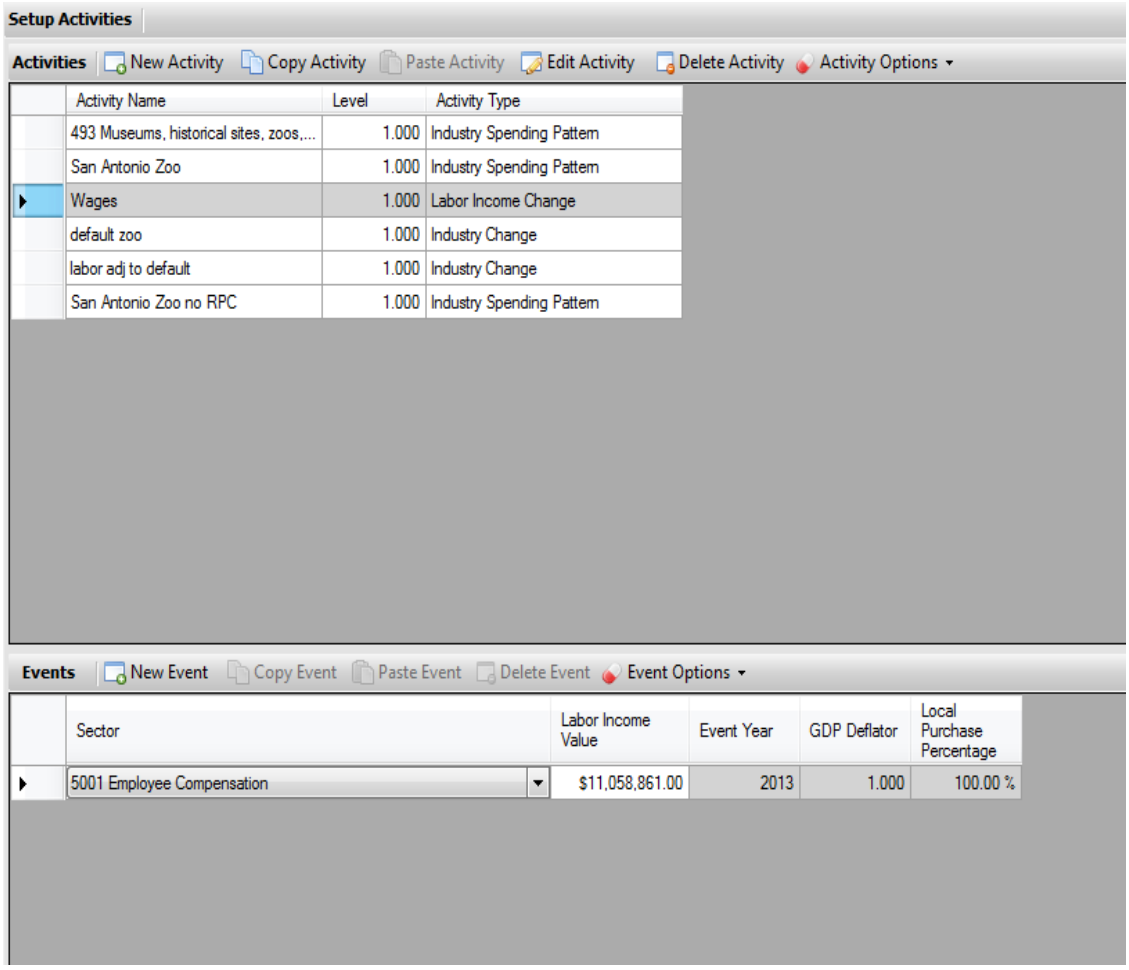


Figure 17. Labor income change

To begin to fully customize the model, from the IMPLAN home screen (as shown in Figure 1) New Model was selected in the left hand control panel (Figure 2). The model was named and saved (Figure 3). For each zoo, the counties in the metropolitan statistical area were selected by holding the control key and clicking each county (Figure 4). Counties were added to the model by clicking the Select Data File button. With the Build through Multipliers box checked, pressing the Continue button resulted in IMPLAN building the model. When the model was built (Figure 5), analyze explore and customize options became active (blue) in the control panel (Figure 6). Clicking Setup Activities under the Analyze section brought up the activities and scenarios screen (Figure 7).

Clicking the customize study area data link under the customized section on the control panel (Figure 7) brought up the Edit Industry Data screen (Figure 18) where sector 493 was selected. Proprietors' income and other property income were reallocated as labor income for the public zoos and labor income was further adjusted to match the ratio of labor income to output for each zoo. Proprietors income was zeroed out because of the non-profit nature, all workers are employees. When editing this section, it changes the section to all look like a zoo to enable the zoo production function to then be imported in the default model where other aspects of the sector are also represented. For example, default San Antonio estimated the output value of production at $92 million and SA reported this number as $43.2 million. After the changes were made and saved, the model had to be rerun in order for changes to take effect.

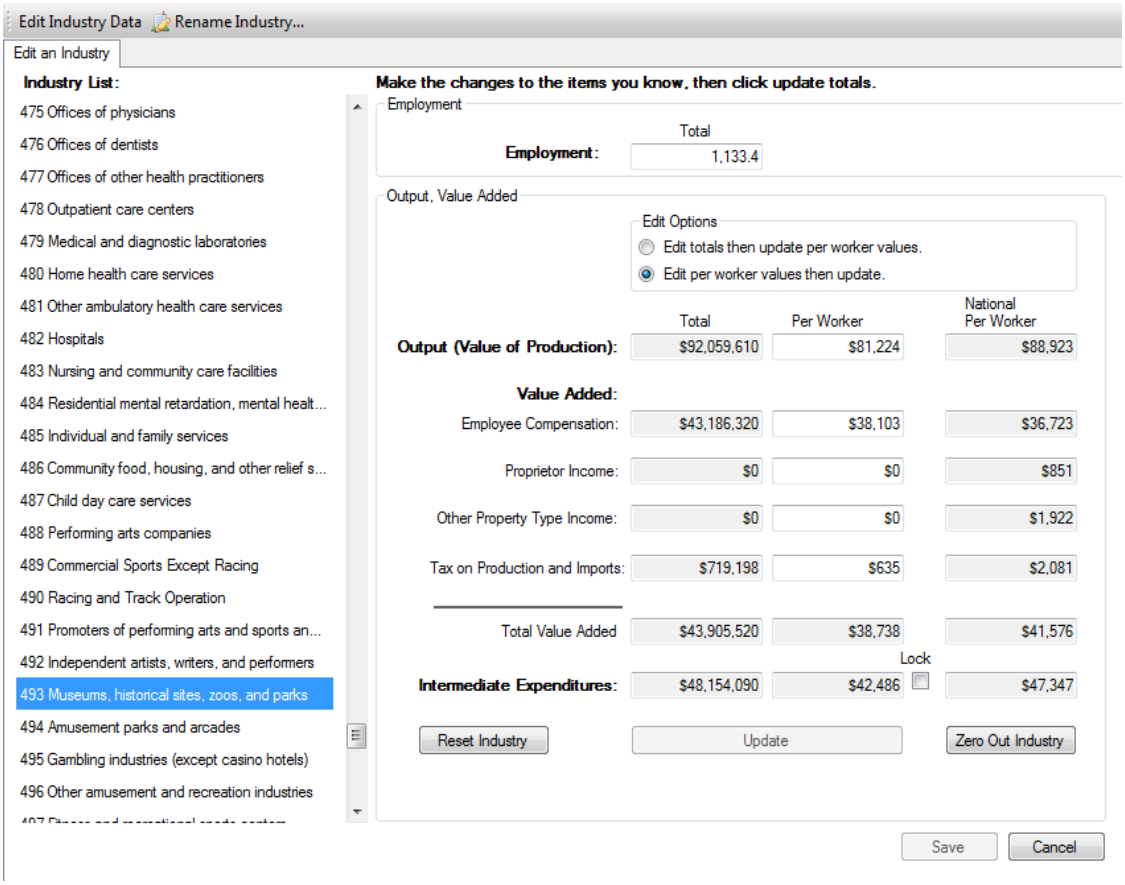


Figure 18. Edit industry data screen

Changing the relationship of employee compensation and other value added components to output also changes the proportion of output available for input purchases. To allocate input purchases by the zoo among sectors, the industry production link was clicked under the customized section in the control panel. This pulled up each absorption coefficient in the Edit Industry production screen (Figure 19).

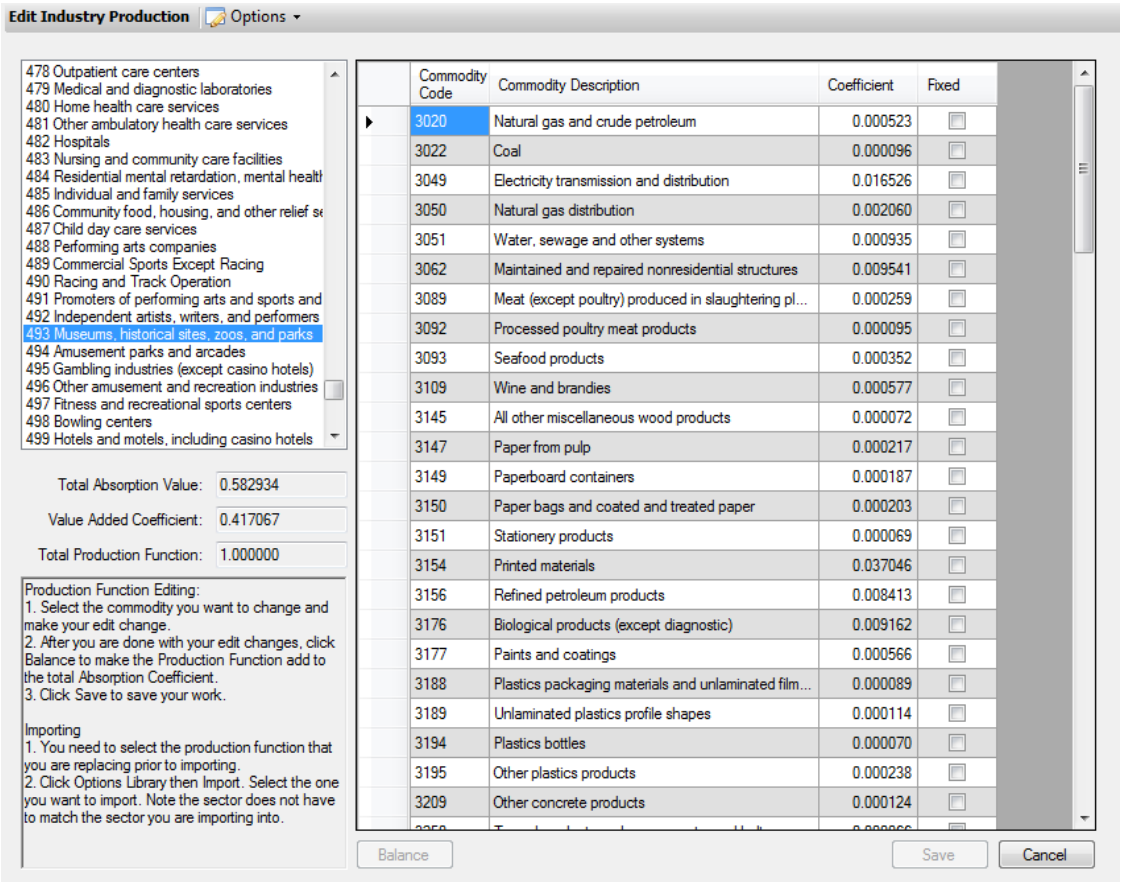


Figure 19. Edit industry production screen

After selecting sector 493, clicking the box at the top left of the absorption window allowed the coefficient data to be copied into Excel (Figure 20).

