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Trends in Angler Expenditures and Economic Contributions of Tourism at a Trophy Fishery in Texas

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By

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This thesis aimed to improve decision-maker access to economic information by testing a price-adjusting methodology to annually update expenditure information for economic impacts analyses and by conducting a trends analysis of economic sector contributions to a regional economy. A secondary data analysis of historical angler survey data generated expenditure profiles adjusted over time using price indices. A replication survey was conducted to compare expenditures. Grouping anglers by trip type (one-day/multiple-day) resulted in expenditure profiles that were generally consistent over time as anglers spent approximately $75 and $130 on one-day and multiple-day trips, respectively. These expenditures resulted in total economic impacts of over $13 million. A series of automatic social accounting matrices (ASAM) were then employed to execute economic base analyses, quantifying the role of sectors in the regional economy. The tourism sector consistently contributed over 20% of gross employment and almost 10% of gross output over time.

DEDICATION

I dedicate this thesis to two of my first fishing partners. Many of my favorite fishing memories came with my late grandfather, Charles Winfred Parker, and late grandmother, Marie Eckl Gordon. Thank you for showing me unconditional love and support, for teaching me the importance of strong convictions, and for reminding me that "education never made a man humpbacked."

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

EXPANDED ABSTRACT

This thesis is organized into three chapters. Chapter I is an Executive Summary presenting a synopsis of the two subsequent chapters, including methodologies and results. Chapter II addresses the methodology to cost-effectively estimate angler expenditure profiles and economic impacts of recreational fishing over time. Last, Chapter III addresses the context for the results of the economic impacts analyses by quantifying the economic role the impacted sectors play in the local economy over time. All chapters are formatted in accordance with the North American Journal of Fisheries Management (NAJFM).

Accurate and updated economic information is a crucial component of decision-making; however, replications of economic studies to update findings are not common practice as studies are often time- and cost-prohibitive. This leaves decision-makers to use information from single cross-sectional studies to make longitudinal inferences, which may be statistically invalid (Bowen and Wiersema 1999) and most likely inaccurate. This problem is exemplified by the lack of studies exploring economic impacts of outdoor recreation and tourism activities and their contribution to an economy of interest over time. The goal of this research was to provide better economic information over time by proposing a price index methodology to annually adjust expenditure profiles used as inputs in economic impacts analyses, and by providing context for those impacts by exploring the trends in economic contributions of impacted sectors. To achieve this goal, there were the following objectives: (1) conduct a secondary data analysis of an angler survey conducted by Hunt and Ditton (1996) to generate historical angler expenditure profiles of trips to Lake Fork Reservoir, Texas and adjust them to 2015 prices using published price indices; (2) test the validity of the price adjustment methodology by comparing adjusted profiles to actual results generated by a replication of the 1994-1995 angler survey; (3) generate angler expenditure profiles annually from 1994-1995 to 2014-2015 using price indices to serve as inputs for economic impacts analysis, if applicable; (4) construct a series of social accounting matrices (SAM) for the regional economy; and (5) execute a base analysis of each SAM using the automated social accounting matrix (ASAM) software to generate a series of economic metrics identifying the role of specific sectors in the economy. By identifying a method to estimate annual economic impacts of an activity, and combining those results with an understanding of how affected sectors contribute to the overall success of an economy of interest, decision-makers have the opportunity to be more informed about the potential economic ramifications of their planning and managerial decisions without conducting costly study replications.

Trends in angler expenditures were explored to attempt to generate annual economic impacts of recreational fishing through a secondary data analysis of the Lake Fork Reservoir Angler Survey (henceforth, "1995 study") conducted by Hunt and Ditton (1996). The 1995 study generated expenditure profiles for non-local anglers (anglers residing in Texas, but outside the local area consisting of Wood, Rains, and Hopkins Counties) and non-resident anglers (anglers residing outside of Texas) on trips to Lake

Fork Reservoir. Using the price indices published by the U.S. Bureau of Labor Statistics (USBLS), these angler expenditures were adjusted to 2015 dollars. To determine if the price adjustment methodology was appropriate for angler expenditures, a replication of the angler survey was conducted to compare adjusted expenditures to actual expenditures (henceforth, "2015 study"). A hypothesis test using a 95% confidence interval for the difference between adjusted and actual means of the angler expenditures resulted in a conclusion that the expenditure profiles for non-local and non-resident anglers were significantly different between the two periods. These conclusions suggested that significant differences within angler groups existed between the two angler surveys, so an alternate grouping mechanism was explored.

Anglers were then regrouped by trip type, and average daily expenditures were calculated to be $25.77 and $59.36 for one-day and multiple-day trips from June 1, 1994 to May 31, 1995, respectively. These 1995 study average expenditures were then adjusted using price indices and compared to actual results from the 2015 study using a hypothesis test for the difference of means. Adjusted average daily expenditure total for one day trips during the 1995 study ($69.38) was not significantly different from the average daily expenditure total of the 2015 study ($77.18), and the same conclusion was found for all item categories. For multiple day trips, the 1995 study adjusted average daily expenditure ($130.48) was not significantly different from the average daily expenditure ($128.04) of the 2015 study. Only one expenditure item, gasoline, was significantly different between the two studies. However, gasoline was kept in the analysis since total expenditures were not significantly different, and it was determined that price adjusting angler expenditures when grouped by trip type was an appropriate method to estimate expenditures over time.

Adjusted and actual expenditure profiles were then combined with effort data collected by the Texas Parks and Wildlife Department (TPWD) and input into the Impact Analysis for Planning (IMPLAN) software model of the region (Wood, Rains, and Hopkins Counties, Texas) to generate estimates of economic impacts. The total economic impacts of one-day fishing trips to Lake Fork Reservoir were estimated to be $1.28 million when using the adjusted expenditure profile, and $1.43 million when using the actual expenditure profiles. For multiple-day trips, economic impacts were estimated to be $10.82 million using the adjusted profile, and $10.80 million using the actual expenditure profile.

The trends in economic contribution of specific sectors to the regional economy around Lake Fork Reservoir were then explored, with an emphasis on the tourism sector which is directly impacted by recreational fishing. The tourism sector was defined as the combination of the lodging, food and beverage stores, eating and drinking establishments, and retail trade sectors, consistent with the literature (Dawson et al. 1993; English et al. 2000; Watson and Beleiciks 2009). To estimate the contribution of the tourism sector over time, multiple base analyses were conducted to reallocate output to the sector originally responsible for bringing new money into the economy. To do this, payments within an economy were traced using SAMs. Each SAM was exported from IMPLAN models of the region for each year there were available data sets (1997-2004; 2008-2013). Each IMPLAN model was modified into an aggregated sector scheme that placed every sector into one of nine sector categories, including tourism. From there, the industry by industry (IxI) SAM was imported into the Automated Social Accounting Matrix (ASAM) software developed by Rodriguez et al. (2011). This open-source software (a Microsoft Excel-based macro) executed a base analysis and produced gross and base measures of economic production in terms of output and employment as well as a percent contribution to total output and employment.

The multiple SAMs constructed by the IMPLAN data sets allowed for a series of information on economic contribution to be collected and explored. Over the study period, it was found that the tourism sector contributed about 8% of gross output, but only about 2% of base output. Tourism was the largest contributor to gross employment at almost 20%, but this only translated into about a 3% contribution to base employment. The two largest contributors to gross output were the aggregated agriculture and mining sectors and the aggregated construction and manufacturing sectors. These sectors, along with households, were also the biggest contributors to base employment. However, their total contribution to base employment decreased over time as the contribution of the wholesale trade, tourism, and services sectors increased.

Identifying the percent contribution of specific sectors in an economy provides insight to each sector's role and importance. In turn, this provides context in which to better understand results from other economic research such as economic impacts analyses. Alone, these two types of research only present an incomplete picture of an economy. However, when used to complement one another, researchers can understand how an activity can affect specific sectors in an economy through economic impacts analysis while understanding the importance of those affected sectors to the overall economy. Further research is needed to verify the validity of this price-adjustment methodology across different reservoirs and activities. By providing a cost-effective method to annually update economic impact-based research and presenting the needs to frame those results with corresponding contribution analysis, this thesis will improve the collection of, and access to economic information for better decision-making.

1.1 References

Bowen, H. P., and M. F. Wiersema. 1999. Matching method to paradigm in strategy research: limitations of cross-sectional analysis and some methodological alternatives. Strategic Management Journal 20:625-636.

Chen, R. J., K. M. Hunt, and R. B. Ditton. 2003. Estimating the economic impacts of a trophy largemouth bass fishery: issues and applications. North American Journal of Fisheries Management 23:835-844.

Dawson, S. A., D. J. Blahna, and J. E. Keith. 1993. Expected and actual regional economic impacts of Great Basin National Park. Journal of Park and Recreation Administration 11(4):45-59.

Dillman, D. A. 1978 Mail and telephone surveys – the Total Design Method. John Wiley & Sons, Inc., New York, New York.

English, D. B. K., D. W. Marcouiller, and H. K. Cordell. 2000. Tourism dependence in rural America: estimates and effects. Society & Natural Resources 13:185-202.

Hunt, K. M., and R. B. Ditton. 1996. A social and economic study of the Lake Fork Reservoir recreational fishery. Human Dimensions of Fisheries Research Laboratory Technical Report #HD-608, Texas A&M University, College Station, Texas.

Rodriguez, A., W. J. Braak, and P. Watson. 2011. Getting to know the economy in your community: automated social accounting. Journal of Extension 49(4): 4IAW3.

Watson, P., and N. Beleiciks. 2009. Small community level social accounting matrices and their application to determining marine resource dependency. Marine Resource Economics 24:253-270.

CHAPTER II

EXPLORING THE USE OF PRICE INDICES TO ADJUST

ANGLER EXPENDITURE PROFILES OVER TIME

2.1 Introduction

Recreational fishing is an important part of many local and state economies as non-resident anglers travel to these areas and generate economic impacts by injecting new money into their respective economies (Oh and Ditton 2008). In 2011, 27.5 million anglers spent approximately $26 billion on fishing expenditures in the United States, with about 80% of all freshwater fishing effort concentrated at reservoirs (USFWS 2011). In some cases, reservoirs produce a sustained succession of trophy catches resulting in a reputation among anglers as a ‘trophy destination’. Rural communities that are endowed with these amenities likely experience growing demands for local businesses (Beale and Johnson 1998, English et al. 2000). As the reputation persists, anglers travel to the reservoir in search of the catch of a lifetime, spending money mostly in the lodging, food and drink, retail, and recreation services sectors. A large portion of the total economic activity in these tourism-related sectors in rural communities is commonly produced by visitors like anglers (English et al. 2000). Often, studies are commissioned by state and local agencies to quantify the economic growth and gather additional economic information regarding recreational fishing (Chen et al. 2003, Driscoll et al. 2010, Hutt et al. 2013, McKee 2013). One location that has been of economic interest to the Texas Parks and Wildlife Department (TPWD) is Lake Fork Reservoir.

Lake Fork Reservoir is an 11,033 ha reservoir approximately 80 miles east of Dallas, Texas, sharing shoreline boundaries within Wood, Rains, and Hopkins Counties (Figure 2.1). Combined, these three rural counties have a population of 88,039 (USCB 2010), accounting for about 0.3% of the state. Nevertheless, the reservoir has been the most productive trophy bass fishery in Texas since its impoundment in 1980, boasting the state record largemouth bass (8.25 kg) along with 33 of the top 50 largemouth bass caught in Texas (Texas Parks and Wildlife 2015). In 1995, TPWD and Sabine River Authority (SRA) commissioned a study of Lake Fork Reservoir to explore the economic impacts recreational fishing was having on the local economy. That study found non-local anglers spent 311,283 activity days visiting the reservoir and spent a total of $14,540,000 on trip-related goods and services. These direct expenditures resulted in total economic impacts of $18,559,871 on the local economy (Chen et al. 2003). Results from the 1995 study provided economic information to enhance managerial decision-making.

According to Hunt and Grado (2010), economic information is needed as part of fisheries assessments for several reasons. First, angler expenditures provide important revenue and employment for local communities, states, provinces, and nations. Second, many communities and their businesses, especially those in rural areas, are dependent on users of local resources for tax generation and retail sales revenues. Third, because of these benefits, there will likely be economic consequences to fisheries legislation and management decisions. Fourth, economic dependency can help to justify the need for protection or conservation of fisheries resources. Fifth, economic information can show the value of resources over time, which can reflect the changing quality of fisheries resources and/or fishing experiences. Sixth, economic information can aid in determining compensation in the event of environmental damage to fisheries resources through negligent land-use practices or blatant criminal activity (e.g., dumping). Finally, economic information is useful in setting license and permit fee structures.

One type of study used to collect and derive economic information is through the use of economic impacts analysis. Economic impacts have been defined as the net changes, which would otherwise not exist, to the economic base of a defined area or region that can be attributed to a particular activity of interest (Watson et al. 2007). A popular method to quantify economic impacts is using the impact analysis for planning (IMPLAN) software. Originally developed by USDA Forest Service in 1976 to assess its forest management plans on a local economy, the software has since been modified to estimate economic impacts resulting from a variety of events and activities (Chen et al. 2003). IMPLAN is an input-output (I-O) database and modeling system that uses a social accounting matrix, or SAM, to quantify interdependencies between an economy's sectors and applies matrix inversion to generate a predictive multiplier model (MIG 2004). This, in turn, is used to calculate total output resulting from a change in demand (i.e., consumer spending) as one sector's output becomes another industry's input.

Inputs for the IMPLAN model are generated by coupling angler expenditure profiles with respective angler use in terms of activity days. Angler expenditures can be identified during a survey process (e.g., mail or on-site) by collecting data on purchases made in a specific location for angling activity (e.g., sporting gear or equipment) and trip-related expenses (e.g., food and fuel). These expenditures can then be allocated to final demands on a county or state industry or business. An activity day is the presence of one person for a portion of a day at a resource where the activity is taking place (Hunt and Grado 2010). The resulting itemized expenditure profile (U.S. dollars/angler/activity day) is input into the model with each expenditure entered separately and aligned with its appropriate economic sector. Once entered, expenditures are matched with total activity days for the site or activity (Hunt and Grado 2010).

Input-output models generate direct and secondary impacts on the defined economy (e.g., county, county combination, zip-code region, or state) resulting from in-economy expenditures and coinciding activity days (Hunt and Grado 2010). Direct impacts include the money spent directly on local businesses and industries by the anglers. Secondary impacts are composed of indirect and induced impacts. Indirect impacts occur when businesses re-spend money in the local supply chain to support their business. Induced impacts occur when additional money is spent by households due to an increase in income generated by employment tied to direct and indirect impacts (MIG 2004). The sum of direct and secondary impacts is the total economic impact to the economy of interest as a result of angler expenditures. For all impacts, when money is spent outside of the economy of interest, it does not count as "impacts" and is commonly referred to as leakage.

Although economic impacts studies are a common way to gather economic information, they only provide a cross-sectional perspective of the resource suggesting that technology, prices, trade relations, and overall structure of the economy are fixed (Dawson et al. 1993). New IMPLAN models are released periodically to account for changes in economy structure and trade relations; nevertheless, economic impacts assessments are rarely repeated at a specific site due to the cost and the time required generating new expenditure profiles. This leaves decision-makers to use information from a single cross-sectional study to make longitudinal inferences, which may be statistically invalid (Bowen and Wiersema 1999) and potentially inaccurate. However, trends in price, which is the foundation of the model's expenditure inputs have been well documented and could provide insights to updating expenditure profiles, thus providing longitudinal data.

The U. S. Bureau of Labor Statistics (USBLS) produces indices that quantify price changes over time. The two main indices used are the Producer Price Index (PPI) and the Consumer Price Index (CPI), each with different primary goals (USBLS 2014). The PPI aims to deflate revenue streams to measure real growth output and is a measure of the average change in sale prices for the entire domestic market for raw goods and services. The PPI provides an inflation measure from the point of view of the seller of final goods and services, and includes the price collected by the producer when its goods and services are bought by: (1) consumers directly from producers; (2) consumers indirectly through retailers; or (3) other producers as inputs for final goods. These prices exclude sales and excise taxes, as they do not represent actual revenue for the producer. Although it was established in 1902 as the Wholesale Price Index (a name that was used until 1978), the PPI only began expanding coverage beyond a few production industries in the mid-1980s. As of the 2007 U.S. Census, the PPI still only covered measures for about 72% percent of service industries, leaving the CPI to be the main index to adjust prices for a wide range of industries and businesses. The CPI aims to adjust income and expenditure streams for changes in the cost of living and includes costs of goods and services, both domestic and imported, incurred by urban or metropolitan residents only. This index is reflective of the actual out-of-pocket costs of consumers and includes sales and excise taxes. Although different in scope and coverage, both indices play an important role in adjusting for price changes over time. Prices that have not been adjusted for changes over time, and so reflect the value in a respective year, are "nominal" prices. On the other hand, prices that have taken into account the effects of time are considered "real." To adequately compare economic information over time, they must be adjusted to the same point in time (i.e., "real").

If applied to an angler expenditure profile, price indices could adjust expenses from a single study to generate annual expenditure profiles over time. These profiles, coupled with activity level data routinely collected by state agencies, can generate the needed annual inputs for IMPLAN models to calculate economic impacts in respective years. This chapter's goal was to describe and evaluate the use of price indices to adjust angler expenditures over time to function as inputs for economic analyses. The ability to accurately and efficiently update economic impact studies would allow decision-makers to use the most up-to-date information and establish trends in both angler expenditures and resulting total economic impacts. Furthermore, by establishing trends, decision-makers may have more confidence in economic planning and forecasting. To achieve this chapter's goal, there were three main objectives: (1) conduct a secondary data analysis of an angler survey conducted between June 1, 1994 and May 31, 1995 by Hunt and Ditton (1996) to generate angler expenditure profiles for non-local and non-resident angler groups and adjust them to 2015 prices using published price indices; (2) test the validity of the price adjustment methodology by comparing adjusted profiles to actual 2014-2015 results generated by a replication of the 1994-1995 angler survey; and (3) generate angler expenditure profiles annually from 1994-1995 to 2014-2015 using price indices to serve as inputs for economic impacts analysis, if applicable.

2.2 Methods

2.2.1 Angler Expenditure Profiles and Price Adjustments

A secondary data analysis of angler expenditures at Lake Fork Reservoir from June 1, 1994 to May 31, 1995 required data to be obtained from the original principal investigator (Hunt and Ditton 1996) with permission from TPWD. To generate angler expenditure profiles and adjust them for price changes over time, there were eight steps. First, since only expenditures made by non-local anglers were to be considered for economic impacts analysis, anglers residing in Wood, Rains, and Hopkins Counties in Texas were excluded from the analysis. Second, the remaining anglers were assigned to one of two residence groups: non-local anglers residing in Texas but outside of the three-county local area; and non-resident anglers residing outside of Texas. These groups were consistent with the groupings studied by Hunt and Ditton (1996) and Chen et al. (2003), and could be matched to available effort data collected by TPWD. Third, an angler 'basket of goods' was defined, comprised of seven items: fuel, lodging, restaurant meals, groceries, bait and tackle, fees, and other retail. These items accounted for approximately 95% of all trip expenditures for both resident groups. The remaining percentage of expenditures was spent on guide fees, airplane tickets, boat rentals, and license fees. However, since these expenditures did not account for a significant portion of the trip, or were not likely to recur on every trip an angler made to the reservoir, they were excluded from the analysis. Fourth, expenditure profiles describing mean per-day expenditures were generated for non-local and non-resident anglers visiting Lake Fork Reservoir. For each group, angler expenditures for each item were divided by the total number of days on their trip to create an average daily expenditure for each item. Then, the mean expenditure on each item per day across all anglers in each residence group was found. Fifth, each item in the 'basket of goods' was assigned an appropriate price index published by the USBLS (2015). The following PPIs were assigned to fuel, lodging, groceries, and bait and tackle, respectively: gasoline (Series ID: WPU0517); accommodation (PCU721---); food and beverage stores (PCU445---); fishing tackle and equipment (PCU3399203399201). Because appropriate PPIs were not available for all items, the following CPIs were assigned to restaurant meals, fees, and other retail, respectively: food away from home (CUUR0000SEFV); parking and other fees (CUUR0000SETF03); and other goods and services (CUURD300SAG). Sixth, an annual index for each item was calculated. Because the originally collected data were bound for a period starting June 1, 1994 and ending May 31, 1995, the published average annual index for neither 1994 nor 1995 would be reflective of the period. Therefore, monthly indices for each item were collected for the one-year period (June 1994 to May 1995) and averaged so they can be used as an average annual index. Seventh, Step 5 was repeated for every 12-month period beginning in June and ending the following May for every item to generate seven series of indices, ending in 2014-2015 (Table 2.1). Eighth, the series of price indices from Step 7 were used to adjust mean expenditures made for each of the seven items during the 1994-1995 survey to prices in 2014-2015 (starting June 1st and ending the following May 31st) with the following formula:

$$Adjusted\ Expenditures = \frac{Base\ Expenditures \times Index\ of\ Adjusted\ Year}{Index\ of\ Base\ Year} \qquad (2.1)$$

where, base expenditures were the mean expenditures on an item during the 1995 study, the index of the base year was the calculated average annual index from June 1994 to May 1995, and the index of the adjusted year is the calculated average annual index for any subsequent year. This step was completed for both one-day and multiple-day trips to adjust mean expenditures occurring in 1994-1995 to account for price changes in 2014-2015.

2.2.2 Replication Survey and Hypothesis Testing

To test the accuracy of the price adjustment methodology for angler expenditure profiles fishing at Lake Fork Reservoir, adjusted expenditure profiles needed to be compared to expenditure profiles generated from a new collection of angler expenditure data. Therefore, it was necessary to conduct a replication of the 1995 Lake Fork Angler Survey to provide updated angler expenditure profiles of non-local and non-resident anglers. The replication survey was conducted from June 1, 2014 to May 31, 2015, exactly 20 years after the 1995 survey. The survey process mirrored, as similar as possible while maintaining practicality, the mail survey methodology executed for the original study (Dillman 1978, Hunt and Ditton 1996). The following steps outline the mail survey process.

First, a sampling frame of n=384 non-resident anglers was targeted to reach the desired precision of a 5% margin of error per Krejcie and Morgan (1970). To help minimize cost, names and addresses of anglers were collected during regularly conducted TPWD creel surveys. From 2009-2014, creel surveys conducted by TPWD intercepted an average of 644 parties at Lake Fork Reservoir on 48 sampling days per year (C. Bonds, Texas Parks and Wildlife Department, personal communication, 2014). However, taking into account avidity bias (i.e., anglers being intercepted more than once), historic residency proportions, and an expected response rate of 70% (Hutt et al. 2013), the creel survey alone would not have provided the necessary level of precision. Based on those variables, it was calculated that an additional 53 intercepts (stratified by season and weekday/weekend) were necessary to achieve the desired level of precision among non-local anglers after survey response. Names collected during the 48 regularly scheduled creels and 53 additional intercepts constituted the sampling frame. These additional intercepts were conducted as closely to the TPWD creel intercept as possible, with the exception of questions regarding catch and effort.

At the time of the intercept, anglers were informed about the study, given an information flyer, and asked for their future participation. As each party was encountered, the angler with a birthday closest to the day of intercept was asked to participate. If that angler declined, or had already participated, the angler with the next closest birthday was asked to participate and names and addresses were solicited. Second, anglers were sent a mail questionnaire about the fishing trip to Lake Fork Reservoir on which they were intercepted. Rather than conducting one survey at the end of the creel season, questionnaires were mailed to anglers at the end of each quarter in which they were intercepted. Mail surveys were conducted starting in September 2014, January 2015, April 2015, and June 2015. Mailing questionnaires within three months of original contact was essential in reducing recall bias effects on expenditure items (Chase and Godbey 1983; Chase and Harada 1984). The mail questionnaire collected information regarding trip expenditures, distance traveled to Lake Fork Reservoir, and days spent on the trip. The mail questionnaire was sent by first class mail. This was followed by second and third first class mailings to non-respondents three weeks apart and included a cover letter and replacement questionnaire. Instead of a post-card being sent between the first and second mailing as per Dillman (1978), a fourth questionnaire was sent with non-profit postage two weeks after the third mailing. This aimed to reduce overall mailing costs, get another questionnaire in the possession of non-respondents to improve response rate, and aid in nonresponse analysis if biases were detected.

Next, angler expenditure profiles were generated for non-local and non-resident anglers from the data collected by the survey. These profiles were generated using the same methodology as the 1994-1995 profiles in objective one. Lastly, the adjusted mean daily expense per angler per day for each item from the 1995 angler expenditure profile was compared to those of the 2015 angler expenditure profile using confidence intervals for the difference between two means. The following equation was used to create a 95% confidence interval for the difference between the adjusted expenditures from the 1995 angler expenditure profile and those from the 2015 angler expenditure profile:

$$(\mu_{1995a} - \mu_{2015}) \pm 1.96 \times \sqrt{SE_{1995}{}^2 + SE_{2015}{}^2} \qquad (2.2)$$

where, μ_{1995a} is the 1995 item mean expenditure adjusted for price changes, μ_{2015} is the actual 2015 item mean expenditure, SE_{1995} is the unadjusted standard error of the 1995 item expenditure, and SE_{2015} is the standard error of the actual 2015 item expenditure. This process was conducted for both residence group profiles. The resulting interval was used to test the null hypothesis that the difference between the two means was equal to zero. If the interval for the difference between expenditure profiles did not contain zero, the null hypothesis that the two means were the same was rejected. A conclusion of fail to reject the null hypothesis (an interval with the inclusion of zero) led to the assumption that the index methodology to adjust expenditures from 1995 to 2015 was an accurate method of estimating the expenses over time for each expenditure item on fishing trips to Lake Fork Reservoir.

2.2.3 Annual Extrapolation and Economic Impacts Analysis

In the event hypothesis test results indicated significant differences between the adjusted profiles and actual profiles for 2015, alternate groupings of anglers were explored and re-tested using the same average daily expenses and price adjustment methods as well as a hypothesis test of a 95% confidence interval. If any adjusted angler expenditure profiles were determined to be accurate reflections of actual expenditures of similar anglers in 2014-2015, annual expenditure profiles were generated for each year between the two studies using the series of price indices and Equation 2.1. To calculate total economic impacts, effort data that corresponds to the angler groups must be available to extrapolate expenditures to the population. For any angler groups, adjusted annually and accompanied by corresponding effort data, economic impacts were calculated using standard methodologies.

First, average expenditure per angler per day for each item was entered into the most appropriate IMPLAN sector. The latest model data available at the time of the study was for the year 2013. This database had industries broken down into 536 sectors whereby the user could select to apply expenditure data to once the model of the economy was built. The following sectors were selected: fuel (402 – Retail – Gasoline stores); lodging (499 – Hotels and motels, including casino hotels); restaurant meals (501 – Full-service restaurants); groceries (400 – Retail – Food and beverage stores); bait and tackle (404 – Retail– Sporting goods, hobby, book and music stores); fees (496 – Other amusement and recreation industries) and other retail (405 – Retail Stores – General merchandise stores). Due to IMPLAN methodology and categorization changes from 1995-2015, the number and names of the sectors used in the software were not consistent over time. In the case of these inconsistences, the most appropriate sector was used in place of those previously listed.

Second, margins were applied to applicable sectors. For some sectors, the producer price does not equal the consumer price as there is a wholesale/retail relationship resulting in a price markup. There were four expenditure categories represented by three retail sectors (402, 404, and 405) in the analysis that were collected with consumer prices. To correct for this, margins were used to split the purchaser price into the correct producer value (essentially isolating the price markup), so that only the money impacting the local retail industry would be included. Third, once the expenditure data was entered into the model, the activity level was set to the total activity days by angler group for each respective year. Consistent with Chen et al. (2003), only the activity days of non-resident (residing outside of Wood, Rains, and Hopkins Counties) anglers were included in the analyses. However, since creel surveys are a measure of total effort regardless of residence status, these estimates needed modification so to exclude the fishing effort of local anglers to properly reflect economic impacts. From 2001-2015, TPWD collected zip code data from anglers recreating at Lake Fork Reservoir. Previous to 2001, the agency collected distance traveled (miles) from origin of trip data. Together, these data were used to determine the proportion of anglers that resided outside the counties of Wood, Rains, and Hopkins. This proportion was then applied to the total activity for each year to calculate non-resident fishing days. From these inputs, the model generated the direct, indirect, and induced impacts of expenditures. These steps were repeated for every year between 1995 and 2015, inclusive.