L	M	N	O	P	Q	R
	Column1	Column2	Column3	Column4	Column5	Column6
			Default	SA Data	WAVG	
	3020	Natural gas and crude petroleum	0.000523	0.01945958	0.02723249	0.00052993
	3022	Coal	0.000096		0.0049987	9.7273E-05
	3049	Electricity transmission and distributi	0.016526		0.86050508	0.01674507
	3050	Natural gas distribution	0.00206		0.10726373	0.00208731
	3051	Water, sewage and other systems	0.000935	0.0180639		0.0180639
	3062	Maintained and repaired nonresiden	0.009541	0.02182718		0.01419101
	3089	Meat (except poultry) produced in sla	0.000259	0.02161363	0.36685552	0.00792908
	3092	Processed poultry meat products	0.000095		0.13456091	0.00290835
	3093	Seafood products	0.000352		0.49858357	0.0107762
	3109	Wine and brandies	0.000577			0.000577
	3145	All other miscellaneous wood produc	0.000072			0.000072
	3147	Paper from pulp	0.000217			0.000217
	3149	Paperboard containers	0.000187			0.000187
	3150	Paper bags and coated and treated pa	0.000203			0.000203
	3151	Stationery products	0.000069			0.000069
	3154	Printed materials	0.037046	0.03008045		0.01342053
	3156	Refined petroleum products	0.008413			0.0017394
	3176	Biological products (except diagnostic	0.009162			0.009162
	3177	Paints and coatings	0.000566			0.000566
	3188	Plastics packaging materials and unla	0.000089		0.1741683	0.00061403
	3189	Unlaminated plastics profile shapes	0.000114		0.22309198	0.00078651
	3194	Plastics bottles	0.00007		0.1369863	0.00048294
	3195	Other plastics products	0.000238	0.00352549	0.46575342	0.00164201
	3209	Other concrete products	0.000124			0.000124
	3250	Turned products and screws, nuts, and	0.000066			0.000066
	3261	Other fabricated metals	0.000167			0.000167

Figure 20. Excel calculations of Absorption Coefficients

IMPLAN said 103 sectors were supplying sector 493, approximately 36 sectors were modified based on the expenditure patterns based on the zoo questionnaire. Again, IMPLAN assigns expenditures across sectors were the zoo would not be aware that when purchasing electricity they also are purchasing natural gas and coal according to IMPLAN. Thus, weighted averages were used to assign expenditure across related categories. Weighted average is similar to an average except certain data points contribute more than others. The weighted average for example is, sector 3022 or coal's default coefficient divided by the sum of sectors: 3020, 3022, 3049, and 3050. The new

coefficient was then calculated by multiplying the San Antonio data and weighted average.

The new coefficients were copied and pasted individually and unfixed except for sector 3469 (Figure 21). The zoo reported no landscaping and horticultural services and so fixing the coefficient prevents IMPLAN from changing it when rebalancing. Note after rebalancing, the box will no longer be checked. After all coefficients were entered, sector expenditures were saved and rebalanced. After the rebalance, the model had to be rerun in order for changes to take effect.

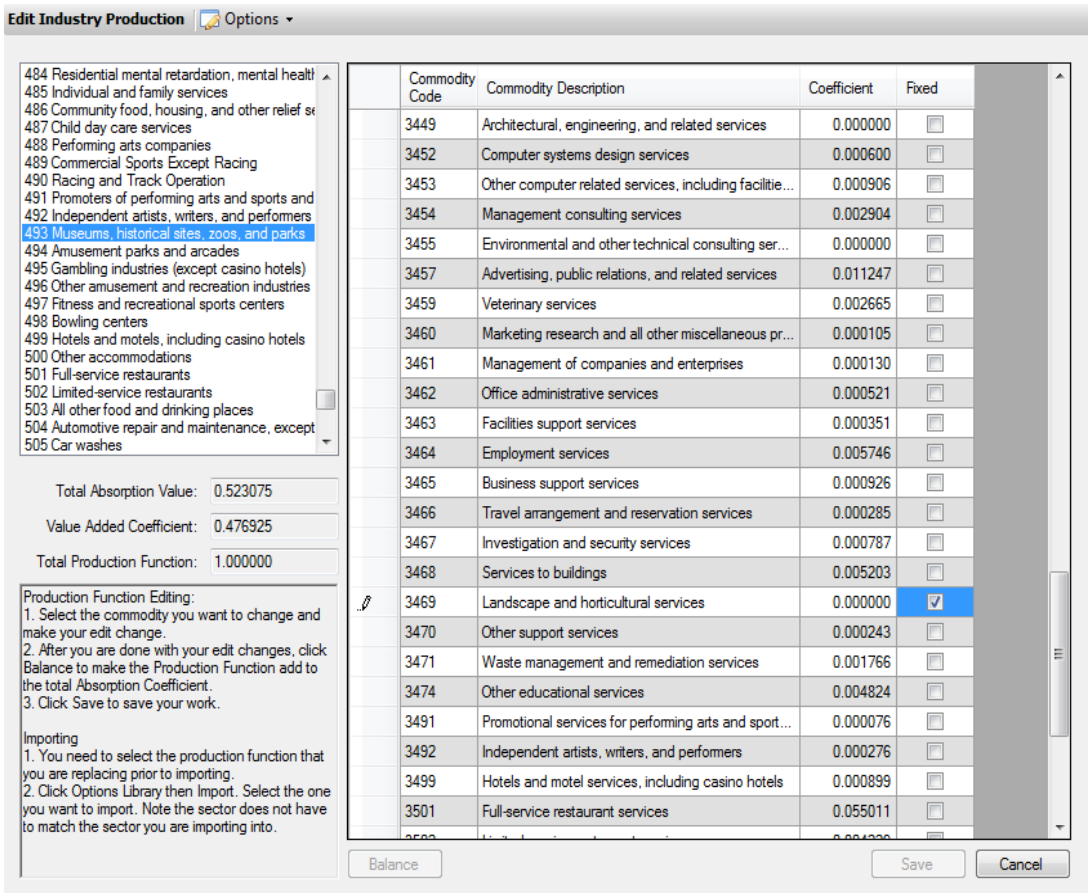
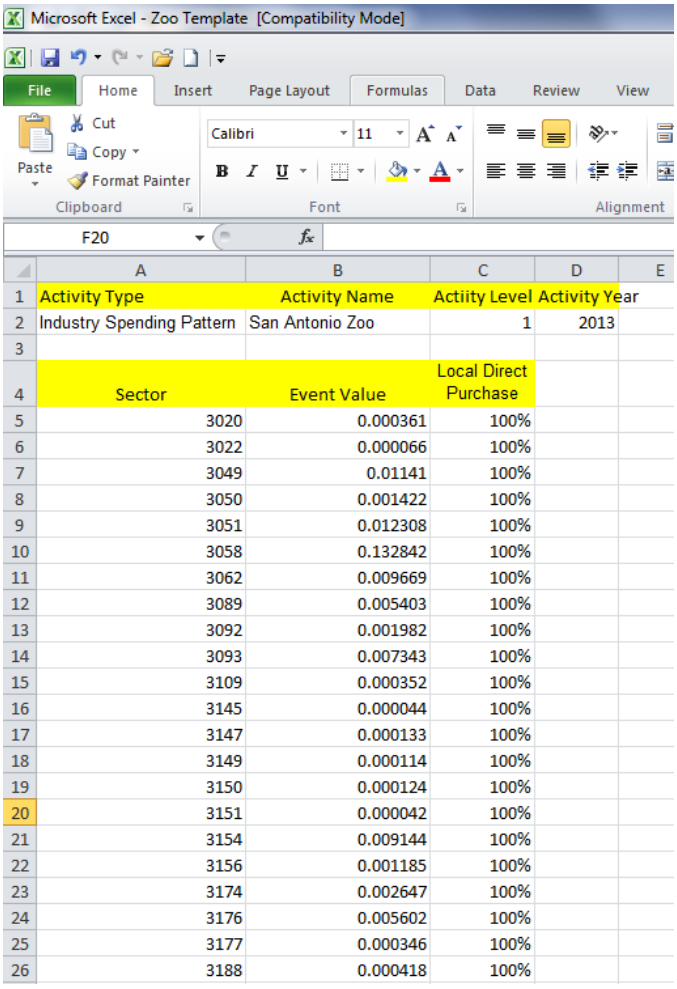


Figure 21. Customized and rebalanced coefficients

Following the methods described after Figure 19, the modified absorption coefficients were copied into the activity template available from the templates folder of the IMPLAN program files which are downloaded with the IMPLAN software (Figure 22). In the activity template, the Industry Spending Pattern tab was used.



	A	B	C	D	E
1	Activity Type	Activity Name	Actiity Level	Activity Year	
2	Industry Spending Pattern	San Antonio Zoo	1	2013	
3					
4	Sector	Event Value	Local Direct Purchase		
5	3020	0.000361	100%		
6	3022	0.000066	100%		
7	3049	0.01141	100%		
8	3050	0.001422	100%		
9	3051	0.012308	100%		
10	3058	0.132842	100%		
11	3062	0.009669	100%		
12	3089	0.005403	100%		
13	3092	0.001982	100%		
14	3093	0.007343	100%		
15	3109	0.000352	100%		
16	3145	0.000044	100%		
17	3147	0.000133	100%		
18	3149	0.000114	100%		
19	3150	0.000124	100%		
20	3151	0.000042	100%		
21	3154	0.009144	100%		
22	3156	0.001185	100%		
23	3174	0.002647	100%		
24	3176	0.005602	100%		
25	3177	0.000346	100%		
26	3188	0.000418	100%		

Figure 22. Activity template

When importing the modified coefficients into the activity template the local direct purchase column defaulted to 100%. This was easiest to change from within the IMPLAN model in a later step. The Activity name in cell B2 was changed to the name of the zoo and the Activity year was changed to 2013 reflect the IMPLAN data used (Figure 22). While zoos provided 2014 revenues and expenses, the IMPLAN model was using 2013 data. Entering all zoo revenues and expenses for the year 2013 prevented IMPLAN from estimating inflation, which was not important for this study and in fact would have introduced a new source of potential error. A default model was opened and the activity template was imported from Excel as shown in Figure 23.

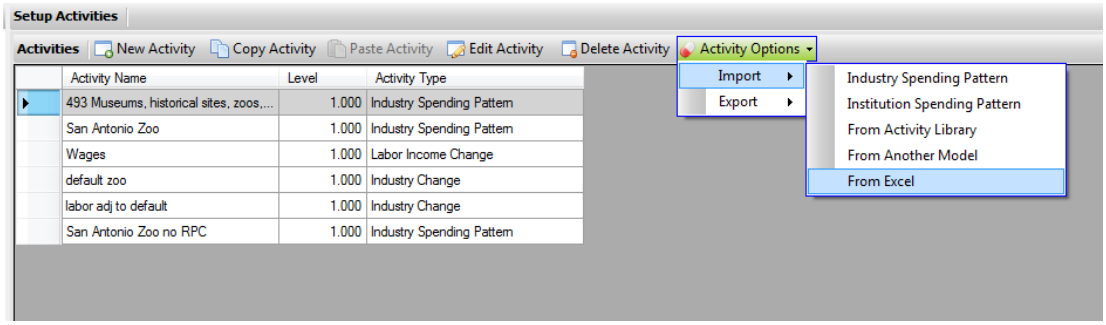


Figure 23. Activity import

The default 100% local purchase shares were reset to the default SAM model values as shown in Figure 24. Thus most of the local purchase shares were identical to those in Figure 16. If local purchase shares were zoo-specified they were changed by manually typing in the zoo-specific percentage for that sector.