2.3 Results

2.3.1 1994-1995 Angler Expenditure Profiles and Price Adjustments

From June 1, 1994 to May 31, 1995, anglers residing outside of Wood, Rains, and Hopkins Counties took an estimated 176,786 trips to Lake Fork Reservoir for a total of 311,203 activity days. Non-local anglers spent 257,457 of those days (about 83%) fishing the reservoir and non-residents accounted for the remaining 53,746 days. Non-local anglers (n=225) spent per day an average of $13.10 on fuel, $4.11 on lodging, $6.42 on restaurant meals, $5.15 on groceries, $2.99 on bait and tackle, $0.48 on fees, and $1.12 on other retail items for a total average of $33.37 per day. Non-resident anglers (n=213) spent per day an average of $21.69 on fuel, $33.15 on lodging, $16.12 on restaurant meals, $7.89 on groceries, $6.33 on bait and tackle, $0.66 on fees, and $2.23 on other retail for a total average of $88.07 per day (Table 2.2). Once adjusted for price changes, non-local anglers in 1994-1995 spent an equivalent of $82.76 per day in 2014-2015 dollars. Non-resident anglers spent an equivalent of $190.92 per day (Table 2.3).

2.3.2 Replication Study and Hypothesis Tests

From June 1, 2014 to May 31, 2015, a total of 961 anglers agreed to participate in the survey when intercepted by TPWD and were mailed a questionnaire. Of those, 515 anglers (122 local anglers, 312 non-local anglers, and 81 non-resident anglers) returned usable questionnaires for an effective response rate of 56% after non-deliverables were excluded. For the economic impacts analyses, local anglers and responses with incomplete economic or trip length data were excluded leaving n=260 non-local and n=68 non-resident anglers for analysis. Although less than the target sample size of n=384, this sample size (n=328) still resulted in a margin of error of 5.4%.

During the 12-month period, anglers residing outside of Wood, Rains, and Hopkins Counties took an estimated 38,330 trips to Lake Fork Reservoir for a total of 86,520 activity days. Non-local anglers spent 34,388 of days (about 90%) fishing the reservoir, and non-residents accounted for the remaining 9,621 days. Non-local anglers (n=260) spent per day an average of $44.63 on fuel, $22.74 on lodging, $15.63 on restaurant meals, $11.35 on groceries, $8.07 on bait and tackle, $1.24 on fees, and $4.19 on other retail for a total average of $107.85 per day. Non-resident anglers (n=68) spent per day an average of $51.19 on fuel, $47.28 on lodging, $30.49 on restaurant meals, $15.63 on groceries, $14.71 on bait and tackle, $1.18 on fees, and $2.35 on other retail for a total average of $162.83 per day (Table 2.4).

For non-local anglers, 95% confidence intervals for the difference between adjusted 1995 and 2015 mean expenditures included zero for only four of the seven expenditure items: fuel, groceries, fees, and other retail. Intervals for lodging, restaurant meals, bait and tackle, and total trip costs all excluded zero, resulting in a rejection of the null hypothesis and indicating there were significant differences between the adjusted and actual expenditures. Furthermore, these intervals included only negative integers indicating that, for these items, adjusted average daily expenditures were significantly less than actually observed average expenditures (Table 2.5). For non-resident anglers, 95% confidence intervals for the difference between adjusted 1995 and 2015 mean expenditures included zero for six of the seven expenditure items: lodging, restaurant meals, groceries, bait and tackle, fees, and other retail. Only the confidence intervals for fuel and the overall total included zero, therefore rejecting the null hypothesis that there were no significant differences (Table 2.6).

With significant differences between means for multiple items among angler groups, as well as significant differences between adjusted and actual total daily trip expenditures for both non-local and non-resident anglers, it was determined that price adjusting expenditure profiles of anglers fishing Lake Fork Reservoir based on residence was not an accurate methodology.

2.3.3 Angler Regrouping and Hypothesis Tests

With numerous significant differences between the adjusted and actual expenditures for both non-local and non-resident groups, new expenditure profiles were calculated for two new comparison groups of anglers residing outside the three county area: anglers who fished Lake Fork Reservoir on one-day trips and anglers who fished on multiple-day trips regardless of their residence. Due to the potential for a large variance in trip distance for both non-local Texas anglers and non-resident anglers from other states, it was suspected that a greater similarity in expenditure patterns would exist among trips of similar length then among trips taken by anglers of similar residence.

From June 1, 1994 to May 31, 1995, non-local anglers made 106,184 one-day trips and 70,602 multiple-day trips to the Reservoir for a total of 311,203 days. The average trip length for multiple-day trips was 2.90 days. Non-local anglers on one-day trips (n=158) spent per day an average of $12.82 on fuel, $4.59 on restaurant meals, $3.95 on groceries, $2.83 on bait and tackle, $0.34 on fees, and $1.24 on other retail for a total average of $25.77 per day. Noticeably, anglers on one-day trips did not incur lodging costs. Anglers on multiple-day trips (n=274) spent per day an average of $15.21 on fuel, $18.73 on lodging, $11.98 on restaurant meals, $7.06 on groceries, $4.29 on bait and tackle, $0.67 on fees, and $1.42 on other retail per day for a total average of $59.36 per day (Table 2.7). Once adjusted for price changes, anglers on one-day trips in 1994-1995 spent an equivalent of $69.38 per day in 2014-2015 dollars. Anglers on multiple-day trips spent an equivalent of $130.48 per day (Table 2.8).

From June 1, 2014 to May 31, 2015, non-local anglers made 16,731 one-day trips and 21,599 multiple-day trips to Lake Fork Reservoir accounting for a total of 86,520 days. The average trip length for multiple-day trips was 3.23 days. Non-local anglers on one-day trips (n=107) spent per day an average of $52.21 on fuel, $9.93 on restaurant meals, $6.17 on groceries, $6.73 on bait and tackle, $0.71 on fees, and $1.43 on other retail for a total average of $77.18 per day. Non-local anglers on multiple-day trips (n=211) spent per day an average of $39.30 on fuel, $37.07 on lodging, $19.73 on restaurant meals, $15.03 on groceries, $9.22 on bait and tackle, $1.63 on fees, and $6.06 on other retail for a total average of $128.04 per day (Table 2.9).

For one-day trips, the 95% confidence intervals for the difference between adjusted 1995 and 2015 mean expenditures included zero for each individual item and the total daily trip cost. This led to a conclusion to not reject the null hypothesis for each item indicating that there were no significant differences at the 95% level between adjusted expenditures collected during the 1995 Lake Fork Reservoir Angler Survey and the actual expenditures collected during the 2015 study (Table 2.10). For multiple-day trips, the 95% confidence interval for the difference of mean fuel expenditures between adjusted and actual 2015 expenditures was [9.22, 20.05], resulting in a rejection of the null hypothesis. Price adjusted expenditures made on fuel by anglers on multiple-day trips to the Reservoir from the 1994-1995 study were significantly greater than the actual expenditures observed during the 2014-2015 study. However, the six remaining items showed no significant difference. Furthermore, adjusted daily expenditures for multiple-day trips in total were not significantly different than observed results from the 2015 study (Table 2.11).

2.3.4 Expenditure Profile Extrapolation and Economic Impacts

With all seven expenditure items and the overall daily total having no significant difference between adjusted and actual means for one-day trips, it was concluded that the methodology was an appropriate way to adjust angler expenditure profiles over time. Therefore, average daily expenditures of anglers on one-day fishing trips to Lake Fork Reservoir were subsequently adjusted to every year between the original study and the replication (Table 2.12). Although gasoline was significantly different between studies for multiple-day trips, total cost showed no significant differences, so all seven items remained in the profiles and were extrapolated annually (Table 2.13).

These annual expenditure profiles are one input to the IMPLAN software, along with effort data. However, length of trip information was only collected during the two studies and during the annual creel surveys. Without the ability to determine the number of one-day and multiple-day trips, total expenditures and total economic impacts could not be found for each year between the two studies. Still, economic impacts of anglers on one-day fishing trips were calculated from adjusted and actual 2015 expenditure profiles for reference. Using the adjusted expenditure profiles, it was found that anglers on one-day trips had a direct impact of $1,160,797 on the local three-county economy, resulting in an indirect impact of $58,951 and induced impact of $61,900 (Table 2.14). These total impacts of $1.28 million were comparable to the total economic impacts calculated using expenditure profiles of the replication study totaling $1.43 million (Table 2.15). One-day trips only accounted for 19% of the total effort during the 2014-2015 creel period, with the remainder spent on multiple-trip day trips. Economic impacts of multiple-day trips were also calculated using adjusted and actual expenditure profiles; although fuel expenditures were found to be significantly different between the two studies. Using the adjusted expenditure profiles, it was found that anglers on multiple-day trips had a direct impact of $9,106,069 on the local economy, resulting in an indirect impact of $932,307 and induced impact of $781,576 (Table 2.16). Total economic impacts of multiple-day trips calculated using the adjusted expenditures ($10.82 million) were nearly identical to total impacts of $10.80 million calculated from the actual profiles (Table 2.17).

2.4 Discussion

The chapter goal was to propose and evaluate a methodology to calculate measures of economic impacts of recreational fishing over time from a single economic study. To achieve this goal, there were three main objectives: 1) generate angler expenditure profiles from a secondary data analysis and adjust using price indices, 2) test the validity of the price adjustments with a comparison to results of a replication study, and 3) generate annual economic impacts from the validated annually adjusted expenditure profiles. Objectives one and two were achieved as an expenditure profile was generated, adjusted, and compared to actual results during a later time period. However, hypothesis testing results led to the conclusion that the adjusted profile was significantly different from the actual profile of the replication study. Without a valid method to adjust expenditures, annual economic impacts could not be accurately calculated (Objective 3). Through the process of initially rejecting the effectiveness of the proposed methodology, adjusting the grouping structure, and re-evaluating the methodology under new angler groupings, three conclusions were drawn. First, grouping anglers by residence is not appropriate when adjusting expenditures over time. Second, angler expenditures on a 'basket of goods' are consistent with price changes over time when grouped by trip type (one-day or multiple-day), although not indefinitely. Third, future research is necessary to confirm the study findings to determine the optimal period to re-collect data. However, any study must also collect the correct effort information to ensure an accurate calculation of total economic impacts.

The initial attempt of the proposed methodology resulted in significant differences between adjusted and actual expenditures for a majority of items in an angler's 'basket of goods'. Once it was found that the methodology did not accurately reflect actual expenditures, it was important to find an explanation. In this case, there were two reasons why differences would occur between adjusted and actual expenditure profiles: (1) price indices did not properly adjust angler expenditures; and (2) there were significant differences within angler groups between the two studies. It was more likely that the angler grouping methodology was the problematic mechanism because price indices were empirically generated. Economic impacts analyses traditionally group participants by residence group (non-local or non-resident) to be able to apply impacts to multiple scales (i.e., county, region, and/or state level) at a single point in time. However, this study's purpose necessitated an ability to account for changes over time without being bound by a need to calculate impacts for multiple scales. This difference in study goals suggested that anglers may need to be grouped by something other than residence location.

Further evidence against grouping anglers by residence location became apparent when non-local and non-resident anglers were compared between the two studies. First, it was found that the number of one-day trips to the reservoir by non-locals dropped from 65% to 43%; a similar pattern was found for non-residents. These changes in trip length significantly affected the type of expenditures that occurred on a trip and how average daily expenditures were calculated. Second, grouping by residence generally combined heterogeneous trips while separating homogenous trips to the reservoir. Anglers residing in Dallas and Fort Worth, Texas; and Shreveport, Louisiana are all within 120 miles of Lake Fork Reservoir and would likely have similar trip expenditures; yet, these anglers were separated when grouped by residence. Instead, anglers from the Dallas/Fort Worth area were grouped with anglers traveling from Austin or Houston Texas, who travel roughly the same distance as anglers from Oklahoma City and Tulsa, Oklahoma; Little Rock, Arkansas; and Lake Charles, Louisiana. The departure from traditional economic impacts analyses goals and constraints, coupled with the understanding of the effects that grouping by residence has on expenditure profiles over time, provided enough evidence that an alternate method of grouping was necessary when adjusting average daily expenditures over time.

With the major shift from one-day to multiple day trips, it was hypothesized that grouping anglers based on their trip length (one-day or multiple-day) could be a solution to control for variations in expenditures due to the changes in trip characteristics that grouping by residence could not address. In 1995, nearly 95% of average daily trip expenditures were on: fuel, lodging, food, bait and tackle, fees, and other retail (e.g., sunscreen or souvenirs). These items made up the 'basket of goods' that non-local anglers purchase on their trip to Lake Fork Reservoir and were subject to specific (but undefined) parameters corresponding to one-day or multiple-day trips. Most obvious was the parameter on lodging in the local area for one-day trips, as non-local anglers traveling to the local area for the day did not incur any lodging expenses. Additionally, there is a parameter on food costs set by the conventional three daily meals (i.e., breakfast, lunch, and dinner) per day and a parameter for a particular set of groceries (e.g., ice, drinks, and snacks) purchased for a one-day fishing trip. Similarly, there is some maximum distance anglers will travel in one day to make a fishing trip, limiting the amount of fuel that can be used getting to and from the Reservoir. Multiple-day trips theoretically follow parameters as well, once adjusted to a per day basis. All non-local anglers are subject to the same range of lodging costs, three traditional meals, and a particular set of groceries for their fishing trip. Moreover, these items' parameters were expected remain relatively constant across every day of the trip.