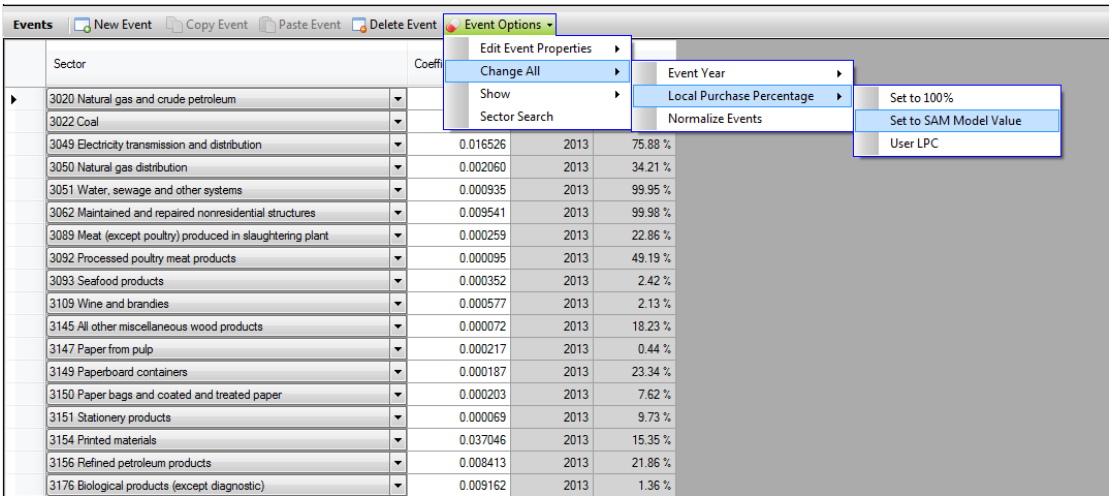


Figure 24. Local purchase share change

Following Figures 14-17 analysis by parts was run using the industry production specified in the activity template run at the level of the zoos output and the zoo's labor income which was specified exactly as in Figure 17.

Results were copied from IMPLAN to Excel where analysis by part results was combined and changes between models were calculated (Figure 25). Percent difference was calculated from default as the difference of the default model total less new model total effect divided by default total effect; this measure was used to show the difference that customization had on the final results.

	A	B	C	D	E	F
39						
40	**Zoo**	**Impact Type**	**Employment**	**Labor Income**	**Value Added**	**Output**
41		**Direct Effect**	**400**	$11,058,861	$11,243,028.36	$23,574,002
42		Indirect Effect	88.4	$3,363,455	$6,236,185	$11,316,776
43		Induced Effect	22.8	$940,870	$1,657,920	$2,868,075
44		**Total Effect**	511.2	$15,363,186	$19,137,133	$37,758,853
45	**Wages**	**Impact Type**	**Employment**	**Labor Income**	**Value Added**	**Output**
46		Direct Effect	0	$0	$0	$0
47		Indirect Effect	0	$0	$0	$0
48		Induced Effect	75.4	$3,114,488	$5,489,647	$9,495,583
49		**Total Effect**	75.4	$3,114,488	$5,489,647	$9,495,583
50		***Total (wages +Expenditures)***	***586.6***	***$18,477,674***	***$24,626,780***	=F41+F42+F43+
51		***Percent Difference from Default***	20.58%	8.76%	-0.65%	-3.83%
52			**Employment Multiplier**	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
53			24.88334395	0.783815748	1.044658449	2.004514804
54		Percent Difference from Default	20.58%	8.76%	-0.65%	-3.83%
55						

Figure 25. Addition of analysis by parts results

Significant Commodity Modification

Each zoo's expenditure data were entered into the IMPLAN software and interpreted. IMPLAN's default model makes the assumption in calculating the economic contribution that the revenues and expenditures for a zoo would be the same as a museum or other historical sites. IMPLAN allows for modification of sector expenditure patterns to more reasonably represent expenditures in a specific industry and location. Differences in expenditure patterns result in different economic outcomes because sectors have different linkages within the economy. The share of an input commodity purchased locally can also be adjusted. Larger shares of local purchases result in fewer leakages and larger economic contributions. It would be impractical to ask a zoo to note expenditures across all 536 IMPLAN sectors due to the level of burden and the fact that IMPLAN assigns a portion of retail purchases to producing sectors. For example, part of

a copy paper purchase at an office supply store sector was apportioned to paper manufactory sector, but the zoo purchasing the paper was not cognizant of this split.

Major changes to the default San Antonio IMPLAN model are included in Table 1. The sectors are listed in numerical order except that the three commodity sectors that had to be added to the modified model are separated out in the base of the table. Each coefficient represents the amount per dollar spent in each commodity, and the percent local represents the percent of each commodity that was purchased in the local metropolitan area defined as Atascosa, Bandera, Bexar, Comal, Guadalupe, Kendall, Medina, and Wilson County. Purchases from the utilities sector 3051 and maintenance sector 3062 both increased significantly. While the increase was greater for the utilities, the share bought locally only increased slightly; however the slightly increased coefficient for maintenance had a significant decrease from 99.98% purchased locally to 65% purchased locally. Of course, coefficients other sectors in the IMPLAN model changed as well due to rebalancing, but the sectors listed in Table 1 represent the sectors adjusted to represent expenditure information provided by the San Antonio Zoo.

Table 1. San Antonio Compared to Default

Sector	Commodity	SA Default Coefficient	SA Default % local	SA Coefficient	SA % local
3051	Water, sewage and other systems	0.000935	99.95%	0.018064	100%
3062	Maintained and repaired nonresidential structures	0.009541	99.98%	0.014191	65%
3089	Meat (except poultry) produced in slaughtering plant	0.000259	22.86%	0.007929	85%
3092	Processed poultry meat products	0.000095	49.19%	0.002908	85%
3093	Seafood products	0.000352	2.42%	0.010776	85%
3188	Plastics packaging materials and unlaminated films and sheets	0.000089	10.56%	0.000614	50%
3189	Unlaminated plastics profile shapes	0.000114	0.04%	0.000787	50%
3194	Plastics bottles	0.000070	0.00%	0.000483	50%
3195	Other plastics products	0.000238	2.94%	0.001642	50%
3433	Monetary authorities and depository credit intermediation	0.002736	99.95%	0.020828	99.95 %
3469	Landscape and horticultural services	0.002282	77.83%	-	-
3499	Hotels and motel services, including casino hotels	0.000083	1.54%	0.001319	0%
3501	Full-service restaurant services	0.003087	99.96%	0.080736	45%
3502	Limited-service restaurant services	0.000241	99.95%	0.006206	45%
3459	Vet services	-	-	0.003912	50%
3174	Pharmaceuticals	-	-	0.003885	25%
3058	Newly Constructed Nonresidential Structures	-	-	0.194962	50%

Meat sectors including 3089, 3092, and 3093, each increased by 0.00767, 0.00281, and 0.0104 respectively. While the coefficients represent pennies on a per dollar basis, they are important over millions of dollars in zoo spending. For the same meat sectors, shares purchased locally increased from 36% to 83%. The four plastics commodity sectors were thought to be important because of the common use of plastics for animal enrichment including entertainment and exercise in their enclosures. Each plastic commodity reported by San Antonio showed that more was spent per dollar and 40%-50% more was purchased locally than assumed by the default IMPLAN zoo sector. The San Antonio Zoo provided extensive information regarding banking resulting in an increase in sector 3433 from 0.002 to 0.02. Reported shares bought locally were similar to the IMPLAN reported shares, therefore the 99.95% was left the same.

The questionnaire asked about landscaping services because it might be assumed that a zoo would bring in outside services to do landscaping; however, as reported by the San Antonio Zoo all of their landscaping was done in-house by current employees. As a result, the coefficient decreased from 0.002 to zero, and shares purchased locally decreased from 77.83% to 0%. In fact, the landscape services sector was fixed at zero in the revised IMPLAN model's zoo sector production function, meaning that even when rebalancing the expenditures in the production function, landscaping remained at zero.

Travel expenditures were split between air fare, hotel, and full-service restaurant services. Hotels and motel services expenditures changed from 0.000083 to 0.0013 with 0% purchased locally rather than the original 1.54%. Full-service restaurant services changed from 0.003 to 0.08 with a decrease in shares bought locally from 99.96% to

45%. Limited-service restaurant can be considered a sort of concession stand on zoo premise; zoo expenditures reported 0.006 per dollar was spent with 45% purchased locally, rather than the default expenditure of 0.0002 at 99.95% purchased locally.

Veterinary services, pharmaceuticals, and newly constructed non-residential structures were not included in the default IMPLAN museums, historical sites, and zoos sector. These were added because all zoos employ on-staff veterinarians who need medical supplies such as pharmaceuticals, and most zoos are often adding new additions and enclosures which were represented by the new construction sector. Veterinary services totaled 0.0039 per dollar spent in with 50% purchased locally, 0.0038 per dollar spent in pharmaceutical supplies at 25% locally, and 0.1949 per dollar spent in newly constructed non-residential structures at 50% locally. Considering the number of museums, historical sites, and parks relative to zoos, it may not be surprising that the veterinary services and pharmaceutical sectors did not exist in the IMPLAN default sector. It was reasonable to include a construction sector because the zoos insisted that construction was part of ongoing operations rather than special initiatives, and ongoing construction may well be more critical to zoos than to museums, historical sites, and parks (Table1).

Major changes to the default Dallas IMPLAN model are included in Table 2. The metropolitan area that represents the Dallas Zoo in this model includes, Tarrant, Ellis, Kaufman, Rockwall, Collin, Denton, and Dallas County. Based on limited and more aggregated data from the budget sheets provided by Dallas, ratios from the San Antonio Zoo were used to allocate expenditures within the broader categories provided by Dallas.

The two similarly-sized zoos were thought to have more similar expenditure patterns within those particular categories than were represented by the IMPLAN default including museums, historical sites, and parks. Dallas did not provide data on local purchases.

The Dallas Zoo's utilities sector 3051 and maintenance sector 3062 both increased significantly from 0.0085 to 0.01823 and 0.008 to 0.0143 respectively. Meat sectors including 3089, 3092, and 3093, each increased 0.014, 0.0049, and 0.0191 respectively. All of these significant increases demonstrate that some sectors are underestimated when grouping together museums, historical sites, zoos, and parks. All plastic containing sectors differed in the reported expenditures from the default IMPLAN expenditures. Sector 3188 increased from 0.000081 to 0.0055, sector 3189 increased from 0.000103 to 0.00707, and sector 3194 increased from 0.000216 to 0.0148 (Table 2).