Taking into account the shift in trip types and theoretical parameters on expenditure items, average daily expenditures were calculated for one-day and multiple-day trips and the expected patterns emerged, such that expenditure profiles were more consistent with price changes. Non-local anglers on one-day trips purchased arguably the same amount of all seven items in the 'basket of goods' in 2015 as they did in 1995; only prices appeared to have changed. Overall, anglers on multiple-day trips also had similar total daily expenditures in both studies, despite one expenditure item being significantly different. These findings indicated that the 'basket of goods' anglers purchase on their fishing trip was consistent with price changes over time when grouped by trip type and thus provided support for the methodology.

The significant difference between adjusted and actual fuel expenditures on multiple-day trips prompted the importance of periodically re-collecting data to generate new expenditure profiles. It was beyond the scope of this thesis' research to determine the optimal period before replication would be, but it would be prudent to survey the population of anglers to generate new expenditure profiles more frequently than every 20 years. The quantity demanded for certain goods may be affected due to changes in product availability as retail stores open or close, technological advances, or changes in preferences due to unknown influences.

Fuel expenditures on multiple-day trips provide an example of a change in demand as adjusted expenditures on fuel were significantly higher than actual expenditures in 2015, indicating that anglers on multiple-day trips during the replication study purchased a smaller quantity of fuel than during the original study. One possible explanation for this would be that fewer anglers were traveling from extreme distances to fish the Reservoir, driving down average fuel consumption. Additionally, fuel expenditures were not likely to be constant across every day of the trip, as anglers are expected to spend more money on fuel on days they arrive and leave the local area than they do on days spent fishing the Reservoir. This effect is magnified by the increase in average trip length of multiple-day trips from 2.90 to 3.23 day between the two studies. When spending more days on their trip, anglers reduce their average daily expenditure for gasoline. Another explanation could be the improvement in fuel efficiency for vehicles and boat engines alike during the period between the two studies. The effects on this improved efficiency become more visible with the scale of consumption, which would explain why fuel expenditures on one-day trips remained consistent with price changes. These factors provided an explanation for some of the discrepancies between the adjusted expenditures and actual expenditures for fuel on multiple-day trips and were gradual in nature, rather than abrupt. Since these changes in customer base, trip characteristics, or fuel efficiency likely change slowly over time, replications on intervals shorter than 20 years would allow for the incorporation of these changes and result in more accurate profiles. Future research is necessary to determine the optimal interval between data collections to calculate expenditures on the items in the 'basket of goods'.

What to include in the 'basket of goods' during data collection is at the discretion of the researcher. As outlined in the methodology, four items (i.e., fishing guide fees, fishing license fees, other travel expenses, and boat rental fees) were determined not to be core items of a fishing trip to Lake Fork Reservoir and thus were excluded from the 'basket of goods' for this analysis. These items did not share characteristics of the other line items, and were not considered recurring trip costs. Fishing guides are a luxury item that can cost up to $450 or more per day and were only an expense incurred on about 3% of trips in the original study and 6% of trips in the replication study. When hired, fishing guides are commonly used for only a portion of an angler's trip to learn fishing techniques, current fish patterns, or the morphology of the lake before anglers fish the remainder of their trip alone. These aspects differentiate them from common recurring trip costs. Fishing licenses also differ from items in the 'basket of goods' as they can be a one-time expenditure for the year and do not have to be purchased on every trip, especially for Texas residents. Other travel expenses and boat rental fees were both insignificant costs (< \$0.02/angler/day), and were excluded for simplicity. With such a difference in price, utilization, or significance, these items would not be expected to follow the same pattern as other recurring trip costs, nor would they play a significant role in determining total expenditures or total economic impacts. When applying this methodology to a different site or activity, it is possible that core/recurring expenditures differ from those used in this study. However, if properly selected, it is expected other activity 'basket of goods' would follow the same pattern consistent with price changes.

Regardless of the period of replication or composition of the 'basket of goods', future research needs to have access to effort data that coincides with the expenditure profiles to properly extrapolate total expenditures and calculate economic impacts. In this study, effort data were attributable to residence groups, but not groups based on trip type due to trip length data not being annually collected. The inability to calculate the proportion of one-day trips to Lake Fork Reservoir kept annual estimates for total expenditures and total economic impacts from being calculated annually between 1995 and 2015, as per the original study design. However, since full effort data were available for the one-year period of the replication study, the calculation of total economic impacts of both adjusted and actual expenditures for comparison during the final year alone was possible. Total economic impacts of both one-day and multiple-day fishing trips were similar when calculated using adjusted and actual expenditures, despite fuel expenditures being significantly different for multiple-day trips. These results are a function of this methodology generating accurate average daily costs in total for both trip types, despite the discrepancy in fuel expenditures for multiple-day trips. In aggregate, this discrepancy was corrected as the average daily total differed by less than three dollars between the adjusted and actual profiles. However, due to the difference in fuel expenses, impacts attributed to specific sectors were likely affected, so individual sector results should be used with caution. Still, this methodology (once anglers were properly grouped) led to an accurate measure of total expenditures and total economic impacts of recreational fishing at Lake Fork Reservoir 20 years after the initial analysis.

Any conclusions drawn from this study about price adjusting expenditures to calculate economic impacts over time are limited to recreational fishing at Lake Fork Reservoir. However, expenditure profiles and economic impacts analyses have not been exclusive to recreational fishing, and were conducted for various recreation or amusement activities including concerts and festivals. Findings here suggested that similar patterns in expenditures may exist across these other activities. It is likely that verification of this method and further research on optimal study replication periods would be more feasible for another activity or industry. Access to information was a limiting factor in this study, as effort data was not available to extrapolate expenditures to one-day and multiple-day trips. Most public fisheries lack the opportunity and means to collect participant data as they are open access and available free of charge. Other outdoor recreation sites such as parks or campgrounds with controlled access may be better suited for replication trials of this methodology as they should have the ability to readily collect both expenditure and effort data from participants over time.

Should the findings of this research hold true across other sites and/or activities, there are important implications. First, utility/value of economic impact studies would increase as they would be used to calculate a series of economic impacts instead of looking at a single year. As a result, this methodology could be a response to the critique that input-output models ignore changes over time. With adjusted expenditures, properly collected effort data and updated IMPLAN models, changes to expenditures and interrelationships of sectors would all be accounted for. Second, decision-makers would have access to more up to date economic information to assist in decision-making instead of relying on dated, cross-sectional studies. Finally, this improvement in data management is available at a low marginal cost as price indices are publicly available and remaining inputs are already commonly collected as a standard operating procedure for many agencies. In other cases, a single addition to a creel study or other data collection practice would likely provide any missing information necessary for this methodology.

Table 2.1 Series of annual (June to May) price indices of the seven items constituting an angler's 'basket of goods' from 1994 to 2015.

Year	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Fuel	64.6	66.2	74.4	64.3	52.5	79.1	99.3	80.7	95.3	109.3	139.5
Lodging	96.0	100.0	103.3	106.0	110.6	114.0	119.4	120.7	122.2	123.0	128.1
Restaurant Meals	147.0	150.3	154.6	158.7	162.8	166.6	170.8	175.9	179.9	184.2	190.0
Groceries	95.0	98.5	99.0	98.7	100.0	103.7	106.9	112.5	116.5	122.2	128.2
Bait and Tackle	127.1	129.6	131.8	135.4	137.1	140.3	142.9	145.1	147.5	149.4	151.9
Fees	85.1	90.5	100.0	105.8	108.4	112.6	117.7	121.9	124.8	130.2	137.4
Other Retail	179.9	195.0	202.8	216.4	240.5	259.5	272.9	284.9	292.6	298.5	306.4

Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Fuel	187.9	200.4	250.5	211.2	210.4	255.1	300.9	298.7	289.5	229.1
Lodging	134.5	139.1	145.6	143.9	141.1	141.3	144.9	147.3	151.2	155.8
Restaurant Meals	195.9	202.1	210.1	219.8	224.5	227.8	234.3	240.2	245.2	252.1
Groceries	134.5	137.5	145.3	153.8	146.8	154.1	162.3	166.6	169.6	179.7
Bait and Tackle	158.6	166.0	167.8	188.7	185.3	189.7	199.1	201.4	207.4	216.0
Fees	141.1	145.6	153.0	162.3	166.7	170.0	181.2	186.6	190.2	194.4
Other Retail	314.0	320.0	333.4	354.4	400.8	410.6	418.7	423.3	425.8	433.7

Table 2.2 Average trip-related expenditures (U.S. dollars) per angler per day for non-local (n=225) and non-resident (n=213) angler fishing trips to Lake Fork Reservoir, Texas from June 1, 1994 to May 31, 1995.

Expenditure Item	Average Daily Expenditures of Non-Local Anglers (SE)	Average Daily Expenditure of Non-Resident Anglers (SE)
Fuel	13.10 (1.04)	21.69 (1.17)
Lodging	4.11 (0.73)	33.15 (2.09)
Restaurant Meals	6.42 (0.52)	16.12 (0.79)
Groceries	5.15 (0.43)	7.89 (0.59)
Bait and Tackle	2.99 (0.37)	6.33 (0.49)
Fees	0.48 (0.09)	0.66 (0.11)
Other Retail	1.12 (0.56)	2.23 (0.89)
Total	33.37 (2.22)	88.07 (3.48)

Table 2.3 Average trip-related expenditures (U.S. dollars) per angler per day for non-local and non-resident angler fishing trips to Lake Fork Reservoir, Texas from June 1, 1994 to May 31, 1995 adjusted to 2014-2015 prices.

Expenditure Item	Average Daily Expenditures of Non-Local Anglers	Average Daily Expenditure of Non-Resident Anglers
Fuel	46.46	76.92
Lodging	6.67	53.79
Restaurant Meals	11.01	27.65
Groceries	9.74	14.93
Bait and Tackle	5.08	10.76
Fees	1.10	1.51
Other Retail	2.70	5.38
Total	82.76	190.92

Table 2.4 Average trip-related expenditures (U.S. dollars) per angler per day for non-local (n=260) and non-resident (n=68) angler fishing trips to Lake Fork Reservoir, Texas from June 1, 2014 to May 31, 2015.

Expenditure Item	Average Daily Expenditures of Non-Local Anglers (SE)	Average Daily Expenditure of Non-Resident Anglers (SE)
Fuel	44.63 (2.90)	51.19 (5.74)
Lodging	22.74 (2.68)	47.28 (5.50)
Restaurant Meals	15.63 (1.24)	30.49 (3.14)
Groceries	11.35 (0.90)	15.63 (1.94)
Bait and Tackle	8.07 (0.73)	14.71 (2.87)
Fees	1.24 (0.55)	1.18 (0.30)
Other Retail	4.19 (0.99)	2.35 (1.42)
Total	107.85 (6.19)	162.83 (13.83)

Table 2.5 Hypothesis test results regarding a 95% confidence interval for the difference between the adjusted 1994-1995 and the 2014-2015 mean expenditure for items purchased by non-local anglers on a trip to Lake Fork Reservoir, Texas.

Expenditure Item	μ_1	SE_1	μ_2	SE_2	$(\mu_1-\mu_2)$	$1.96 * \sqrt{(SE_1 + SE_2)}$	Interval	Conclusion
Fuel	46.46	1.04	44.63	2.90	1.83	6.04	[-4.21, 7.86]	Do Not Reject H_0
Lodging	6.67	0.73	22.74	2.68	-16.07	5.44	[-21.52, -10.63]	Reject H_0
Restaurant Meals	11.01	0.52	15.63	1.24	-4.62	2.64	[-7.25, -1.98]	Reject H_0
Groceries	9.74	0.43	11.35	0.90	-1.61	1.95	[-3.56, 0.35]	Do Not Reject H_0
Bait and Tackle	5.08	0.37	8.07	0.73	-2.99	1.60	[-4.59, -1.38]	Reject H_0
Fees	1.10	0.09	1.24	0.55	-0.14	1.09	[-1.24, 0.95]	Do Not Reject H_0
Other Retail	2.70	0.56	4.19	0.99	-1.49	2.23	[-3.72, 0.74]	Do Not Reject H_0
Total	82.76	2.22	107.85	6.19	-25.09	12.89	[-37.98, -12.21]	Reject H_0

Table 2.6 Hypothesis test results regarding a 95% confidence interval for the difference between the adjusted 1994-1995 and the 2014-2015 mean expenditure for items purchased by non-resident anglers on a trip to Lake Fork Reservoir, Texas.

Expenditure Item	μ_1	SE_1	μ_2	SE_2	$(\mu_1-\mu_2)$	$1.96 * \sqrt{(SE_1 + SE_2)}$	Interval	Conclusion
Fuel	76.92	1.17	51.19	5.74	25.73	11.48	[14.25, 37.21]	Reject H_0
Lodging	53.79	2.09	47.28	5.50	6.51	11.53	[-5.03, 18.04]	Do Not Reject H_0
Restaurant Meals	27.65	0.79	30.49	3.14	-2.84	6.35	[-9.19, 3.50]	Do Not Reject H_0
Groceries	14.93	0.59	15.63	1.94	-0.70	3.97	[-4.68, 3.27]	Do Not Reject H_0
Bait and Tackle	10.76	0.49	14.71	2.87	-3.95	5.71	[-9.66, 1.75]	Do Not Reject H_0
Fees	1.51	0.11	1.18	0.30	0.33	0.63	[-0.30, 0.95]	Do Not Reject H_0
Other Retail	5.38	0.89	2.35	1.42	3.03	3.28	[-0.26, 6.31]	Do Not Reject H_0
Total	190.92	3.48	162.83	13.83	28.09	27.95	[-0.14, 56.04]	Reject H_0

Table 2.7 Average trip-related expenditures (U.S. dollars) per angler per day for one-day (n=158) and multiple-day (n=274) fishing trips to Lake Fork Reservoir, Texas from June 1, 1994 to May 31, 1995.

Expenditure Item	Average Daily Expenditures of One-Day Trips (SE)	Average Daily Expenditure of Multiple-Day Trips (SE)
Fuel	12.82 (1.33)	15.21 (0.78)
Lodging	-	18.73 (1.46)
Restaurant Meals	4.59 (0.49)	11.98 (0.64)
Groceries	3.95 (0.43)	7.06 (0.44)
Bait and Tackle	2.83 (0.48)	4.29 (0.35)
Fees	0.34 (0.10)	0.67 (0.10)
Other Retail	1.24 (0.79)	1.42 (0.51)
Total	25.77 (2.47)	59.36 (2.72)

Table 2.8 Average trip-related expenditures (U.S. dollars) per angler per day for one-day and multiple-day fishing trips to Lake Fork Reservoir, Texas from June 1, 1994 to May 31, 1995 adjusted to 2014-2015 prices.

Expenditure Item	Average Daily Expenditure of One-Day Trips	Average Daily Expenditure of Multiple-Day Trips (SE)
Fuel	45.46	53.94
Lodging	-	30.39
Restaurant Meals	7.87	20.55
Groceries	7.47	13.36
Bait and Tackle	4.81	7.29
Fees	0.78	1.53
Other Retail	2.99	3.42
Total	69.38	130.48

Table 2.9 Average trip-related expenditures (U.S. dollars) per angler per day for one-day (n=107) and multiple-day (n=211) fishing trips to Lake Fork Reservoir, Texas from June 1, 2014 to May 31, 2015.

Expenditure Item	**Average Daily Expenditure of One-Day Trips (SE)**	**Average Daily Expenditure of Multiple-Day Trips (SE)**
Fuel	52.21 (5.26)	39.30 (2.65)
Lodging	-	37.07 (3.48)
Restaurant Meals	9.93 (1.43)	19.73 (1.56)
Groceries	6.17(0.86)	15.03 (1.14)
Bait and Tackle	6.73 (1.02)	9.22 (0.92)
Fees	0.71 (0.18)	1.63 (0.79)
Other Retail	1.43 (1.10)	6.06 (1.26)
Total	77.18 (6.98)	128.04 (7.69)

Table 2.10 Hypothesis test results regarding a 95% confidence interval for the difference between the adjusted 1994-95 and the 2014-15 mean expenditure for items purchased by anglers on one-day trips to Lake Fork Reservoir, Texas.

Expenditure Item	μ_1	SE_1	μ_2	SE_2	$(\mu_1-\mu_2)$	$1.96 * \sqrt{(SE_1 + SE_2)}$	Interval	Conclusion
Fuel	45.46	1.33	52.21	5.26	-6.75	10.63	[-17.38, 3.89]	Do Not Reject H_0
Lodging	-	-	-	-	-	-	-	Do Not Reject H_0
Restaurant Meals	7.87	0.49	9.93	1.43	-2.06	2.96	[-5.02, 0.91]	Do Not Reject H_0
Groceries	7.47	0.43	6.17	0.86	1.30	1.88	[-0.58, 3.19]	Do Not Reject H_0
Bait and Tackle	4.81	0.48	6.73	1.02	-1.92	2.21	[-4.13, 0.29]	Do Not Reject H_0
Fees	0.78	0.10	0.71	0.18	0.07	0.40	[-0.34, 0.47]	Do Not Reject H_0
Other Retail	2.99	0.79	1.43	1.10	1.56	2.65	[-1.10, 4.21]	Do Not Reject H_0
Total	69.38	2.47	77.18	6.98	-7.80	14.51	[-22.31, 6.71]	Do Not Reject H_0

Table 2.11 Hypothesis test results regarding a 95% confidence interval for the difference between the adjusted 1994-95 and the 2014-15 mean expenditure for items purchased by anglers on multiple-day trips to Lake Fork Reservoir, Texas.

Expenditure Item	μ_1	SE_1	μ_2	SE_2	$(\mu_1-\mu_2)$	$1.96 * \sqrt{(SE_1 + SE_2)}$	Interval	Conclusion
Fuel	53.94	0.78	39.30	2.65	14.64	5.41	[9.22, 20.05]	Reject H_0
Lodging	30.39	1.46	37.07	3.48	-6.68	7.40	[-14.08, 0.72]	Do Not Reject H_0
Restaurant Meals	20.55	0.64	19.73	1.56	0.82	3.30	[-2.49, 4.12]	Do Not Reject H_0
Groceries	13.36	0.44	15.03	1.14	-1.67	2.40	[-4.07, 0.72]	Do Not Reject H_0
Bait and Tackle	7.29	0.35	9.22	0.92	-1.93	1.93	[-3.86, 0.00]	Do Not Reject H_0
Fees	1.53	0.10	1.63	0.79	-0.10	1.56	[-1.66, 1.46]	Do Not Reject H_0
Other Retail	3.42	0.51	6.06	1.26	-2.64	2.66	[-5.30, 0.03]	Do Not Reject H_0
Total	130.47	2.72	128.04	7.69	2.43	15.99	[-13.55, 18.42]	Do Not Reject H_0

Table 2.12 Series of price index adjusted annual (June to May) expenditures within an angler's 'basket of goods' and totals for one-day trips to Lake Fork Reservoir, Texas from 1994 to 2015.

Expenditure Item	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Fuel	12.82	13.13	14.77	12.76	10.42	15.70	19.70	16.02	18.91	21.70	27.69
Lodging	-	-	-	-	-	-	-	-	-	-	-
Restaurant Meals	4.59	4.69	4.83	4.96	5.09	5.20	5.34	5.49	5.62	5.75	5.93
Groceries	3.95	4.10	4.12	4.11	4.16	4.31	4.45	4.68	4.84	5.08	5.33
Bait and Tackle	2.83	2.88	2.93	3.02	3.05	3.12	3.18	3.23	3.28	3.33	3.38
Fees	0.34	0.36	0.40	0.42	0.43	0.45	0.47	0.49	0.50	0.52	0.55
Other Retail	1.24	1.34	1.40	1.49	1.66	1.79	1.88	1.96	2.02	2.06	2.11
Total	25.77	26.51	28.45	26.76	24.81	30.58	35.02	31.87	35.18	38.44	45.00

Expenditure Item	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Fuel	37.30	39.78	49.72	41.91	41.76	50.63	59.71	59.28	57.45	45.46
Lodging	-	-	-	-	-	-	-	-	-	-
Restaurant Meals	6.12	6.31	6.56	6.87	7.01	7.12	7.32	7.50	7.66	7.87
Groceries	5.59	5.72	6.04	6.40	6.11	6.41	6.75	6.93	7.05	7.47
Bait and Tackle	3.53	3.70	3.74	4.20	4.13	4.22	4.43	4.48	4.62	4.81
Fees	0.56	0.58	0.61	0.65	0.67	0.68	0.72	0.75	0.76	0.78
Other Retail	2.16	2.21	2.30	2.44	2.76	2.83	2.89	2.92	2.93	2.99
Total	55.27	58.29	68.97	62.47	62.43	71.89	81.82	81.86	80.48	69.38

Table 2.13 Series of annual (June to May) expenditures within an angler's 'basket of goods' and totals for multiple-day trips to Lake Fork Reservoir, Texas from 1994 to 2015.

Expenditure Item	**1994-95**	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**
Fuel	15.21	15.58	17.52	15.14	12.37	18.63	23.38	19.01	22.44	25.75	32.85
Lodging	18.73	19.51	20.15	20.68	21.59	22.25	23.30	23.54	23.84	24.00	24.99
Restaurant Meals	11.98	12.25	12.60	12.94	13.27	13.58	13.93	14.34	14.66	15.01	15.49
Groceries	7.06	7.32	7.36	7.34	7.43	7.71	7.95	8.36	8.66	9.09	9.53
Bait and Tackle	4.29	4.37	4.45	4.57	4.63	4.73	4.82	4.90	4.98	5.04	5.13
Fees	0.67	0.71	0.79	0.83	0.85	0.89	0.93	0.96	0.98	1.03	1.08
Other Retail	1.42	1.54	1.60	1.71	1.90	2.05	2.15	2.25	2.31	2.36	2.42
Total	59.36	61.29	64.47	63.21	62.04	69.83	76.45	73.35	77.87	82.27	91.49

Expenditure Item	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Fuel	44.26	47.19	58.99	49.72	49.54	60.07	70.85	70.33	68.16	53.94
Lodging	26.24	27.14	28.40	28.08	27.53	27.57	28.27	28.75	29.49	30.39
Restaurant Meals	15.97	16.48	17.13	17.92	18.30	18.57	19.10	19.58	19.99	20.55
Groceries	10.00	10.22	10.80	11.43	10.91	11.46	12.07	12.38	12.61	13.36
Bait and Tackle	5.35	5.60	5.66	6.37	6.25	6.40	6.72	6.80	7.00	7.29
Fees	1.11	1.15	1.20	1.28	1.31	1.34	1.43	1.47	1.50	1.53
Other Retail	2.48	2.53	2.63	2.80	3.16	3.24	3.30	3.34	3.36	3.42
Total	105.40	110.31	124.82	117.60	117.02	128.65	141.73	142.65	142.11	130.47

Table 2.14 Total economic impacts of price index-adjusted angler expenditures on the local economy (Wood, Rains, and Hopkins Counties, Texas) during one-day trips from June 1, 2014 to May 31, 2015.

Impact Type	Employment	Labor Income	Value Added	Output
Direct	17.3	498,970	723,686	1,160,797
Indirect	0.5	13,856	30,922	58,951
Induced	0.5	15,658	35,163	61,900
Total	18.3	528,484	789,771	1,281,648

Employment is number of jobs; labor income, value added, and output are in 2015 U.S. dollars.

Table 2.15 Total economic impacts of actual angler expenditures on the local economy (Wood, Rains, and Hopkins Counties, Texas) during one-day trips from June 1, 2014 to May 31, 2015.

Impact Type	Employment	Labor Income	Value Added	Output
Direct	19.4	555,851	801,137	1,291,299
Indirect	0.5	15,978	35,626	67,888
Induced	0.6	17,964	40,342	71,018
Total	20.5	589,793	877,105	1,430,205

Employment is number of jobs; labor income, value added, and output are in 2015 U.S. dollars.

Table 2.16 Total economic impacts of price index-adjusted angler expenditures on the local economy (Wood, Rains, and Hopkins Counties, Texas) during multiple-day trips from June 1, 2014 to May 31, 2015.

Impact Type	Employment	Labor Income	Value Added	Output
Direct	134.6	3,471,118	5,422,625	9,106,069
Indirect	7.5	236,519	471,881	932,307
Induced	6.4	197,703	443,980	781,576
Total	148.5	3,905,340	6,338,486	10,819,952

Employment is number of jobs; labor income, value added, and output are in 2015 U.S. dollars.

Table 2.17 Total economic impacts of actual angler expenditures on the local economy (Wood, Rains, and Hopkins Counties, Texas) during multiple-day trips from June 1, 2014 to May 31, 2015.

Impact Type	**Employment**	**Labor Income**	**Value Added**	**Output**
Direct	131.6	3,276,305	5,283,415	8,935,784
Indirect	8.3	262,520	518,168	1,027,427
Induced	6.9	212,089	476,287	838,449
Total	146.8	3,750,914	6,277,870	10,801,660

Employment is number of jobs; labor income, value added, and output are in 2015 U.S. dollars.

Figure 2.1 Map of Lake Fork Reservoir located in Wood, Rains, and Hopkins Counties, Texas (Water Data for Texas 2017).

2.5 References

Beale, C. L., and K. M. Johnson. 1998. The identification of recreational counties in nonmetropolitan areas of the USA. Population Research and Policy Review 17:37-53.

Bowen, H. P., and M. F. Wiersema. 1999. Matching method to paradigm in strategy research: limitations of cross-sectional analysis and some methodological alternatives. Strategic Management Journal 20:625-636.

Chase, D. R., and G. Godbey. 1983. The accuracy of self-reported participation rates: A research note. Leisure Studies 2:231-235.

Chase, R. C., and M. Harada. 1984. Response error in self-reported recreation participation. Journal of Leisure Research 16:322-329.

Chen, R. J., K. M. Hunt, and R. B. Ditton. 2003. Estimating the economic impacts of a trophy largemouth bass fishery: issues and applications. North American Journal of Fisheries Management 23:835-844.

Dawson, S. A., D. J. Blahna, and J. E. Keith. 1993. Expected and actual regional economic impacts of Great Basin National Park. Journal of Park and Recreation Administration 11(4):45-59.

Dillman, D. A. 1978 Mail and telephone surveys – the Total Design Method. John Wiley & Sons, Inc., New York, New York.

Driscoll, M. T., J. Leitz, and R. Myers. 2010. Annual economic value of tournament and non-tournament angling at Sam Rayburn Reservoir. Texas Parks and Wildlife Department, Inland Fisheries Division, Austin, Texas, USA.

English, D. B. K., D. W. Marcouiller, and H. K. Cordell. 2000. Tourism dependence in rural America: estimates and effects. Society & Natural Resources 13:185-202.

Hunt, K. M., and R. B. Ditton. 1996. A social and economic study of the Lake Fork Reservoir recreational fishery. Human Dimensions of Fisheries Research Laboratory Technical Report #HD-608, Texas A&M University, College Station, Texas.

Hunt, K. M., and S. C. Grado. 2010. Use of social and economic information in fisheries assessments. Pages 425-447 in W. A. Hubert and M. C. Quist, editors. Inland fisheries management in North America, 3rd edition. American Fisheries Society, Bethesda, Maryland.

Hutt, C. P., K. M. Hunt, S. F. Steffen, S. C. Grado and L. E. Miranda. 2013. Economic values and regional economic impacts of recreational fisheries in Mississippi reservoirs. North American Journal of Fisheries Management 33(1):44-55.

Krecjie, R. V., and D. W. Morgan. 1970. Determining sample size for research activities. Educational and Psychological Measurement 30:607-610.

McKee, C. E. 2013. Economic impact of recreational angler visitation to Lake Guntersville, Alabama. Doctoral dissertation. Auburn University, Auburn, Alabama.

Minnesota IMPLAN Group (MIG). 2004. IMPLAN Professional Version 2.0 User Guide. Stillwater, Minnesota.

Oh, C., and R. B. Ditton. 2008. A time series approach to estimating the economic impact of exogenous events on recreational fishing. Human Dimensions of Wildlife 13:348-360.

Texas Parks and Wildlife Department. 2015. Top 50 largemouth bass. Texas Parks and Wildlife Department, Austin, Texas.