Table 2. Dallas Compared to Default

Sector	Commodity	Dallas Default Coefficient	Dallas Default % local	Dallas Coefficient	Dallas Default % local
3051	Water, sewage and other systems	0.000850	70.99%	0.018232	70.99%
3062	Maintained and repaired nonresidential structures	0.008670	99.95%	0.014323	99.95%
3089	Meat (except poultry) produced in slaughtering plant	0.000235	5.36%	0.014337	5.36%
3092	Processed poultry meat products	0.000086	12.22%	0.005247	12.22%
3093	Seafood products	0.000320	0.17%	0.019523	0.17%
3188	Plastics packaging materials and unlaminated films and sheets	0.000081	28.35%	0.005568	28.35%
3189	Unlaminated plastics profile shapes	0.000103	8.87%	0.007080	8.87%
3194	Plastics bottles	0.000064	11.20%	0.004399	11.20%
3195	Other plastics products	0.000216	13.21%	0.014847	13.21%
3433	Monetary authorities and depository credit intermediation	0.002486	96.30%	0.002486	96.30%
3469	Landscape and horticultural services	0.002074	99.77%	-	-
3499	Hotels and motel services, including casino hotels	0.000076	2.42%	0.000076	2.42%
3501	Full-service restaurant services	0.002805	99.84%	0.003668	99.84%
3502	Limited-service restaurant services	0.000219	99.85%	0.000286	99.85%
3459	Vet services	-	-	0.032720	92.49%
3174	Pharmaceuticals	-	-	0.032492	1.16%
3058	Newly Constructed Nonresidential Structures	-	-	0.181938	100%

The Dallas Zoo provided less extensive information regarding the banking sector (3433) so the default was used. Because of a lack in specific data the landscaping sector 3469, was based on San Antonio and fixed at zero.

Travel expenditures were not specified on the budget sheets provided from Dallas, therefore the sector including hotels and motel services expenditures was left at the default value. Full-service restaurant services changed from 0.002 to 0.003. Limited-service restaurant only had a slight change from 0.000219 to 0.000286. Based on limited and more aggregated data from the budget sheets provided by Dallas both the full-service and limited-service percent purchased locally relied on the default IMPLAN percentages, which were highly similar.

Veterinary services, pharmaceuticals, and newly constructed non-residential structures were not included in the Dallas default IMPLAN museums, historical sites, zoos, and parks sector. Vet services added 0.0327, pharmaceuticals added 0.0324, and new construction added 0.1819 to the production function.

The San Antonio Zoo and Dallas Zoo made for a good comparison because of their similar sizes in zoo and their different metropolitan regions to specify and compare in IMPLAN. Expenditures on commodity sectors 3051 and 3062 were highly similar; however the data shows that Dallas spent less on utilities and more on maintenance locally (Table 3). San Antonio spent less on meat products, but more of that was spent locally. San Antonio also spent slightly less on plastic products than Dallas, but again a higher percentage of that spent locally.

Table 3. San Antonio Compared to Dallas

Sector	Commodity	SA Coefficient	SA % local	Dallas Coefficient	Dallas Default % local
3051	Water, sewage and other systems	0.018064	100%	0.018232	70.99%
3062	Maintained and repaired nonresidential structures	0.014191	65%	0.014323	99.95%
3089	Meat (except poultry) produced in slaughtering plant	0.007929	85%	0.014337	5.36%
3092	Processed poultry meat products	0.002908	85%	0.005247	12.22%
3093	Seafood products	0.010776	85%	0.019523	0.17%
3188	Plastics packaging materials and unlaminated films and sheets	0.000614	50%	0.005568	28.35%
3189	Unlaminated plastics profile shapes	0.00079	50%	0.00708	8.87%
3194	Plastics bottles	0.00048	50%	0.0044	11.20%
3195	Other plastics products	0.00164	50%	0.01485	13.21%
3433	Monetary authorities and depository credit intermediation	0.02083	99.95%	0.00249	96.30%
3469	Landscape and horticultural services	-	-	-	-
3499	Hotels and motel services, including casino hotels	0.00132	0%	7.6E-05	2.42%
3501	Full-service restaurant services	0.08074	45%	0.00367	99.84%
3502	Limited-service restaurant services	0.00621	45%	0.00029	99.85%
3459	Vet services	0.00391	50%	0.03272	92.49%
3174	Pharmaceuticals	0.00389	25%	0.03249	1.16%
3058	Newly Constructed Nonresidential Structures	0.19496	50%	0.18194	100%

San Antonio spent slightly more on monetary authorities and depositor credit intermediation, and both San Antonio and Dallas spent more than 95% of that in their local economy. San Antonio's expenditures were 0.0013 per dollar of revenue on hotels with 0% spent locally while Dallas spent significantly less at 0.00076 while just over 2% was spent locally.

San Antonio spent 0.077 per dollar more than Dallas on full-service restaurant services but with 45% spent locally where Dallas spent 99% locally (Table 3). IMPLAN failed to include vet services, pharmaceuticals and newly constructed non-residential structures which added up to just over 20 cents spent per dollar for both zoos. Both zoos claimed that construction was a part of their on-going costs rather than a special project beyond regular zoo operations. The effects of these seemingly small changes to cost functions result in changes to the zoos' multipliers.

The data provided by the zoos indicated different expenditures and local purchase shares than assumed by the default museums, historical sites, zoos, and parks sector. Expenditures drive the creation of multipliers in IMPLAN so changes in expenditures can be expected to result in changes in the multipliers. Results of IMPLAN modifications and comparisons of multipliers and economic outcomes are presented in the next chapter.

CHAPTER IV

RESULTS

The direct value of zoo operations was not the only benefit to the local economy. Money is multiplied as it circulates through the economy. Economic activity (direct effect) ripples through the regional economy as firms purchase inputs (indirect effect) and pay employees who also make regional purchases (induced effect). Many zoo input purchases are made from local suppliers. Zoo employees also spend part of their wages at businesses within the region. In turn, the employees of these make purchases at local businesses. Of course, money also leaks from the regional economy as firms and households purchase goods and services from other parts of the state, nation, and world. These leakages reduce the overall economic contribution of the zoo.

This study customized the production function, sector expenditures, and the percentage of shares purchased locally using data from the questionnaire in Appendix A, with the significant changes listed in Tables 1 and 2. The IMPLAN model was then run in a two-step process as an analysis by parts. Modeling the analysis by parts, yields results in two sections, zoo operations and zoo wages. The analysis by parts isolates the zoo cost function as the starting point for the impact assessment, but still allows the economy to interact with the broader sector 493 including museums, historical sites, and parks.

San Antonio Zoo Results

Given that the San Antonio Zoo provided data that gave great attention to detail in each commodity expenditure and percentage of shares purchased locally, the San Antonio results can be presented with greater reliance. When observing the total output contribution from the San Antonio Zoo on the San Antonio metropolitan region compared to the total output contribution from the Dallas Zoo on the Dallas metropolitan area, there must be a consideration that the sizes of their economies differ greatly in size and therefore it would be unreasonable to compare them to each other.

The San Antonio Zoo's economic contribution was initially calculated in different ways that are common for researchers or consultants. The simplest way was calculated first with the only change for the San Antonio region in IMPLAN being the total operations output for the zoo. Table 4 shows this one step process and the economic multipliers as IMPLAN sees the San Antonio zoo affecting its surrounding economy.

Table 4. Economic Impact for the San Antonio Zoo Default

Impact Type	Employment	Labor Income	Value Added	Output
Direct	290.2	$9,052,294	$9,831,924	$23,574,002
Indirect	106	$4,209,742	$8,386,857	$14,195,111
Induced	90.2	$3,727,786	$6,570,124	$11,364,881
Total Effect	***486.5***	***$16,989,821***	***$24,788,905***	***$49,133,994***
	Employment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
	20.63714086	0.720701602	1.051535713	2.084244924

The total effects are the sum of direct, indirect and induced for each of the outcomes: output (gross sales), value added, labor income, and employment (contribution to gross regional product). The original $23.6 million economic contribution from zoo operations led to a total county-level economic output of $49.1 million and 487 full- and part-time jobs. This total contribution includes a $24.8 million contribution to gross regional product (value added) and a $16.9 million contribution to labor income across the region. Labor income is a component of value added, which is a component of output, so the figures in Table 4 cannot be summed.

The effective multipliers are calculated by dividing the total effect for output, value added and labor income by final demand (total revenue) for the zoo. The effective multipliers are 2.08, 1.05, and 0.72, respectively. The employment multiplier represents full- and part-time jobs per million dollars of final demand so the effective multiplier was calculated by dividing total jobs by the quotient of revenue divided by $1 million. The effective employment multiplier was 20.64.

Multipliers are calculated based on purchasing patterns of industries in the local economy. The multipliers include three components: the direct effect which is the initial economic activity, indirect effect which is a secondary effect from the direct effect that is a result of business to business transactions, and induced effect which is also a secondary effect from the direct effect that results from transaction from individuals and their households. The output multiplier, which measures direct spending overall, is the largest economic impact value and as such is often the most used and reported number

for studies; however, the output multiplier doesn't give a good indication of the effects on the welfare of households or the profitability of businesses.

Value-added multiplier measures the entities' contribution to regional GDP and is the more appropriate measure of regional welfare. Labor Income is a component of value-added and in this study because the zoos are non-profit and there is no proprietor's income, labor income makes up the majority and is the driving force for value-added. Labor income multiplier measures the effects on the incomes of households and is appropriate for observing the benefit of the entity on the region's residents. In the instance of the San Antonio default model the IMPLAN generated labor income of $9 million generates $4.2 million in business to business (indirect) spending and $3.7 million in household (induced) spending. In this default model, across all impact types the indirect effects contribute more than the induced effect because the business to business transactions spend more and have fewer leakages than household spending; whereas households have incentives to save money which means it is not spent locally and businesses have incentives to spend the money in their business which multiplies the money back into the economy.

The next step in customizing the IMPLAN model to match the San Antonio zoo with greater accuracy was to change the underestimated direct labor income from the zoo. However even though the labor costs were customized, in the one-step process the actual direct employment numbers were not run. Table 5 shows the default San Antonio impacts with the addition of labor income adjustment.

Table 5. Economic Impact for the San Antonio Zoo Default with Labor Adjustment

Impact Type	Employment	Labor Income	Value Added	Output
Direct	290.2	$11,093,308	$11,872,938	$23,574,002
Indirect	106	$4,209,742	$8,386,857	$14,195,111
Induced	104.1	$4,302,593	$7,583,289	$13,117,378
Total Effect	***500.4***	***$19,605,643***	***$27,843,084***	***$50,886,491***
Percent Difference from Default	2.86%	15.40%	12.32%	3.57%
	Employment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
	21.2267	0.8316	1.1810	2.1585
Percent Difference from Default	2.86%	15.40%	12.32%	3.57%

With the addition to labor income, instead of it just affecting labor, total output increased from $49.1 million in the default model to $50.9 million, adding induced output associated with labor income but not accounting for the commensurate decrease in intermediate input purchases (e.g., costs of goods sold) as the share of labor income increased. The total effects from the original $23.6 million economic contribution from zoo operations led to a total county-level economic output of $50.9 million and 500 full- and part-time jobs (Table 5). Table 5 shows the total contribution which includes a $27.8 million contribution to gross regional product (value added) and a $19.6 million contribution to labor income across the region.

The total effective output, value added, and labor income multipliers were 2.16, 1.18, and 0.83 respectively (Table5). The employment multiplier representing full- and

part-time jobs per million dollars of final demand was 21.23. This one-step model changes the labor income and total direct output and adjusts all the expenditures in the background.

After changing the IMPLAN-generated labor income from $9 million to the zoo reported labor income of $11 million, all of the multipliers increased. In this scenario, IMPLAN held everything else the same and just added another $2 million to labor income without offsetting the income change by decreasing cost of goods sold (note that the indirect output effect is the same in Table 4 and 5). Thus, results were artificially high in this scenario. The indirect and induced effects of labor income changed to be almost the same; additionally, the indirect and induced effects of both value added and output were calculated by IMPLAN to be more similar. This indicated that with changing the labor income direct effect IMPLAN found that business to business transaction were contributing similarly as much as spending from households, because an additional $2 million was artificially added to the economy.

When running economic contribution models, researchers or consultants can either: do the bare minimum with a one-step analysis by only specifying output, go one step further by changing output and labor income, or specify another step further with running a two-step analysis by parts. Table 6 presents the results of an analysis by parts model of the San Antonio Zoo including changes to output, labor income, and direct employment. Table 6 exhibits how analysis by parts provides a double section results table with the wages being run separately.

Table 6. Economic Impact for the San Antonio Zoo Default Analysis by Parts

Zoo	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	400	$11,058,861	$9,831,938.29	$23,574,002
	Indirect	106	$4,209,743	$8,386,859	$14,195,116
	Induced	28.5	$1,178,785	$2,077,243	$3,593,409
	Total Effect	534.5	$16,447,389	$20,296,040.29	$41,362,527.00
Wages	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	0	$0	$0	$0
	Indirect	0	$0	$0	$0
	Induced	75.4	$3,114,488	$5,489,647	$9,495,583
	Total Effect	75.4	$3,114,488	$5,489,647	$9,495,583
Total (wages +Expenditures)		***609.9***	***$19,561,877***	***$25,785,687***	***$50,858,110***
Percent Difference from Default		25.36%	15.14%	4.02%	3.51%
		Employ-ment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
		25.8717	0.8298	1.0938	2.1573
Percent Difference from Default		25.36%	15.14%	4.02%	3.51%

Even though analysis by parts was done with only the addition to labor income, total output, and employment, without specifying anything else within the economy, the Table 6 results are essentially the same as those in Table 5. The total effects from the original $23.6 million economic contribution from zoo operations led to a total county-level economic output of $50.9 million and 609 full- and part-time jobs. The total employment changed the most because it accounted for actual employment. The main

point of running analysis by parts was to run the wages separately, and it was striking how little effect employment numbers have on the dollar figures in the analysis. The total contribution includes a $25.8 million contribution to gross regional product (value added) and a $19.6 million contribution to labor income across the region. The total effective output, value added, and labor income multipliers were 2.16, 1.09, and 0.83 respectively. The employment multiplier representing full- and part-time jobs per million dollars of final demand was 25.87 (Table6).

When running wages separately IMPLAN allows you to specify how many employees work at the entity and therefore the IMPLAN generated number of employees changed from 290 to the zoo reported 400 employees. The multipliers for all impact types again were all larger than the default IMPLAN model. In running the analysis by parts for this case the non-labor portion's indirect effects were much larger than induced. This indicates that IMPLAN adjusted its calculations to represent only induced effects from subsequent business to business transactions, and not from spending by zoo employees. The wages section only has induced effects because that is money going straight to the zoo employees to be spent by the households. Tables 5 and 6 provide similar bottom lines: both methods increased labor income without decreasing spending on other inputs, which artificially increased the calculated economic impact.

The comparison of Tables 5 and 6 shows that analysis by part was a more advanced way of analyzing the contribution and effectively changing the wages and employment, but not much else will change unless more specific information is input into IMPLAN to show a more complete picture of how the San Antonio Zoo actually

makes purchases in the local economy. The expenditure data reported in Table 1 allowed this study to not only customize individual commodity expenditures but also specify the percentage of those expenditures that were purchased locally for the San Antonio zoo.

After the customization to IMPLAN with a more complete picture of the zoo spending, and how much of that spending was local, it appears that IMPLAN, without specification, was over estimating the total contribution to the economy from the San Antonio Zoo (Table 7). Instead of running the expenditure commodities in the background of IMPLAN, they were brought to the foreground in IMPLAN and customized by using a template to import the changes from Excel. Changes consisted of the commodity expenditures included in Table 1, the percentage purchased locally for each of those, labor income, employment, and total output, all run in analysis by parts in IMPLAN.

The total effects from the original $23.6 million economic contribution from zoo operations led to a total county-level economic output of $47.3 million and 587 full- and part-time jobs (Table 7). This total contribution includes a $24.6 million contribution to gross regional product (value added) and a $18.5 million contribution to labor income across the region. The total effective output, value added, and labor income multipliers were 2.00, 1.04, and 0.78 respectively. The employment multiplier representing full- and part-time jobs per million dollars of final demand was 24.88 (Table 7).

Table 7. San Antonio Zoo Customized Economic Impacts

Zoo	Impact Type	Employ-ment	Labor Income	Value Added	Output
	Direct	400	$11,058,861	$11,243,028.36	$23,574,002
	Indirect	88.4	$3,363,455	$6,236,185	$11,316,776
	Induced	22.8	$940,870	$1,657,920	$2,868,075
	Total Effect	511.2	$15,363,186	$19,137,133	$37,758,853
Wages	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	0	$0	$0	$0
	Indirect	0	$0	$0	$0
	Induced	75.4	$3,114,488	$5,489,647	$9,495,583
	Total Effect	75.4	$3,114,488	$5,489,647	$9,495,583
Total (wages +Expenditures)		***586.6***	***$18,477,674***	***$24,626,780***	***$47,254,436***
Percent Difference from Default		20.58%	8.76%	-0.65%	-3.83%
		Employ-ment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
		24.8833	0.7838	1.0446	2.0045
Percent Difference from Default		20.58%	8.76%	-0.65%	-3.83%

After complete customization value added and output multipliers slightly decreased from the default IMPLAN model. However, labor income increased by 8.79% from the default model. In this customized model IMPLAN calculated that the indirect effects were well over the induced effects for the zoo portion of the model. In output, with a direct spending of $23.6 million, $11.3 million was generated through business to business transactions and $2.9 million was generated though household spending, and wages run separately added an additional $9.5 million in induced spending. With labor income increasing from the default this suggests that the San Antonio Zoo paid its

employees more than what IMPLAN originally calculated; this increased labor income coefficient shows the greater benefit to the zoos' regional residents.

Regional Purchase Coefficient

Regional Purchase Coefficient (RPC) is the percent share of a commodity purchased locally. Due to limited availability of data from the Dallas Zoo the specific percentage of their commodities bought locally was not specified. Fortunately, IMPLAN provides an estimate in the default zoo sector. However, a comparison of the impact of change in RPC was not possible for Dallas. The San Antonio Zoo however, provided ample data allowing customization of the RPC. Previous studies have discussed how changing the production function or the percentage shares purchased locally affect results. Dudensing, Robinson, and Hanselka (2016) found that changes to the production function matter more than the RPC changes. This study, however, found the opposite to be true; the changes in the percent of shares purchased locally caused a greater difference than the change in the production function. Table 8 shows the San Antonio Zoo data after running the model with all the customization as the previous Table 7, while leaving the default RPC.

Table 8. San Antonio Zoo Customized with Default RPC

Zoo	Impact Type	Employ-ment	Labor Income	Value Added	Output
	Direct	400	$11,058,861	$11,243,028.36	$23,574,002
	Indirect	119.6	$4,598,783	$7,906,208	$14,492,497
	Induced	31.1	$1,286,486	$2,266,938	$3,921,627
	Total Effect	550.7	$16,944,130	$21,416,174	$41,988,126
Wages	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	0	$0	$0	$0
	Indirect	0	$0	$0	$0
	Induced	75.4	$3,114,488	$5,489,647	$9,495,583
	Total Effect	75.4	$3,114,488	$5,489,647	$9,495,583
Total (wages +Expenditures)		***626.1***	***$20,058,618***	***$26,905,821***	***$51,483,709***
Percent Difference from Default		*28.69%*	*18.06%*	*8.54%*	*4.78%*
		Employ-ment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
		26.5589	0.8508	1.1413	2.1839
Percent Difference from Default		28.69%	18.06%	8.54%	4.78%

Table 8 more closely resembles Table 6 than Table 7 even with the changes in the production function (commodity expenditures). This demonstrates that, in this particular study, the RPC changes were extremely important in calculating results. Comparing the specific differences between the percent shares purchased locally in the default IMPLAN data and the data from the San Antonio zoo, there were significant changes in RPCs. Many shares were decreased or increased by 50% and others dropped to 0%. Other studies may not have observed as large of an impact of the RPCs on outcomes, but the RPC changes in these studies were relatively small. Customizing the

RPCs should be a consideration when conducting a study when using IMPLAN because if the differences are significant, they could contribute to significant changes in reported outcomes.

With changing the Regional Purchasing Coefficient back to the IMPLAN default RPC's the indirect and induced effects increased for both labor income and value added. This indicates that the IMPLAN's default model calculated that a greater percentage of commodities were purchased locally that what was reported by the San Antonio Zoo. For example, IMPLAN calculated that landscaping services was 77% purchased locally for San Antonio and 99% purchased locally for Dallas, however, neither zoo reported any landscaping services; in fact, San Antonio reported that all landscaping was done by current employees and thus, this RPC was reduced to 0%. The business to business transactions have a larger effect then the spending from households and the indirect effects of labor income make up of about half of value added. Additionally, the induced effects from the wages sections when running analysis by parts, remains the same.

Dallas Zoo Results

The Dallas Zoo didn't provide detailed data on their questionnaire (Appendix A), and therefore the Dallas results are less specific than the San Antonio results. However the commodity coefficients were customized to the data that was provided by Dallas, and it can reasonably be expected that the customized total output was more specific to zoo operations than the default total output including museums, parks, and historical sites. The Dallas results are provided in the following tables.

Often economic contribution studies are modeled using only the total output. This data was put into IMPLAN and allowed to run a one-step process with the assumed allocation of those expenditures and production function as opposed to an analysis by parts. An example of this was provided in Table 9 where the IMLAN model was ran in one step by only changing the output expenditures.

Table 9. Economic Impact of the Dallas Zoo Default

Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**
Direct	306.2	$12,045,709	$12,868,305	$27,365,354
Indirect	110	$5,836,374	$10,548,589	$16,751,787
Induced	98.7	$5,091,410	$8,375,253	$13,815,478
Total Effect	***514.9***	***$22,973,493***	***$31,792,148***	***$57,932,619***
	Employment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
	18.8157	0.8395	1.1617	2.1170

In the above Table 9, the total effects are the sum of direct, indirect and induced for each of the outcomes: output (gross sales), value added (contribution to gross regional product), labor income, and employment. The original $27.4 million economic contribution from zoo operations leads to a total county-level economic output of $57.9 million and 515 full- and part-time jobs. This total contribution includes a $31.8 million contribution to gross regional product (value added) and a $22.9 million contribution to labor income across the region. Labor income is a component of value added, which is a component of output, so the figures in Table 9 cannot be summed.

The effective multipliers are calculated by dividing the total effect for output, value added and labor income by final demand (total revenue or output) for the zoo. The effective multipliers are 2.12, 1.61, and 0.83, respectively. The employment multiplier represents full- and part-time jobs per million dollars of final demand, so the effective multiplier was calculated by dividing total jobs by the quotient of revenue divided by $1 million. The effective employment multiplier was 18.82 (Table 9).