USBLS (United States Bureau of Labor Statistics). 2015. Producer price indexes [online database]. United States Bureau of Labor Statistics, Washington, D.C. Available: http://www.bls.gov/ppi/ppifaq.htm#4 (September 2015).

USCB (United States Census Bureau). 2010. American Fact Finder [online database]. United States Census Bureau, Washington, D.C. Available: www.factfinder.census.gov (September 2015).

USFWS (United States Fish and Wildlife Service). 2011. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Washington, D.C., USA.

Water Data for Texas. 2017. Lake Fork Reservoir [online database]. Texas Water Development Board, Austin, Texas. Available: https://waterdatafortexas.org/reservoirs/individual/fork (Accessed February 2017).

Watson, P., J. Wilson, D. Thilmany, and S. Winter. 2007. Determining economic contributions and impacts: what is the difference and why do we care? Journal of Regional Analysis & Policy 37(2):1-15.

CHAPTER III

A TRENDS ANALYSIS OF ECONOMIC CONTRIBUTIONS OF TOURISM TO A RURAL ECONOMY USING AUTOMATED SOCIAL ACCOUNTING MATRICES

3.1 Introduction

There has been a strong interest in the nature and magnitude of local economic changes that result from a variety of public and private sector industries (Davis 1993). One of these industries is tourism, which has become increasingly important to economic development over the past 40 years as a source of revenue with a potential for rapid growth (Giaoutzi and Nijkamp 2006). However, a strict definition of tourism does not exist, as the term can encompass all travelers away from home and businesses that serve them, including activities from an abundance of disparate industries (Lundberg et al. 1995, Daniels and Pennington-Gray 2006). Most expenditures made by visitors fall into the retail, lodging, food and beverage, and recreational services sectors, leading to a heuristic method of defining tourism by combining these categories (Dawson et al. 1993, English et al. 2000, Watson and Beleiciks 2009). For rural communities, a large portion of the total economic activity from these sectors is attributed to visitors traveling to enjoy recreation opportunities. Often, studies are commissioned by state and local agencies to quantify economic impacts of tourism, including sporting events (Crompton 1995), festivals (Brown et al. 2002), and outdoor consumptive recreation such as hunting and fishing (Chen et al. 2003; Driscoll et al. 2010; Munn et al. 2010; Grado et al. 2011; Hutt et al. 2013).

One area that has been the subject of such research is Lake Fork Reservoir. This recreational fishery is located in rural Texas, approximately 80 miles east of Dallas in Wood, Rains, and Hopkins Counties (Figure 2.1). Combined, these counties have a population of 88,039 (USCB 2010), accounting for about 0.3% of the state population. This 11,033 ha reservoir that has been the most productive trophy bass fishery in Texas since its impoundment in 1980, boasting the state record largemouth bass (8.25 kg) along with 33 of the top 50 largemouth bass caught in Texas (Texas Parks and Wildlife 2015).

In 1995, Texas Parks and Wildlife Department (TPWD) and Sabine River Authority (SRA) commissioned a study of Lake Fork Reservoir to explore the economic impacts that recreational fishing was having on the local economy. The study found that non-local anglers spent 311,283 activity days visiting the reservoir and spent a total of $14,540,000 on trip-related goods and services. These direct expenditures generated an additional $4,019,871 in indirect and induced impacts, resulting in total economic impacts of $18,559,871 on the local economy (Chen et al. 2003). Simple, one-line derivations of dollar amounts or employment figures are common products of such studies because they can be easily reported to provide evidence of an activity's benefit to an economy of interest. However, results of economic impacts analyses are incomplete unless tourism economic impacts are compared to the total economic activity of the impacted region (Dawson et al. 1993). To fully understand economic changes due to tourism, decision-makers must understand the structure of the economy of interest (Shields and Deller 2003).

Early methodologies to define the tourism industry's economic role in a local economy were overly simplistic because of the lack of data available that could be attributed to an ill-defined tourism industry. Over time, methods to quantify tourism's role in an economy have become as varied as the definition of tourism itself. Initially, the role of tourism in a community was quantified using "relative tourism dependency" ratios proposed by Royer et al. (1974) and later modified by Harvey et al. (1995). These ratios compared lodging receipts to per capita income and gross state product (GSP) to rank state economies (Smith and Krannich 1998). Although these ratios provided quantitative measures for the economic role of lodging, they did not fully capture the influence of tourism. Specifically, they only considered one aspect, ignoring other expenditures in the retail, food and beverages, or recreational services industries (English et al. 2000).

Research conducted by the U.S. Department of Agriculture (USDA) Economic Research Service (ERS) included more industries commonly related to tourism to create a typology of nonmetropolitan counties and identify tourism dependence (Bender et al. 1985, Hady and Ross 1990). This research defined tourism dependent counties as having a proportion of total employment and labor income in the eating and drinking, lodging, and amusement sectors greater than 10%. Beale and Johnson (1998) employed a threshold of two-thirds of a standard deviation above the nation average (rather than 10%) to declare dependency, and incorporated per capita spending on accommodations. In terms of rural development, these expenditures from recreation and tourism activities were categorized as exports of the economy which brought in money from outside the region (Dawson et al. 1993). English et al. (2000) explored export levels of these sectors through an estimation of the number of rural jobs and income generated by resource-based recreation (i.e., tourism) by clustering like counties and subtracting local demands using a minimum requirements technique. However, a more common method of estimating the role of specific industries in an economy has been through economic base analysis, which is rooted in economic base theory.

First presented by Haig (1928), and later refined by Weimer and Hoyt (1939), economic base theory introduced the mathematical relationship between basic activities (i.e., activities which export goods and services to points outside the local economic boundaries or to persons who come from outside those boundaries) and non-basic activities (i.e., activities with the principle function of providing for the needs of persons inside the local economic boundaries) (Andrews 1953). Basic activities are the primal focus of this theory as it is assumed that regional prosperity is dependent on external demand for a region's products; however, non-basic activities also serve an important role (despite not generating new money) by keeping money within the region (Watson and Beleiciks 2009).

One way to conduct an economic base analysis is to estimate levels of basic activities with a Social Accounting Matrix (SAM). A SAM is a square matrix serving as a double bookkeeping device tracing transactions between accounts in a specified economy. Generally, there are four types of accounts in a SAM: industries, factors, institutions, and trade (Table 3.1; Alward 2015). Industry accounts include the production and sales of goods and services, including payments to intermediates along the supply chain. Factor accounts include capital and labor income associated with industry accounts. Institution accounts include households and government which experience non-labor, transfer payments such as retirement funds, interest and dividends, rent, taxes, and government payments. Finally, trade accounts encompass exogenous markets and reflect payments for imports and revenues from exports. Each account has a row in which incomes or revenues are recorded and a column in which expenditures are recorded. These models trace the interactions between all accounts in an economy and have been used to quantify economic contributions (Waters et al. 1999, Seung and Waters 2004, Watson and Beleiciks 2009). A SAM can be built using a combination of specific data sources, but are most commonly extracted from input-output modeling software such as IMPLAN. When determining industry contributions, the main advantage of using the SAM model over traditional I-O models is its ability to create a "closed" model by treating expenditures by regional households, state and local governments, and residential investments as endogenous. This addresses the distributional effects on households and government by helping the SAM model trace factor payments and tax payments to institutional spending accounts by residence (Waters et al. 1999, Seung and Waters 2006).

The SAM-based methodology for base analysis has been used to explore the role of agriculture in Oregon (Waters et al. 1999), the seafood industry in Alaska (Seung and Waters 2006), and marine resource enterprises in the Pacific Northwest (Watson and Beleiciks 2009). The role of these economic activities was quantified in terms of gross and base measures. Gross measures were simply a count of all economic activity in a given industry, while base measures credited these industries for bringing in new dollars rather than re-spending, reflecting the assumptions of economic base theory. Base output is equal to gross output, with only the proportions of output by each sector differing. In each of these studies, the base and gross measures of each industry in terms of output or jobs was identified and calculated as a percentage of total gross output (i.e., gross regional product plus value-added) or employment. These analyses provide comparable, quantitative results regarding economic activity, which allows inferences to be drawn about a specific sector's contribution to basic and non-basic activity, and therefore dependency.

Declaring an economy dependent on any sector is a subjective task, as demonstrated by the differences in criteria (e.g., 10%, two-thirds a standard deviation, relative rank). Furthermore, measures of contribution on which dependency is based on will rely on the scope of the analysis. Specifically, county-level models may mask substantial impacts on economic activity and employment at the community level (Watson and Beleiciks 2009). For example, the commercial fishing and fish processing sectors only contributed 1.2% to gross output for the Lincoln County, Oregon economy, but contributed 18% gross output and 23% base output to the economy of Newport, a community within the county (Watson and Beleiciks 2009). This illustrates the importance of understanding the effects of scope and potential for bias when declaring community dependence, an objective that has experienced increased demand over time due to federal mandates requiring the consideration of the effects of management decisions on resource dependent communities (Watson and Beleiciks 2009)

In response to the demand for economic base assessments, automated social accounting matrix (ASAM) software was developed by Rodriguez et al. (2011) to more readily estimate economic contributions of different sectors for different counties and small regions through economic base modeling. This open-source software (a Microsoft Excel-based macro) pulls data directly from a constructed IMPLAN matrix and calculates the gross and base totals and proportions of output and employment attributed to specific industries. Base measures are computed by reallocating economic activity back to the sector responsible for generating new money by quantifying the re-spending within the economy as a result of a sector's exports. A sector with a base output higher than its gross output is indicative of a basic sector which generates spending of new money in the economy. A sector with a base output lower than its gross output indicates a non-basic sector which is responsible for the re-spending of money already in the economy and prevents leakage. Both types of sectors are important to a healthy economy, and their contribution to either type of output can constitute dependency within the region.

The understanding of economic contribution and structure provides a context which may assist with drawing conclusions from findings of other economic studies, such as economic impacts analyses. Still, like other economic studies, replications of contribution analyses are not prevalent in the literature, despite the well documented limitation of these studies' inability to account for changes over time in technology, consumer tastes, or prices. This leaves decision-makers to use information from a single cross-sectional study to make longitudinal inferences, which may be statistically invalid (Bowen and Wiersema 1999). With the development of a methodology to feasibly update economic impacts analyses over time (Chapter I), a need exists to provide a corresponding annual economic contribution analysis to capture the full benefit of the economic information. The ASAM software, coupled with access to a series of IMPLAN data sets, presents an opportunity to evaluate the structure of an economy over time by the proportion of gross and base output measures of economic industries. This chapter's goal was to identify the trend in these proportions in the local economy surrounding a recreation fishing destination with special reference to the collection of sectors that make up the recreation/tourism industry. By exploring the contribution of specific sectors to the regional economy over time, decision-makers could be presented with more information about their economy so that they can more fully understand the implications of findings from similar economic research to make more informed decisions.

3.2 Methods

3.2.1 Social Accounting Matrices

For the purpose of this thesis, the regional economy was defined as the three Texas counties (Wood, Rains, and Hopkins) that contain the inundated boundary of the recreational fishery, as this was the likely range of expenditures by visitors to the Reservoir. To create a series of gross and base output measurements of the regional economy, a SAM had to be built for each year of the intended study period from 1995 to 2015. County-level IMPLAN data sets were provided by the Alward Institute to construct each SAM, and included annual data sets from 1997 to 2004 and from 2008 to 2013. The annual data set for 2005 could not be provided, while format inconsistencies prevented data sets for 2006 and 2007 from being properly imported into the ASAM software.

Building a SAM for any given year involves four steps. First, an IMPLAN model was constructed using the IMPLAN V3 software to combine the data sets for the three counties into a single regional economic model. As part of this process, the software constructed social accounts, industry accounts, and multipliers for the regional economy. Prior to 2007, the IMPLAN software used an econometric regional production coefficient (RPC) to build the economic models (i.e., a location quotient approach). However, beginning with the 2007 data, the software implemented the use of a gravity model to estimate trade flows and RPCs. It has been found that gravity models have been most appropriate in the absence of actual survey data (Riddington et al. 2006), and were therefore used to build the models when available. Similar studies exploring the role of specific sectors in an economy using I-O based models have been able to use direct and secondary data from the economy to supplement estimated models and increase precision (Santos et al. 2016). However, although such data supplementation is feasible for single, cross-sectional references, the task becomes more difficult to achieve for a trend analysis over a 20 year period, and was considered beyond the scope of this chapter. In addition to interindustry relationship data, this model provided economic statistics on population, employment, average household income, and GRP for the regional economy.

Second, once the model was constructed, it needed to be aggregated to allow more accurate comparisons with other models in the series. From 1997 to 2013, the IMPLAN software employed multiple sector schemes comprised of the 440, 509, 528, and 536 sectors. To account for these differences in sector labeling and specificity, every model was aggregated by assigning each sector to one of nine sector group categories using 2-digit North American Industrial Classification System (NAICS) codes. These nine sector grouping included: agriculture (11) and mining (21); construction (23) and manufacturing (31-33); transportation (48-49), communication (51), and utilities (22); services (54-56, 81); finance, insurance, and real estate (52-53); health and education (61-62); government and institutions (92); wholesale trade (42); and tourism (44-45, 71-72). For the purpose of this chapter, the tourism sector grouping included sectors pertaining to lodging, food and beverage stores, recreational services, and retail, consistent with previous research (English 2000; Watson and Beleiciks 2009). Prior to 2001, the

IMPLAN software used a Standard Industrial Classification (SIC) sectoring scheme. In these instances, sectors were aggregated using the NAICS code that the SIC code most appropriately corresponded to. Third, after aggregation, social accounts, industry accounts, and multipliers for the model had to be reconstructed by the V3 software. This process resulted in the generation of an industry by industry (IxI) SAM with four blocs: industry accounts, factor accounts, institution accounts, and trade accounts. Fourth, the (IxI) SAM was exported to be used as an input for the ASAM software. These steps were repeated for every year of available data sets of the three Texas counties.

3.2.2 Calculating a Series of Gross and Base Outputs using ASAM Software

Once a SAM was constructed for every available data year (1997 to 2004; 2007 to 2013), the ASAM software was employed to conduct a base analysis by quantifying the base and gross outputs of each sector group. There were four steps involved in creating these series of data. First, the IxI SAM constructed and aggregated in the IMPLAN software was imported into the ASAM software. As the SAM is imported, the blocs of the SAM were confirmed by having the user identify the aggregated sectors, other endogenous sectors, and households. Second, the software checked the integrity of the matrix by balancing the account rows and columns, and then executed the program to quantify gross and base outputs of the regional economy. As part of the program, the software performed two key steps to determine the base output measures: (1) households were changed from being treated as exogenous to being treated as endogenous, and (2) output was reallocated to the sector responsible for originally generating the new dollars into the economy. The latter was done internally by subtracting total output and employment as a result from other industry activities from each sector, then adding it to the originating sector. The remaining output/employment could then be attributed to industries outside the system (i.e., exports). Third, once outputs were reallocated, gross and base percentage ratios were calculated by the software by comparing base outputs and employment to total outputs and employment. Fourth, steps one through three were repeated for every SAM generated to produce gross and base outputs across all available data sets, which were combined to create a series of outputs over time.

3.3 Results

3.3.1 Regional Economic Metrics

From 1997 to 2013, the three-county region of Wood, Rains, and Hopkins Counties experienced overall growth in population, employment, average household income, and GRP (Table 3.2). The regional population increased by over 22% during the time period to approximately 89,000, resulting in total employment increasing by about 5,500 jobs to breach the 40,000 jobs mark of 2013. The region also had a slight increase in the Shannon-Weaver Index between from 0.93 to 0.96 over the course of the study period. This index is measured on a scale from 0 to 1, indicating perfect inequality and diversity in employment distribution among industries, respectively. Average household income in 2013 was $86,875, more than a 75% increase from 1997. The region's GRP experienced the biggest annual fluctuations in percent change over the period, but increased overall from $1.46 billion in 1997 to $2.91 billion in 2013.

3.3.2 Gross Output Metrics

With the overall growth in the regional economy during the study period, some sector groups had small shifts in their percentage contributed to gross output, although many remained relatively consistent (Table 3.3). Tourism consistently contributed about 8.5% to gross output over time. The largest contributor in every year analyzed was the construction and manufacturing sector group. These sectors contributed an average of about 33% of the gross output of the regional economy over the entire time period. Additionally, for the study period the average percentage of gross output contributed by construction and manufacturing was about the same (34%) during the early stage (1997-1999) and the late stage (2011-2013). The second largest contributor to gross output on average was the agriculture and mining sector group, contributing about 15% of gross output. However, this group contributed an average over 17% in the early stage, but only 13% in the late stage. The finance, insurance, and real estate sector group slowly increased contribution to the gross output from about 9% during the early stage to about 12.5% during the late stage. The remaining sector groups contributed an average of 4 to 8% annually to gross output over the study period. Transportation, communication, utilities, and government and institutions remained relatively constant between early and late stages. Wholesale trade and services each increased their contribution by about 1.5 percentage points between stages, while health and education sectors decreased 1.6 percentage points. Households did not contribute to gross output.

3.3.3 Base Output Metrics

Once gross output was reallocated to the sector responsible for bringing in new money to the economy, base output was measured, and a percent contribution was calculated (Table 3.4). The two largest contributors to gross output, agriculture and mining along with construction and manufacturing, combined to make up more than 50% of the contributions to base output in the regional economy. During the early stage, these two sector groups contributed over 65% to the overall base output; however, they combined to contribute 53% during the late stage. Although households did not contribute to the gross output, this sector contributed approximately 20% annually to the base output. The base output contribution by wholesale trade increased from 1.5% to 5.0% from the early to late stage. Tourism and services also increased between the two stages from 0.6% to 1.8% and from 0.9% to 4.0%, respectively. The remaining sector groups contributed a relatively stable percent to the base output: transportation, communication and utilities about 4%; finance, insurance, and real estate about 1.5%; health and education about 0.5%; and government and institutions about 7%.

3.3.4 Gross Employment

Similar to gross output, contributions to gross employment over the entire study period were relatively stable (Table 3.5). Although it only contributed about 8% to gross output, the tourism sector group was the largest contributor to total gross employment and annually accounted for almost 20% of gross jobs in the economy. The agriculture and mining, construction and manufacturing, and government and institutions sector groups each consistently contributed about 15% to 18% of gross employment. The health and education sector group contributed about 9% annually, while wholesale trade and transportation, communications, and utilities sector groups both steadily contributed 4% to 6%. The services sector group increased from about 8% in the early stage to almost 12% in the late stage. Households did not provide a contribution to gross employment.

3.3.5 Base Employment

The tourism sector group, the largest contributor to gross employment, accounted for less than 3% of gross employment on average over the entire study period (Table 3.6). Still, this sector group's contribution to base employment did appear to increase over time, from 1.1% in the early stage to 3.4% in the late stage. The two major contributors to the base measure, the agriculture and mining sector group and construction and manufacturing sector group, both declined in terms of contributions to base employment from a combined 53% in the early stage to only 39% in the late stage. Households and the government and institutions sector group both consistently contributed about 26% and 13% to base employment, respectively. Tourism, wholesale trade, and services each increased their contribution percentage from less than 2% to 3.4%, 4.5%, and 6.5%, respectively, between the two stages. Health and education along with finance, insurance, and real estate contributed approximately 1% on average to base employment.

3.4 Discussion

This chapter's goal was to quantify the roles of specific sectors in the regional economy encompassing a recreational fishery by calculating the percent contribution to output and employment over a period from 1997 to 2013, with a special interest in the tourism sector. This objective aimed to provide decision-makers with additional economic information to use in combination with other economic data such as results from an economic impact analysis to better understand how economic activities affect a region.

Results of this research led to three conclusions. First, although it is not the largest contributing sector in terms of output, the tourism sector is still an integral part of the regional economy, and has had an increasing role over the study period. Second, due to the complexity of defining tourism, and its reach into multiple sectors, exact measures of tourism activities and their contribution to the economy are difficult to quantify. Third, this rural economy is most dependent on the agriculture and mining sectors and construction and manufacturing sectors, but there has been a slow shift in in the economy's structure as other sectors have become greater contributors over time. Last, contributions of specific sectors are likely to drastically change with scale, as economic activity of certain sectors is not uniformly concentrated, especially in a rural economy.

The tourism sector, which was defined as hotel and lodging establishments, food and beverage stores, recreational services, and retail stores, consistently contributed between 8% and 10% to gross output, just shy of the 10% dependency threshold originally employed by the USDA. Furthermore, tourism's contribution to base output was even lower and experienced more variation over time. This difference in percent contribution between gross and base outputs for the tourism sector indicates the role this sector plays in the economy. A low base output percentage indicates that only a fraction of tourism's gross output is a direct result of the tourism industry (i.e., brought in from outside the region). Rather, the majority of the tourism sector outputs are a result of re-spending of money brought in by other sectors, which is still has an important role as it keeps money in the local economy and slows the leakage rate. While the percentage of contributions to base output was small throughout the study period, there was an increasing trend. The total output of this regional economy increased by about 245% from 1997 to 2013, a growth rate that was only surpassed by three sectors: tourism

(278%), wholesale trade (287%), and services (425%). Growing faster than the economy as a whole, the tourism sector slowly increased its importance to the economy.

When quantified in term of employment, the role of tourism is much more apparent. In gross figures, the tourism sector accounted for nearly one out of every five jobs in the regional economy throughout the study period. By this metric, the USDA would declare the economy as tourism dependent since employment is nearly double the 10% threshold. Much like output, however, the amount of base jobs contributed by the tourism sectors is only a fraction of gross employment. Again, this implies that this sector is largely non-basic and captures the re-spending of money within the economy rather than bringing in new money from outside the region. From a trend perspective, the growth rate of percent contributed to base employment between 1997 and 2013 for tourism (295%) was greater than all other sectors but services (517%). This further supports the inference that tourism became increasingly important over time; however, the definition of tourism in this study still leaves room for ambiguity.

Second, combining lodging, food and beverage, recreational services, and retail industries to form the tourism sector is a common method and accurately encompasses the vast majority of expenditures associated with recreation; however, production in these sectors is not exclusive to tourism, as they also serve local residents and business travelers. This makes the exact contribution of tourism-exclusive outputs to the economy difficult to quantify. Base output measures quantify the amount of money being brought into the economy as a result of these sectors, but it still cannot be directly linked to recreation or tourism activities as tourists spend money on lodging, food and beverage, or retail items for various reasons. This shortfall illustrates the relationship between contribution analyses and economic impacts analyses. Contribution analyses quantify how sectors affect the overall economy, while economic impact analyses can provide how specific activities affect sector outputs. While each type of study produces results beneficial to decision-makers, neither produces a complete picture of the activity and the economy of interest. Understanding the economic impacts an activity has on an economy's sectors, combined with an understanding of how those sectors contribute to the economy as a whole puts decision-makers in better position to evaluate activities and plan for the future of their region.

Third, for the regional economy around Lake Fork Reservoir, the two biggest contributors to gross output were the construction and manufacturing sectors and agriculture and mining sectors. Although it generally contributed a smaller proportion in the second portion of the study period than the first, construction and manufacturing contributed the most base outputs and base employment to the overall economy. Agriculture and mining saw more of a decline in both base measures, indicating that the rural economy may be shifting away from these activities. The sectors that saw the greatest growth over the study period were services (425%), wholesale trade (287%), and tourism (278%). These three sectors contributed a combined 9% more base output in 2013 than in 1997, while agriculture and mining contributed 9% less. This exchange is likely tied to the overall growth in population (22%) and employment (16%) which likely necessitated development in the service and retail sectors, increasing those sectors' ability to capture new money from outside the region. Additionally, the slight increase in the Shannon-Weaver Diversity Index would also indicate more jobs were being added to these developing sectors.

The second largest contributor to both base output and employment was not an industrial sector, but rather was households. Since salaries and wages are counted as factor payments in the SAM, household base outputs quantify the output generated by new money brought into the region through non-labor transfer payments such as retirement accounts, investments/dividends, interest, rent, and government transfer payments. In this three country region, these payments support 20% of output and over 25% of employment. Interestingly, Wood, Rains, and Hopkins Counties rank as the 17th, 24th, and 114th oldest counties out of the 254 in the state of Texas in terms of median age, perhaps attributing to elevated factor payments.

Last, contributions of specific sectors are likely to drastically change with scale, similar to the commercial fishing and fish processing sectors in the Pacific Northwest. As a rural economy, the prevalence of agriculture, construction, and manufacturing sectors as top contributors to output and employment was expected as those activities likely dominate the landscape in the three counties. Economic output from tourism is not likely evenly distributed, but rather concentrated in select areas where tourism or recreation opportunities are most available. Within this regional economy, the communities of Emory, Alba, Yantis, and Quitman directly surround Lake Fork Reservoir and would be the expected destinations for a large percentage of visitors coming to recreate in the area. There is likely a different economic structure for these community-level economies than the region as a whole, as they have to meet the demand for lodging and recreational services that other areas without natural resources and recreational opportunities do not. It would be expected that the contribution of the tourism sector in these communities would be much higher than the region as a whole.

Even though the county-level approach employed in this chapter likely underrepresented the importance of tourism sectors to specific communities, combining these findings with those of the economic impact analysis reveals the role of recreational fishing at Lake Fork Reservoir. Over the 12-month period from June 2014 to May 2015, anglers traveling to Lake Fork Reservoir generated over $12 million of output and approximately 170 jobs in the regional economy (Chapter I). Because these anglers were identified as residents outside the three counties, these are base measures. When compared to 2013 contributions, these impacts likely translate to about 12% of base output and nearly 14% of base employment. In other words, anglers visiting the area to fish at Lake Fork Reservoir accounted for over 10% of all external money spent on retail, lodging, food and beverage, and recreational services (i.e., tourism) within the three counties. Similarly, almost 14% of all jobs generated by all external money in those sectors can likely be associated with anglers fishing Lake Fork Reservoir.

In addition to these direct relationships between recreational fishing at Lake Fork Reservoir and the resulting economic contributions, there are a few unquantified relationships as well. It is currently unknown how the presence of a quality recreational fishery impacts activities in other sectors. For example, the increase in the quality of life in the region resulting from the fishery has likely had an effect on residential and commercial development. Residential communities with proximity to the Reservoir or waterfront lots draw visitors to the area with the opportunity to recreate. Similarly, fishing-specific businesses (e.g., lure manufacturers, bait shops) can be established in the area to cater to the local residents and visitors recreating at the Reservoir. In this sense, the value of the Reservoir supports construction and other industries in the area; however, these impacts are not likely to be captured by the methods performed in this study.

Future quantitative and qualitative data collection efforts would be necessary to more accurately estimate the true contribution of Lake Fork Reservoir to the regional economy. It is expected that results of a similar study on a community-level would describe a different relationship between the Reservoir and the economy. Without local data to customize the SAMs or to construct community-level SAMs, it was not feasible to explicitly quantify the importance of tourism to some communities as expressed by community leaders in those areas. Now that a baseline has been established for the overall region, future research should aim at collecting more localized data to be able to describe contributions at a community-level; specifically, qualitative data concerning managerial decisions of business owners to open their enterprises in the area. This data could lead to further conclusions about the indirect impacts the Reservoir has on other seemingly unrelated business sectors as quality of life can be an important factor when deciding where to work and/or live.

There were two main limitations to this study. First, there was the methodological change within the IMPLAN software from its use of econometric RPCs to a gravity model based method to construct the SAMs. Although gravity models have been generally accepted as the most appropriate method for this, the difference between the two may have some unknown bearing on the inferences drawn from a trends perspective. Second, there was a lack of community-level data. However, even on the county level, the economic contributions associated with Lake Fork Reservoir to the regional economy are apparent.

Table 3.1 Structure of a social accounting matrix (SAM) double entry bookkeeping framework to trace transactions and organize the flow-of-value statistical data for an economy (Alward 2015).

	Industries	**Factors**	**Institutions**	**Trade**	**Total Receipts**
Industries	Intermediate transactions		Final demand	Exports	Total sales
Factors	Value- added				Value-added
Institutions	Indirect taxes	Income	Direct taxes, transfers		Households & Government - Income, Savings
Trade	Imports				Imports
Total Expenditure	Total costs	Total income	Households & Government – Investment Expenditure	Exports	

Table 3.2 Gross output, (in millions, USD), GRP (in millions, USD), population, total employment, and average household income of the regional economy of Wood, Rains, and Hopkins Counties in Texas from 1997 to 2004 and 2008 to 2013.