In this default model, the indirect and induced effects of labor income are about the same and the indirect effects are slightly more than the induced effects for value added. This indicates that the default IMPLAN calculates that the household spending effects in the economy is close to the effects of business to business spending in the Dallas economy.

While Table 11 observes the economic contribution with the minimum amount of customization to IMPLAN, the next step in Table 10 shows results of both the zoo output and modified labor income on the same “set up activities” screen. This was a simple way to minimally customize the IMPLAN model to a specific enterprise and was a common way of finding economic contributions. This simple labor income customization was sometimes accompanied by changing the default employment number to match information provided by the zoo. Table 10 shows only the effect of changing labor income, but as noted previously, changing employment numbers does not affect labor income, value added, or output.

Table 10. Economic Impact of the Dallas Zoo Default with Labor Adjustment

Impact Type	Employment	Labor Income	Value Added	Output
Direct	306.2	$5,174,519	$5,997,115	$27,365,354
Indirect	110	$5,836,374	$10,548,589	$16,751,787
Induced	60.8	$3,136,949	$5,159,965	$8,512,019
Total Effect	***477.1***	***$14,147,842***	***$21,705,670***	***$52,629,160***
Percent Difference from Default	-7.34%	-38.42%	-31.72%	-9.15%
	Employment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
	17.4344	0.5169	0.7931	1.9232
Percent Difference from Default	-7.34%	-38.42%	-31.73%	-9.15%

The first obvious effect of modifying labor income for the Dallas Zoo was that the value added direct effect decreased by about half because labor income makes up a large share of value added. What was most concerning about the differences in Table 9 and Table 10 was the change in induced effects and total output. The customization of the labor adjustment informed IMPLAN that the Dallas Zoo did not allocate as much money to labor income, but that money was not reallocated to costs of goods sold or total output; it was taken out and not accounted for. This in turn decreased all of the multipliers.

In this minimally-modified IMPLAN model the original $27.4 million economic contribution from zoo operations leads to a total county-level economic output of $52.6 million and 477 full- and part-time jobs. This total contribution includes a $21.7 million contribution to gross regional product (value added) and a $14.1 million contribution to

labor income across the region. The effective multipliers are calculated by dividing the total effect for output, value added and labor income by final demand (total revenue or output) for the zoo. The effective multipliers are 1.92, 0.79, and 0.52, respectively. The employment multiplier was 17.43 (Table 10).

After the labor income was changed in Table 10 from the IMPLAN default of $12 million to the zoo reported $5.2 million, the induced effect of labor income and value added both decreased from the default effects. Because of the decrease in labor income, which is the employee compensation, there is less for the households to spend in the economy. With this change there was a decrease of 30% from the default for both labor income and value added. IMPLAN calculated that the households spending what about half as much as the business to business spending. Yet, the fact that indirect output is the same in Tables 9 and 10 shows that this modeling method artificially removed $7 million from the local economy by decreasing labor income without an offsetting increase in cost of goods sold.

Next, an analysis by parts was run with the default Sector 493 commodity expenditures while only adding the zoo's total output and specifying the labor income. Doing this in analysis by parts by first modeling zoo operations and then zoo wages facilitates a comparison of analysis by parts methods using default IMPLAN settings and expenditures customized to the Dallas Zoo.

As in San Antonio, Table 11, although it was analysis by parts, had essentially the same results as Table 10 relying on a one-step method. The only customization that was done was the direct output from the zoo and the direct labor income. Thus, there

was still no reallocation of sales between wages and costs of goods sold. The total effects were relatively the same with only a few small changes while leaving the same final demand (output) multiplier as 1.92. As shown in the table above the analysis by parts first analyzed the zoo (top half of the table) and then wages (bottom half of the table) which affected the induced effects.

Table 11. Economic Impact of the Dallas Zoo Default Analysis by Parts

Zoo	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	285	$5,174,519	$12,868,306.13	$27,365,354.00
	Indirect	110	$5,836,376	$10,548,591	$16,751,790
	Induced	32.3	$1,665,294	$2,738,917	$4,518,656
	Total Effect	427.3	$12,676,189	$26,155,814	$48,635,800
Wages	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	0	$0	$0	$0
	Indirect	0	$0	$0	$0
	Induced	28.5	$1,471,655	$2,421,048	$3,993,363
	Total Effect	28.5	$1,471,655	$2,421,048	$3,993,363
Total (Expenditure + wages)		***455.8***	***$14,147,844***	***$28,576,862***	***$52,629,163***
Percent Difference from Default		-11.48%	-38.42%	-10.11%	-9.15%
		Employ-ment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
		16.6560	0.5169	1.0442	1.9232
Percent Difference from Default		-11.48%	-38.42%	-10.11%	-9.15%

In Table 11, the original $27.4 million economic contribution from zoo operations leads to a total county-level economic output of $52.6 million and 456 full- and part-time jobs. This total contribution includes a $28.6 million contribution to gross regional product (value added) and a $14.1 million contribution to labor income across the region. The effective multipliers are calculated by dividing the total effect for output, value added and labor income by final demand (total revenue or output) for the zoo. The effective multipliers are 1.92, 1.04, and 0.52, respectively. The employment multiplier was 16.66 (Table 11).

When running the analysis by parts in Table 13 the results for labor income and value added are essentially the same as Table 10 except the wages are run separately. With this separation the zoo portion of household spending for labor income and value added is about cut in half; however that half is just moved to the wages portion of the model. Again, there are no offsetting increases in costs of goods sold.

This study goes several steps further than changing the output and labor income. Specific zoo commodity expenditures were changed, the production function was customized, and exact employment was added. According to the specific budget sheets and information provided by the Dallas Zoo, direct labor income makes up most of direct value added which in turn greatly affects the production function for the zoo (Table 12). Direct employment was changed to match the data provided by the Dallas Zoo. Ultimately with greater specifications and customization of the model given the information from the zoo, total output increased from the default model providing a higher total multiplier of 2.3 (Table 12).

Table 12. Dallas Zoo Customized Economic Impacts

Zoo	Impact Type	Employ-ment	Labor Income	Value Added	Output
	Direct	285	$5,174,519	$5,368,804.25	$27,365,354.00
	Indirect	163.4	$8,962,330	$14,821,675	$24,731,551
	Induced	49.6	$2,557,165	$4,205,789	$6,938,684
	Total Effect	498	$16,694,014	$24,396,268	$59,035,589
Wages	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	0	$0	$0	$0
	Indirect	0	$0	$0	$0
	Induced	28.5	$1,471,655	$2,421,048	$3,993,363
	Total	28.5	$1,471,655	$2,421,048	$3,993,363
Total (Expenditure + wages)		***526.5***	***$18,165,669***	***$26,817,316***	***$63,028,952***
Percent Difference from Default		2.25%	-20.93%	-15.65%	8.80%
		Employ-ment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
		19.2396	0.6638	0.9799	2.3032
Percent Difference from Default		2.25%	-20.93%	-15.65%	8.80%

The original $27.4 million economic contribution from zoo operations leads to a total county-level economic output of $63 million and 527 full- and part-time jobs. This total contribution includes a $26.8 million contribution to gross regional product and a $18.2 million contribution to labor income across the region. Labor income is a component of value added, which is a component of output, so the figures in Table 12 cannot be summed.

The effective multipliers are calculated by dividing the total effect for output, value added and labor income by final demand (total revenue) for the zoo. The effective multipliers are 2.3, 0.97, and 0.66, respectively. The employment multiplier represents full- and part-time jobs per million dollars of final demand so the effective multiplier was calculated by dividing total jobs by the quotient of revenue divided by $1 million. The effective employment multiplier was 19.24 (Table 12).

After complete customization, IMPLAN calculated that the business to business spending made up a larger share of labor income as compared to the household spending. Intuitively the 8.8% increase from the default total output is reasonable because the decrease in spending on labor income resulted in more spending on business transaction which have stronger linkages in the economy. The default model overestimated labor income by 20% and value added by 15%.

This study focused on the output multipliers because they are often the most appealing to businesses and decision makers. The simple reason for this appeal was that output multipliers are the biggest number. However, high output multipliers may not reflect true benefit to workers and to GDP. In fact, local labor income, and employment multipliers were higher for San Antonio than for Dallas. San Antonio's better performance on these metrics reflects its higher wages as compared to Dallas. However, higher wages correspond with lower intermediate expenditures (business-to-business purchases), which have a larger multiplier effect. The San Antonio and Dallas Zoo's relative performance on the different measures points to the importance of considering more than just one metric (usually the output multiplier).

San Antonio Zoo Contribution to Texas Economy

The results in sections 4.1, 4.2, and 4.3 were all relative to their contribution to their very different local economies. Therefore, it would be irrational to compare the multipliers from San Antonio to the multipliers from Dallas. The following tables show the contribution of the San Antonio Zoo to the Texas economy. As in the preceding section, to give a good comparison of methods, the Texas model was run in three different ways: default, default with labor adjustment, and customization to the San Antonio Zoo. In Table 13, the only change that was made was specifying total output from the San Antonio zoo. IMPLAN was then allowed to freely allocate the output statewide similarly as it did regionally.

Table 13. San Antonio Contribution to Texas Default

Impact Type	Employment	Labor Income	Value Added	Output
Direct	280.5	$9,539,083	$10,292,747	$23,574,002
Indirect	102.3	$4,618,940	$8,832,118	$14,859,592
Induced	92.7	$4,151,822	$7,236,461	$12,683,519
Total Effect	***475.5***	***$18,309,845***	***$26,361,326***	***$51,117,113***
	Employment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
	20.17052514	0.77669650	1.1182372	2.16836806

Table 13 shows the total effects from the original $23.6 million economic contribution from zoo operations led to a total state-wide economic output of $51.1 million and 476 full- and part-time jobs. This total contribution includes a $26.4 million

contribution to gross regional product (value added) and $18.3 million contribution to labor income across the state. The total effective output, value added, and labor income multipliers were 2.17, 1.12, and 0.78 respectively. The employment multiplier representing full- and part-time jobs per million dollars of final demand was 20.17.

This default Texas model, similarly to the other default models, had indirect and induced effects that are close to each other with the indirect effects being slightly higher. IMPLAN generates a default labor income of $9.5 million. IMPLAN also calculated that the business transaction effects are only slightly more than the effects of household spending in Texas. IMPLAN calculated $4.6 million in labor compensation from business transaction occurs and that $4.2 million in labor compensation directly to the households occur. This occurs for both Dallas and San Antonio according to the IMPLAN default model. Labor adjustment are shown in Table 14.

Table 14. San Antonio Contribution to Texas Labor Adjustment

Impact Type	Employment	Labor Income	Value Added	Output
Direct	280.5	$11,205,819	$11,959,482	$23,574,002
Indirect	102.3	$4,618,940	$8,832,118	$14,859,592
Induced	103.6	$4,642,693	$8,092,142	$14,183,250
Total Effect	***486.5***	***$20,467,451***	***$28,883,742***	***$52,616,844***
Percent Difference from Default	2.31%	11.78%	9.57%	2.93%
	Employment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
	20.6371	0.8682	1.2252	2.2319
Percent Difference from Default	2.31%	11.78%	9.57%	2.93%

As reported with the regional results, the next step up from running the model with minimum customization would be to additionally change labor income. As shown previously, IMPLAN underestimated the amount of labor income from San Antonio by about $1.7 million. Table 14 shows the results from changing total output and labor income and its' effect on the Texas state economy.