	1997	1998	1999	2000	2001	2002	2003	2004	2008	2009	2010	2011	2012	2013
Gross Output	2,654	2,926	2,654	2,982	2,751	2,854	3,297	3,520	4,093	3,944	4,832	5,250	5,651	6,498
GRP	1,343	1,536	1,463	1,535	1,247	1,347	1,557	1,645	1,909	1,810	2,432	2,496	2,718	2,910
Population	72,632	75,146	75,722	77,851	79,843	80,775	82,912	84,624	87,469	89,004	89,297	88,594	88,434	88,936
Employment	34,666	35,818	36,408	36,307	35,215	29,009	30,710	31,667	34,714	32,901	38,531	38,596	38,178	40,138
Shannon-Weaver Diversity Index	0.939	0.938	0.942	0.938	0.933	0.934	0.936	0.935	0.928	0.935	0.958	0.953	0.949	0.959
Ave Household Income	49,216	51,799	53,370	50,491	43,188	47,067	47,503	60,105	76,304	71,456	77,669	78,665	78,085	86,875

Table 3.3 Percent gross output of sector groups within the regional economy of Wood, Rains, and Hopkins Counties in Texas from 1997 to 2004 and 2008 to 2013.

Sector Group	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture & Mining	19.6	12.2	19.6	15.2	18.2	14.7	16.4	20.9	15.4	13.4	14.4	13.2	12.6	13.0
Const. & Manuf.	32.1	42.3	32.1	32.1	32.6	37.7	37.8	32.4	33.7	33.1	28.3	30.4	34.4	38.5
Trans., Comm., Util.	9.4	8.4	9.4	9.1	6.8	6.8	6.9	7.1	9.0	8.9	8.8	10.6	9.1	7.9
Wholesale Trade	4.5	4.3	4.5	4.6	4.3	3.9	3.5	4.1	4.7	5.0	5.1	5.2	6.5	6.5
Tourism	8.3	8.2	8.3	8.6	10.3	9.8	8.3	9.1	9.5	8.3	8.0	8.4	8.0	7.4
Fin., Insure., R.E.	9.1	9.3	9.1	13.8	5.1	5.5	4.7	4.1	10.6	11.8	16.4	14.8	11.9	11.0
Services	5.3	4.7	5.3	4.6	7.1	4.9	6.7	6.1	5.5	5.1	7.0	6.8	6.7	6.2
Health & Education	5.5	4.8	5.5	4.8	4.8	5.0	4.2	4.3	3.8	5.0	4.1	3.6	3.8	3.5
Gov. & Institutions	6.2	5.7	6.2	7.2	10.9	11.8	11.5	11.9	7.9	9.3	8.1	7.1	6.9	6.0
Households	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.4 Percent base output of sector groups within the regional economy of Wood, Rains, and Hopkins Counties in Texas from 1997 to 2004 and 2008 to 2013.

Sector Group	1997	1998	1999	2000	2001	2002	2003	2004	2008	2009	2010	2011	2012	2013
Agriculture & Mining	22.7	13.2	22.7	19.9	20.1	14.7	16.7	22.5	16.9	16.1	17.4	12.5	12.5	13.8
Const. & Manuf.	41.4	55.9	41.4	41.8	43.2	52.5	50.7	42.5	38.4	38.8	33.6	36.0	38.7	45.5
Trans., Comm., Util.	4.5	2.7	4.5	4.0	2.3	1.8	2.2	2.5	6.1	4.1	5.2	6.5	6.0	4.8
Wholesale Trade	1.6	1.3	1.6	1.5	1.2	0.9	0.8	1.3	3.3	3.5	4.8	4.6	5.8	4.5
Tourism	0.6	0.5	0.6	0.6	0.9	0.5	0.6	0.7	4.4	2.4	2.7	1.8	1.9	1.6
Fin., Insure., R.E.	1.0	1.1	1.0	3.3	1.0	0.7	0.9	0.8	2.2	1.5	3.9	2.3	1.5	1.4
Services	0.9	0.8	0.9	0.9	1.9	1.2	2.2	1.9	3.9	2.9	3.9	4.0	3.9	4.0
Health & Education	0.5	0.1	0.5	1.0	0.2	0.1	0.2	0.2	1.1	0.4	0.6	0.2	0.5	0.5
Gov. & Institutions	6.6	5.6	6.6	6.9	7.5	6.1	6.8	7.7	8.5	9.9	8.7	6.9	6.8	5.1
Households	20.3	18.8	20.3	20.1	21.5	21.4	19.0	20.0	15.3	20.3	19.2	25.1	22.4	18.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.5 Percent gross employment of sector groups within the regional economy of Wood, Rains, and Hopkins Counties in Texas from 1997 to 2004 and 2008 to 2013.

Sector Group	1997	1998	1999	2000	2001	2002	2003	2004	2008	2009	2010	2011	2012	2013
Agriculture & Mining	16.5	16.4	16.5	17.0	18.1	17.9	18.3	17.2	17.1	14.3	13.6	13.6	12.5	15.9
Const. & Manuf.	17.5	17.7	17.5	16.7	15.6	15.6	14.4	14.4	14.9	14.0	14.0	15.4	15.4	14.5
Trans., Comm., Util.	3.9	4.2	3.9	4.7	4.0	5.2	5.5	5.7	5.9	6.1	5.4	6.6	6.6	4.7
Wholesale Trade	4.8	4.6	4.8	4.5	3.8	4.3	4.0	4.1	4.2	4.6	4.1	4.4	5.0	5.1
Tourism	18.7	18.9	18.7	18.0	19.0	21.2	18.8	18.2	18.9	19.2	17.5	18.5	18.5	17.3
Fin., Insure., R.E.	5.4	5.2	5.4	5.9	4.8	4.4	3.7	3.2	3.2	3.4	8.2	5.1	4.0	7.5
Services	8.1	7.9	8.1	6.5	11.5	7.9	10.2	10.0	8.9	8.5	11.0	11.9	12.2	11.7
Health & Education	9.7	9.6	9.7	9.3	8.2	10.0	8.8	9.3	7.6	9.3	8.5	8.2	8.2	8.4
Gov. & Institutions	15.3	15.4	15.3	17.3	15.1	13.7	16.3	17.9	19.3	20.5	17.7	16.2	17.7	14.9
Households	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.6 Percent base employment of sector groups within the regional economy of Wood, Rains, and Hopkins Counties in Texas from 1997 to 2004 and 2008 to 2013.

Sector Group	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture & Mining	20.5	16.6	20.5	21.2	21.2	17.9	19.3	21.0	18.3	16.8	16.7	12.7	12.4	16.4
Const. & Manuf.	31.5	38.7	31.5	32.1	31.5	37.5	34.1	29.6	22.5	23.4	22.4	24.3	24.0	27.2
Trans., Comm., Util.	3.1	2.1	3.1	3.1	1.9	1.7	2.2	2.4	4.7	3.4	4.0	5.0	5.1	3.8
Wholesale Trade	1.8	1.5	1.8	1.6	1.2	1.1	1.0	1.5	3.1	3.4	4.4	4.3	5.1	4.1
Tourism	1.1	1.0	1.1	1.1	1.5	1.0	1.1	1.2	7.6	4.7	4.8	3.3	3.8	3.1
Fin., Insure., R.E.	0.7	0.8	0.7	2.2	1.1	0.7	0.8	0.7	1.0	0.7	2.5	1.1	0.7	1.1
Services	1.3	1.2	1.3	1.1	2.8	1.8	3.2	3.0	5.7	4.3	5.6	6.3	6.4	6.8
Health & Education	0.7	0.2	0.7	1.6	0.3	0.2	0.3	0.3	1.9	0.7	0.9	0.4	0.9	0.9
Gov. & Institutions	13.2	12.2	13.2	12.6	10.1	7.5	9.6	11.4	17.4	18.0	15.6	13.2	14.5	10.7
Households	26.1	25.6	26.1	23.4	28.4	30.6	28.4	29.1	17.9	24.6	23.1	29.3	27.1	25.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

3.5 References

Alward Institute for Collaborative Sciences. 2015. Economic impact models and IMPLAN v3. Huntersville, North Carolina.

Andrews, R. B. 1953. Mechanics of urban economic base: historical development of the base concept. Land Economics 29(2):161-167.

Beale, C. L., and K. M. Johnson. 1998. The identification of recreational counties in nonmetropolitan areas of the USA. Population Research and Policy Review 17:37-53.

Bender, L. D., B. L. Green, T. F. Hady, J. A. Kuehn, M. K. Nelson, L. B. Perkinson, and P. J. Ross. 1985. The diverse social and economic structure of nonmetropolitan America. USDA Economic Research Service, Rural Development Research Report 49, Washington, D.C.

Bowen, H. P., and M. F. Wiersema. 1999. Matching method to paradigm in strategy research: limitations of cross-sectional analysis and some methodological alternatives. Strategic Management Journal 20:625-636.

Brown, M. D., T. Var, and S. Lee. 2002. Messina Hof Wine and Jazz Festival: an economic impact analysis. Tourism Economics 8(3):273-279.

Chen, R. J., K. M. Hunt, and R. B. Ditton. 2003. Estimating the economic impacts of a trophy largemouth bass fishery: issues and applications. North American Journal of Fisheries Management 23:835-844.

Crompton, J. L. 1995. Economic impact analysis of sports facilities and events: eleven sources of misapplication. Journal of Sports Management 9:14-35.

Daniels, M. J., and L. Pennington-Gray. 2006. Introduction to political-economic construction of quality tourism experiences. Pages 159-170 in G. Jennings, and N. P. Nickerson, editors. Quality tourism experiences. Elsevier Butterworth-Heinemann, Burlington, Massachusetts.

Davis, H. C. 1993. Regional economic impact analysis and project evaluation. University of British Columbia Press, Vancouver, Canada.

Dawson, S. A., D. J. Blahna, and J. E. Keith. 1993. Expected and actual regional economic impacts of Great Basin National Park. Journal of Park and Recreation Administration 11(4):45-59.

Driscoll, M. T., J. Leitz, and R. Myers. 2010.0 Annual economic value of tournament and non-tournament angling at Sam Rayburn Reservoir. Texas Parks and Wildlife Department, Inland Fisheries Division, Austin, Texas, USA.

English, D. B. K., D. W. Marcouiller, and H. K. Cordell. 2000. Tourism dependence in rural America: estimates and effects. Society & Natural Resources 13:185-202.

Giaoutzi, M., and P. Nijkamp. 2006. Tourism and regional development: new pathways. Ashgate, Aldershot, England.

Grado, S. C., K. M. Hunt, C. P. Hutt, X. T. Santos, and R. M. Kaminski. 2011. Economic impacts of waterfowl hunting in Mississippi derived from a state-based mail survey. Human Dimensions of Wildlife 16(2):100-113.

Hady, T. F., and P. J. Ross. 1990. An update: the diverse social and economic structure of nonmetropolitan America. USDA Economic Research Service, Staff Report 9036, Washington, D.C.

Haig, R. M. 1928. Major economic factors in metropolitan growth and arrangement, volume 1. Regional Survey of New York and Environs, New York.

Harvey, M. J., J. Hunt, and C. C. Harris, Jr. 1995. Gender and community tourism dependence. Annals of Tourism Research 22(2):349-366.

Hunt, K. M., and R. B. Ditton. 1996. A social and economic study of the Lake Fork Reservoir recreational fishery. Human Dimensions of Fisheries Research Laboratory Technical Report #HD-608, Texas A&M University, College Station, Texas.

Lundberg, D. E., M. H. Stavenga, and M. Krishnamoorthy. 1995. Tourism economics. John Wiley & Sons, Inc., New York, New York.

Munn, I. A., A. Hussain, S. Spurlock, and J. E. Henderson. 2010. Economic impact of fishing, hunting, and wildlife-associated recreation expenditures on the southeast U.S. regional economy: an input-output analysis. Human Dimensions of Wildlife 15:433-449.

Riddington, G., H. Gibson, and J. Anderson. 2006. Comparison of gravity model, survey and location, quotient-based local area tables and multipliers. Regional Studies 40(9):1069-1081.

Rodriguez, A., W. J. Braak, and P. Watson. 2011. Getting to know the economy in your community: automated social accounting. Journal of Extension 49(4): article 4IAW3.

Royer, L. E., S. F. McCool, and J. D. Hart. 1974. The relative importance of tourism to state economies. Journal of Travel Research 12(4):13-16.

Santos, X. T., S. C. Grado, and K. M. Hunt. 2016. Assessing the economic impact of waterfowl hunting in Mississippi. International Journal of Social Economics 43(1):86-103.

Seung, C. K., and E. C. Waters. 2006. The role of the Alaska seafood industry: a social accounting matric (SAM) model approach to economic base analysis. Annals of Regional Science 40:335-350.

Shields, M., and S. Deller. 2003. Using economic impact models as an educational tool in community economic development programming: lessons from Pennsylvania and Wisconsin. Journal of Extension 41(3):1-7.

Smith, M. D., and R. S. Krannich. 1998. Tourism dependence and attitudes. Annals of Tourism Research 25(4):783-802.

Texas Parks and Wildlife Department. 2015. Top 50 largemouth bass. Texas Parks and Wildlife Department, Austin, Texas.

USCB (United States Census Bureau). 2010. American Fact Finder [online database]. United States Census Bureau, Washington, D.C. Available: www.factfinder.census.gov (September 2015).

Waters, E. C., B. A. Weber, and D. W. Holland. 1999. The role of agriculture in Oregon's economic base: findings from a social accounting matrix. Journal of Agricultural and Resource Economics. 24(1):266-280.

Watson, P., and N. Beleiciks. 2009. Small community level social accounting matrices and their application to determining marine resource dependency. Marine Resource Economics 24:253-270.

Weimer, A. M., and H. Hoyt. 1939. Principles of urban real estate. Ronald Press Company, New York, New York.