The total effects from the original $23.6 million economic contribution from zoo operations led to a total state-wide economic output of $52.6 million and 487 full- and part-time jobs. This total contribution includes a $28.9 million contribution to gross regional product (value added) and $20.5 million contribution to labor income across the state. The total effective output, value added, and labor income multipliers were 2.23, 1.22, and .87 respectively. The employment multiplier representing full- and part-time jobs per million dollars of final demand was 20.64 (Table 14).

After changing the IMPLAN generated labor income from $9.5 million to the zoo reported labor income of $11.2 million, all of the multipliers increased. The indirect and induced effects of labor income changed to be almost the same; additionally, value added and output's indirect and induced effects where calculated by IMPLAN to be fairly close. This indicated that with changing the labor income direct effect IMPLAN found that business to business transaction were contributing similarly as much as spending from households. As at the local level, this modeling method resulted in artificially large economic contributions because increases in wages were not offset by reduced costs of goods sold within constant zoo revenue, $2 million in wages were simply added to the economy.

Finally, the customization of the commodity expenditures, total output, labor income, employment, and the percentage shares of the commodities purchased locally was run in IMPLAN for the entire Texas economy are shown in Table 15.

Table 15. San Antonio Contribution to Texas Customized

Zoo	Impact Type	Employ-ment	Labor Income	Value Added	Output
	Direct	400	$11,058,861	$11,243,028	$23,574,002
	Indirect	85.7	$3,640,395	$6,619,512	$11,815,632
	Induced	23.7	$1,060,393	$1,847,839	$3,238,894
	Total Effect	509.4	$15,759,649	$19,710,379	$38,628,528
Wages	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	0	$0	$0	$0
	Indirect	0	$0	$0	$0
	Induced	72.7	$3,256,951	$5,677,480	$9,950,781
	Total Effect	72.7	$3,256,951	$5,677,480	$9,950,781
Total (wages +Expenditures)		***582.1***	***$19,016,600***	***$25,387,859***	***$48,579,309***
Percent Difference from Default		22.42%	3.86%	-3.69%	-4.96%
		Employ-ment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
		24.6924	0.8066	1.0769	2.0607
Percent Difference from Default		22.42%	3.86%	-3.69%	-4.96%

The total effects from the original $23.6 million economic contribution from zoo operations led to a total state-wide economic output of $48.6 million and 582 full- and part-time jobs. This total contribution includes a $25.4 million contribution to gross regional product (value added) and a $19.0 million contribution to labor income across the state. The total effective output, value added, and labor income multipliers were 2.06, 1.08, and .81 respectively. The employment multiplier representing full- and part-time jobs per million dollars of final demand was 24.69. Table 15 exhibits how after the

customization to the IMPLAN model, the original default model might have been over-estimating the total output multiplier.

After complete customization value added and output multipliers slightly decreased from the default IMPLAN model. However, labor income increased by 3.86% from the default model. This customized model IMPLAN calculated that the indirect effects were well over the induced effects for the zoo portion of the model. In output, with a direct spending of $23.6 million, $11.8 million was generated through business to business transactions and $3.2 million was generated though household spending and with wages run separately an additional $9.9 million in induced spending. With labor income increasing from the default this suggests that the San Antonio Zoo pays its employees more than what IMPLAN originally calculated; this greater labor income coefficient shows the greater benefit to the zoos' regional residents, although the outcome multiplier is smaller as a result of higher labor expenses and relativity smaller business-to-business purchases as a share of revenue.

Dallas Zoo Contribution to Texas Economy

Table 16 shows the contribution of the Dallas Zoo to the Texas state economy. To give a good comparison the Texas model was run in three different ways: default, default with labor adjustment, and customization to the Dallas Zoo. Table 16 exhibits the default model.

Table 16. Dallas Contribution to Texas Default

Impact Type	Employment	Labor Income	Value Added	Output
Direct	325.6	$11,073,232	$11,948,106	$27,365,354
Indirect	118.8	$5,361,793	$10,252,567	$17,249,426
Induced	107.6	$4,819,550	$8,400,284	$14,723,380
Total Effect	***552***	***$21,254,575***	***$30,600,956***	***$59,338,160***
	Employment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
	20.1714	0.7766	1.1182	2.1683

The total effects from the original $27.4 million economic contribution from zoo operations led to a total state-wide economic output of $59.3 million and 552 full- and part-time jobs. This total contribution includes a $26.4 million contribution to gross regional product (value added) and $18.3 million contribution to labor income across the state. The total effective output, value added, and labor income multipliers were 2.17, 1.12, and 0.78 respectively. The employment multiplier representing full- and part-time jobs per million dollars of final demand was 20.17. According to IMPLAN, the San Antonio Zoo and Dallas Zoo both have the same contribution and multipliers to the Texas state economy (Table 16).

This default Texas model for the Dallas Zoo was similar to the other default models, having indirect and induced effects that are close to each other with the indirect effect being slightly higher. IMPLAN generated a default labor income of $11 million. IMPLAN also calculated that the business transaction effects are only slightly more than

the effects of household spending in Texas. IMPLAN calculated labor income of $5.4 million in from business transaction and $4.8 million from households spending.

Table 17 is the Dallas default IMPLAN sector contribution to the Texas economy with only changing the total output from the Dallas Zoo and labor income from the zoo. Contrary to the San Antonio IMPLAN sector, the Dallas labor income was over estimated.

Table 17. Dallas Contribution to Texas Labor Adjustment

Impact Type	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
Direct	325.6	$5,345,111	$6,219,985	$27,365,354
Indirect	118.8	$5,361,793	$10,252,567	$17,249,426
Induced	69.9	$3,132,558	$5,459,539	$9,569,208
Total Effect	***514.3***	***$13,839,463***	***$21,932,091***	***$54,183,988***
Percent Difference from Default	-6.83%	-34.89%	-28.33%	-8.69%
	Employ-ment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
	18.7938	0.5057	0.8014	1.9800
Percent Difference from Default	-6.83%	-34.89%	-28.33%	-8.69%

According to IMPLAN, when only the output and labor income was specified, the San Antonio Zoo had a greater impact on Texas than the Dallas Zoo. For the Dallas Zoo, the total effects from the original $27.4 million economic contribution from zoo operations led to a total state-wide economic output of $54.2 million and 514 full- and

part-time jobs. This total contribution includes a $21.9 million contribution to gross regional product (value added) and $13.8 million contribution to labor income across the state. The total effective output, value added, and labor income multipliers were 1.98, 0.80, and 0.50 respectively. The employment multiplier representing full- and part-time jobs per million dollars of final demand was 18.79 (Table 17).

After changing the IMPLAN generated labor income from $11 million to the zoo reported labor income of $5.3 million, all of the multipliers decreased. IMPLAN calculated that the labor income generated about twice as much in business to business transactions compared to household spending; IMPLAN calculated similar results for the value added. Labor income decreased by about 34.89% from the default; value added decreased by about 28.33% from the default. Because labor income is the main driver for value added in the case on non-profit zoos this decreased effect indicates that IMPLAN overestimated employee compensation for the Dallas Zoo. At the same time, this method did not redistribute those overestimated wages back to costs of goods sold, thereby artificially reducing business to business effects.

Finally, to show a more complete picture in IMPLAN, the total output, labor income, and individual commodity expenditures were customized and modeled as analysis by parts for the Texas economy (Table 18). Due to limited data, the percentage shares of the commodities purchased locally could not be customized for the Dallas Zoo, and, therefore, the default RPC's were relied upon.

Table 18. Dallas Contribution to Texas Customized

Zoo	Impact Type	Employ-ment	Labor Income	Value Added	Output
	Direct	285	$5,174,519	$5,368,804	$27,365,354
	Indirect	171.8	$8,306,310	$14,396,999	$25,795,852
	Induced	54	$2,418,638	$4,214,669	$7,387,492
	Total Effect	510.8	$15,899,467	$23,980,472	$60,548,698
Wages	**Impact Type**	**Employ-ment**	**Labor Income**	**Value Added**	**Output**
	Direct	0	$0	$0	$0
	Indirect	0	$0	$0	$0
	Induced	34	$1,523,950	$2,656,533	$4,656,040
	Total Effect	34	$1,523,950	$2,656,533	$4,656,040
Total (Expenditure + wages)		***544.8***	***$17,423,417***	***$26,637,005***	***$65,204,738***
Percent Difference from Default		-1.30%	-18.03%	-12.95%	9.89%
		Employ-ment Multiplier	**Labor Income Multiplier**	**Value Added Multiplier**	**Output Multiplier**
		19.9083	0.6366	0.9733	2.3827
Percent Difference from Default		-1.30%	-18.03%	-12.95%	9.89%

The total effects from the original $27.4 million economic contribution from zoo operations led to a total state-wide economic output of $65.2 million and 545 full- and part-time jobs. This total contribution includes a $26.6 million contribution to gross regional product (value added) and $17.4 million contribution to labor income across the state. The total effective output, value added, and labor income multipliers were 2.38, 0.97, and 0.64 respectively. The employment multiplier representing full- and part-time jobs per million dollars of final demand was 19.91 (Table 18). As at the local level, the Dallas Zoo out-performed the San Antonio Zoo on the output metric, but San Antonio

provides larger value added, labor income, and employment multipliers for reasons discussed in Section 4.3.

After complete customization value added and labor income decreased from the default IMPLAN model by more than 12%. However, output increased by 9.89% from the default model as wage savings were offset by other input purchases. In this customized model, IMPLAN calculated that the indirect effects were well over the induced effects for the zoo portion of the model. In output, with a direct spending of $27.4 million, $25.8 million was generated through business to business transactions and $7.4 million was generated though household spending and with wages run separately an additional $4.7 million in induced spending. With labor income decreasing from the default this suggests that the Dallas Zoo pays its employees less than what IMPLAN originally calculated; this lesser labor income coefficient allows more spending into the cost of goods and in business to business transactions which is the driver for the output multiplier. Therefore intuitively when the labor income decreased, the output increased.

Summary of Results

After customization for the Dallas Zoo's and the San Antonio Zoo's actual expenditures, the total output multipliers for the local economy were significantly different from those calculated using IMPLAN's default assumptions. The San Antonio Zoo's local economic output multiplier decreased from a default of 2.08 to a customized multiplier of 2.00. The Dallas Zoo's total output multiplier for the local economy increased from the default of 2.12 to the customized multiplier of 2.30. However, the local value-added,

labor income, and employment multipliers were higher for San Antonio, reflecting lower labor use by the Dallas Zoo.

The San Antonio local multipliers were customized by changing both the production function and the RPCs. Contrary to expectations, the multiplier rose from 2.00 using the modified San Antonio expenditures and customized RPCs to 2.18 when default local purchase shares were used with the modified production function (expenditures by sector). This demonstrates that IMPLAN assumed that the San Antonio Zoo purchased more locally than what the zoo reported. Due to the RPC having significant decreases, the total multiplier also decreased. Again, data were not available to customize RPCs for Dallas.

After customization for the Dallas Zoo and the San Antonio Zoo, the total output multipliers for the Texas economy differed significantly from IMPLAN's default assumptions. The San Antonio Zoos' state multiplier decreased from 2.17 to 2.06. The Dallas Zoo's total output multiplier for the state economy increased from the default of 2.17 to the customized multiplier of 2.38. As at the local level, state-wide value-added, labor income, and employment multipliers were higher for San Antonio than for Dallas, reflecting the Dallas Zoo's lower wages and thus higher intermediate expenditures with larger output multiplier effects.

These results suggest that how a model is customized to reflect a particular zoo's expenditure may either increase or decrease economic outcomes relative to the default sector 493 multipliers. However, customized data should provide more in-depth, reliable results for decision-makers. Simple adjustments to labor income alone -- either within

the IMPLAN set-up screen or through analysis by parts using default production functions -- artificially added money to the San Antonio economy and removed money from the Dallas economy. Constant revenue (direct effects) can only be achieved by adjusting wages and cost of goods sold in tandem. Adjustments to local purchase shares further refined business to business transactions to more reasonably represented zoo purchasing patterns.

CHAPTER V

CONCLUSIONS

Previous studies have found that zoos are beneficial to the local and state economies, but none of these have customized the I-O model with zoo-specific data to the extent that this study has. This study considered the question of how zoos' allocations of expenditures and revenues change the default economic multipliers and compares a modified zoo IMPLAN sector to a default zoo IMPLAN sector.

The first objective of this study was to capture the economic contribution of each zoo's expenditures. This was done in several different ways for analysis and comparison. In order to find the local and state contributions that were customized to a specific zoo, data were collected using the questionnaire in Appendix A. Locally the economic contribution was captured as default, then with labor adjustment, then as default and labor adjustment with analysis by parts, and finally as customized with analysis by parts. Customized analysis with default RPC's was also run for comparison for the San Antonio Zoo, which provided thorough local purchase data. Statewide for each zoo, default, labor adjustment, and customized IMPLAN models were run for a comparison of how each zoo contributed to the Texas state economy.

The second objective of this study was to compare and contrast each zoo's allocation of resources to determine how the differences between these zoos play out in the economy. Important changes can be seen in Tables 1, 2, and 3; The San Antonio and Dallas default sector 493 of museums, historical sites, zoos and parks, did not include

three commodities that were specified by each zoo. Adding just these commodities, accounts for about 20 cents of every dollar spent. This was then used to help IMPLAN more reasonably distributed these expenditures throughout the local and state economy with the provided percent of capital spent locally. An important assumption by the zoos was that construction was an ongoing part of operations. This objective also lent itself to the comparison of default RPC's and modified RPC's; these were found to cause a measurable difference in total contribution output and multipliers.

The first hypothesis (H1: modifying the default IMPLAN commodity expenditures relative to the reported zoo-specific expenditures will show a measurable difference in the results of outputs and multipliers between zoos and between the default and the modified models), was true for both the San Antonio Zoo and the Dallas Zoo but, in opposite ways. The San Antonio Zoo's total output was overestimated by the default IMPLAN model as compared to the zoo-specified total output. Value Added, Labor Income, and Employment, however, were underestimated by the default IMPLAN model versus the zoo-specified model. On the opposite hand, the Dallas Zoo's total output was underestimated by the default IMPLAN model as compared to the zoo-specified total output. Value Added, Labor Income, and Employment, however, were overestimated by the default IMPLAN model versus the zoo-specified model. It is the deduction of this study that the Dallas Zoo impacted its local economy so greatly due in part to Dallas having a larger economy. However, the Dallas Zoo also had a larger contribution to the statewide economy, suggesting that the Dallas Zoo relies on a mix of inputs with stronger linkages in the state and local economies. For example, the Dallas

Zoo's lower labor costs support a higher output multiplier, although it's lower employment and wages also achieve lower value added, labor income, and employment multipliers. Thus, while it is tempting to look only at the larger output multipliers, other measures are important as well. The customized San Antonio state-level output multiplier decreased from the default Texas output multiplier, due in large part to the effects of non-local purchases, but also due to relatively high labor expenses relative to other costs. It is the deduction of this study that the customized output multiplier was more reasonably represented due to San Antonio providing more specific data.

The second hypothesis (H2: changing regional purchasing coefficients from the default IMPLAN percentages to the reported zoo-specific percentages, will reflect a notable difference between the default IMPLAN and the zoo-specific IMPLAN models, because of a variance in contribution to the local economy through different allocation of resources and different percentages of commodities bought locally) was shown to be accurate. Contrary to other studies, this study found the modification of the RPC's to show a distinct difference in results; almost 5% difference in output and an 18% difference in labor income were calculated. Although this study had particularly large changes in RPC's relative to other studies that changed also adjusted RPCs, it is this study's conclusion that the purchasing coefficients should always be taken into consideration when calculating economic contributions, especially if the percentage of commodities purchased locally deviate substantially from the default. This specific IMPLAN model provided a perfect example of how it's better to have not only data that

is highly specific but also a high quantity of data, in order to provide a reasonable comparison of results.

The importance of specific data when running an economic contribution study such as this cannot be stressed enough. Intuitively, with highly specific data, results can be deemed more reasonable and zoo-specific. San Antonio provided almost verbatim of what was asked via questionnaire; data provided by Dallas was slightly limited in that neither exact expenditures for each sector nor shares of commodities purchased locally were provided in their financial report. However, enough data was provided from the Dallas Zoo to better approximate zoo spending relative to the default IMPLAN sector including museums, historical sites, and parks. Using highly specific data, results in a more reasonable measure of the zoo's economic contributions. This may help to more effectively secure infrastructure and to request support from government or private funders. In the long run, inaccurate economic impact estimates are detrimental to effective decision-making and the reliability of impact studies, even if (or perhaps especially if) models over-estimate economic contributions.

San Antonio was chosen in this study because as one of the top tourist destinations in Texas it posed as an interesting research subject; additionally, after further research the zoo houses around 3,500 animals and had just over 1 million visitors a year and in 2014 revenues were $23.6 million. The San Antonio metropolitan area had a population of almost 2 million. Dallas was chosen as a comparison zoo because, similar to the San Antonio Zoo, it houses over 2,000 animals and had just under 1 million visitors yearly and 2014 revenues were $27.4 million. The Dallas metropolitan

area had a population of just over 6 million. The selection of zoos for this study, however, merely demonstrate that when running an economic contribution study on any business, the amount of business specific data affects the results. In fact, rather than size differences between the zoos' or metropolitan areas, it was differences in the zoos' expenditures (specifically wages as a share of revenues) that drove interesting changes in multipliers. This study demonstrated that not only is it important to know specific business revenues and expenditures but also the percentage of expenditures in the local region.

This study can be replicated for different business entities by following the step-by-step section including Figures 1through 25. This study is unique because, zoos are non-profit causing the proprietors' income to be zero in IMPLAN; when other economic contribution studies are done on businesses that are for-profit the proprietors' income would be adjusted accordingly. Due to the non-profit state of the zoos, this caused labor income to be a major driver in the changes to the economic multipliers. In the case of San Antonio, the total output decreased because the labor income increased. Intuitively, this decrease in total output is reasonable because the increase in labor income resulted in less spending on business to business transactions which have stronger linkages in the economy. In the case of Dallas the opposite happened, because labor income decreased is allowed for more spending on business to business transactions which drove the customized output multiplier to increase.

To reiterate, this study was based solely on expenditures and revenues within the zoos' operations. This study does not take into account visitor spending, travel volume

and behavior, or other tourism aspects. However, this study would complement other studies that did look at tourism to compare the effects of tourism on the economy versus only zoo operation spending.

In conclusion, a significant difference between running a default IMPLAN sector and going the extra mile in customizing the sector with zoo-specific information was discovered. Not only did customization of the IMPLAN production function matter but the percent shares of goods and services purchased locally, when specified, results in substantial differences in results. Additionally, simply changing the expense of labor income from the IMPLAN default to the zoo-reported value artificially added or took away money from the economies. This study demonstrates that although running zoo-specific information though analysis by parts may not result in a higher multiplier, it can reasonably be inferred that a more reasonable multiplier was generated. The study also provides other researchers studying the impacts of zoos and other businesses with a detailed blueprint to modify the IMPLAN model.

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APPENDEX A

Revenue	**Total Revenue for 2014**
Total Number of Visitors	
Ticket Sales (Including special events)	
Memberships	
Food	
Gift Shop	
Donations	
Other forms of Revenue	

Expenditures	**Total Cost for 2014**	**% Purchased Locally**
Labor Costs (Includes employee compensation and temporary agency compensation and benefits)		
Hay for feed		
Processed feed (e.g., pellets, mineral supplements, etc.		
Produce for animals (includes fruits and vegetables)		
Meat for animals		
Other animal feed		
Vet services (excluding zoo staff salary)		
Vet Supplies (Including vaccines, drugs, chemical, etc.)		
Recreation Supplies (Includes plastics for animals)		
Landscaping --services contracted		
Waste Management		
Utilities (Electricity, Gas)		
Water/Sewer		
Building and ground maintenance		
New construction		
Advertising (Including ad, public relation, market research, printed materials)		
Professional Services		
Insurance		
Transportation (Including gas for vehicles)		
Restaurant/Catering (Including full and limited services and contracts with vendors)		
Funds set aside for future investment or purchases		
Other significant expenditures		

APPENDIX B

Expenditures for San Antonio Zoo	Cost in pennies on the dollar	Percent purchased locally		Expenditures for Dallas Zoo	Cost in pennies on the dollar	Percent purchased locally not given
Labor Costs	0.4691	100%		Labor Costs	0.189090154	
Hay for feed	0.0234	85%		Hay for feed	0.039106365	
Processed feed	0.0234	85%		Processed feed	0.039106365	
Produce for animals	0.0234	85%		Produce for animals	0.039106365	
Meats for animals	0.0234	85%		Meats for animals	0.039106365	
Other animal feeds	0.0234	85%		Other animal feeds	0.039106365	
Vet services	0.0039	50%		Vet services	0.032719682	
Vet Supplies	0.0039	25%		Vet Supplies	0.032491892	
Recreation Supplies	0.0038	50%		Recreation Supplies	0.031894034	
Landscaping	0.0000			Landscaping	0	
landscaping supplies	0.0043	100%		landscaping supplies	0.003983491	
Wastes Management	0.0020	100%		Wastes Management	0.00189759	
Utilities	0.0210	100%		Utilities	0.019641105	
Water/Sewer	0.0195	100%		Water/Sewer	0.018232401	
Building and ground maintenance	0.0236	65%		Building and ground maintenance	0.022030788	
New construction	0.1950	50%		New construction	0.181938043	
Advertising	0.0325	65%		Advertising	0.049001961	
Professional Services	0.0083	65%		Professional Services	0	
Insurance	0.0057	0%		Insurance	0	
Transportation	0.0017			Transportation	0	
Restaurant/Catering	0.0927	45%		Restaurant/Catering	0.003954855	
Funds set aside	0.0000			Funds set aside	0.021507341	
Other significant expenditures-				Other significant expenditures-	0.196084838	
Equipment Expense	0.0165	65%		*Equipment Expense*		
Travel	0.0037	0%		*Travel*		
General Administrative Costs	0.0154	65%		*General Administrative Costs*		
Banking and Credit Card Fees	0.0159	15%		*Banking and Credit Card Fees*		
Special Event Expenses	0.0118	85%		*Special Event Expenses*		
Commission expense	0.0087	10%		*Commission expense*		
Interest Expense	0.0094	100%		*Interest Expense*		