University of Nevada, Reno

Methodologies for Forecast Modeling for Small Areas with Limited Data Availability and Unique Tax Structures

A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy in Economics

by
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THE GRADUATE SCHOOL

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ABSTRACT

The downturn in the real estate market and the nationwide economic recession had a considerable impact on the budgets of Nevada's local governments, including the Cities of Reno and Sparks, and Washoe County. Unable to reach revenue levels experienced in the past, local governments were forced to cut services and lay off employees. This experience helped emphasize the need for fiscal planning for local governments. However, many local governments lack access to relevant data and data that is available often lacks the long-term history necessary for planning. The purpose of this analysis is to compare methodologies available for forecast models to determine the most appropriate methodology for creating forecast models for small regions with limited data and a unique tax structure that exists in the State of Nevada. Methodologies for three types of forecasting models are compared to determine the most appropriate methodology for the Reno-Sparks region in Nevada. First, a revenue forecasting model is developed for the Cities of Reno and Sparks, and Washoe County to help forecast assessed property values and taxable sales, which generate the majority of revenues for these entities. Second, a leading economic index for the Reno MSA is created to help forecast economic performance in the region. Finally, a fiscal impact analysis model is developed for Washoe County to determine impacts of future growth on the County's budget. Though it focuses on the Washoe County region as a case study, the goal of this paper is to determine whether modeling techniques can be used for small locations with limited data, and, if so, identify these techniques.

DEDICATION

"Forecasting is the art of saying what will happen, and then explaining why it didn't!"

--Anonymous

This dissertation is dedicated to my brilliant and supportive Sputnik for keeping me on track. Also to mom, dad, Anton, and Ron for being my support system. To Candace for setting me on the public finance track. Finally, to Dr. Harris for his support, knowledge, and patience.

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I would like to thank Brian Bonnenfant at the Center for Regional Studies for his support with data and advice. Finally, I would like to thank Candace Evart for being my mentor, my friend, my teacher, and my family. I would not be where I am without her help and support.

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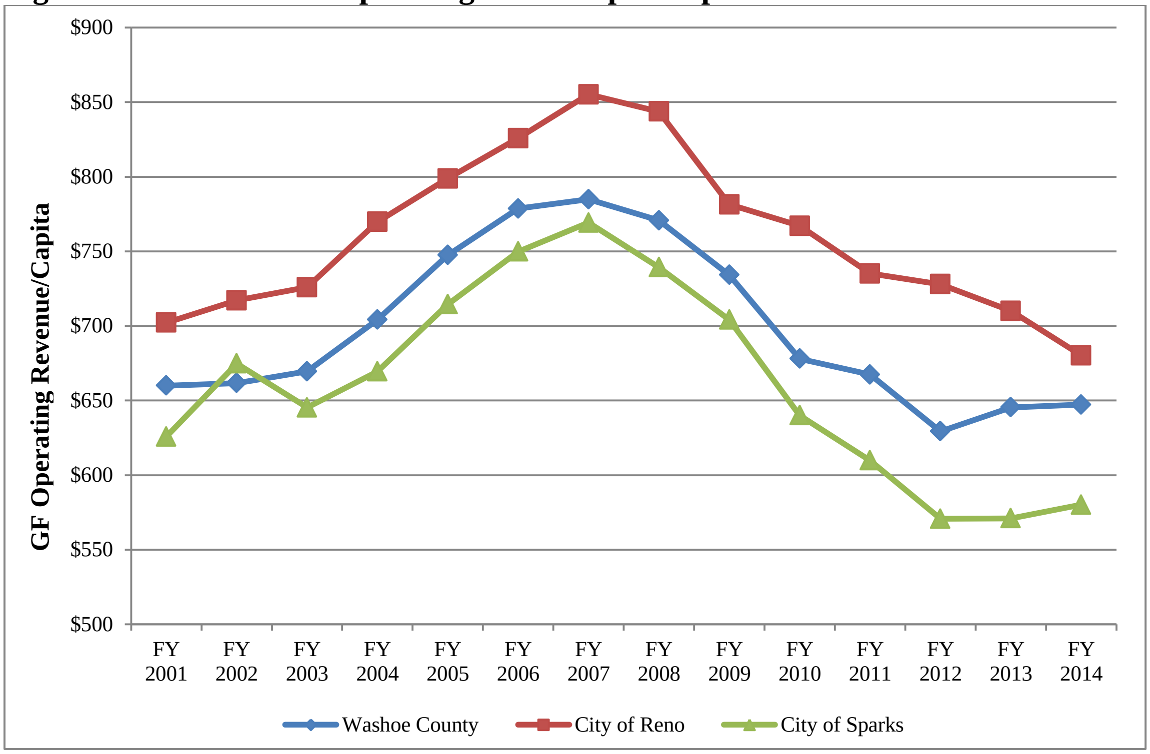
INTRODUCTION

The recent recession, which lasted from 2007 to 2009, had a profound effect on Nevada's local governments and their ability to generate revenues to finance operations. Between its peak performance in fiscal year 2006-2007 (FY 2007)[1] and FY 2014, Washoe County's operating revenue per capita declined by 18 percent, City of Reno revenue per capita declined by 20 percent, and City of Sparks per capita revenue by 25 percent. This is summarized in Figure 1 below (CRS 2014).

Figure 1. General Fund Operating Revenue per Capita



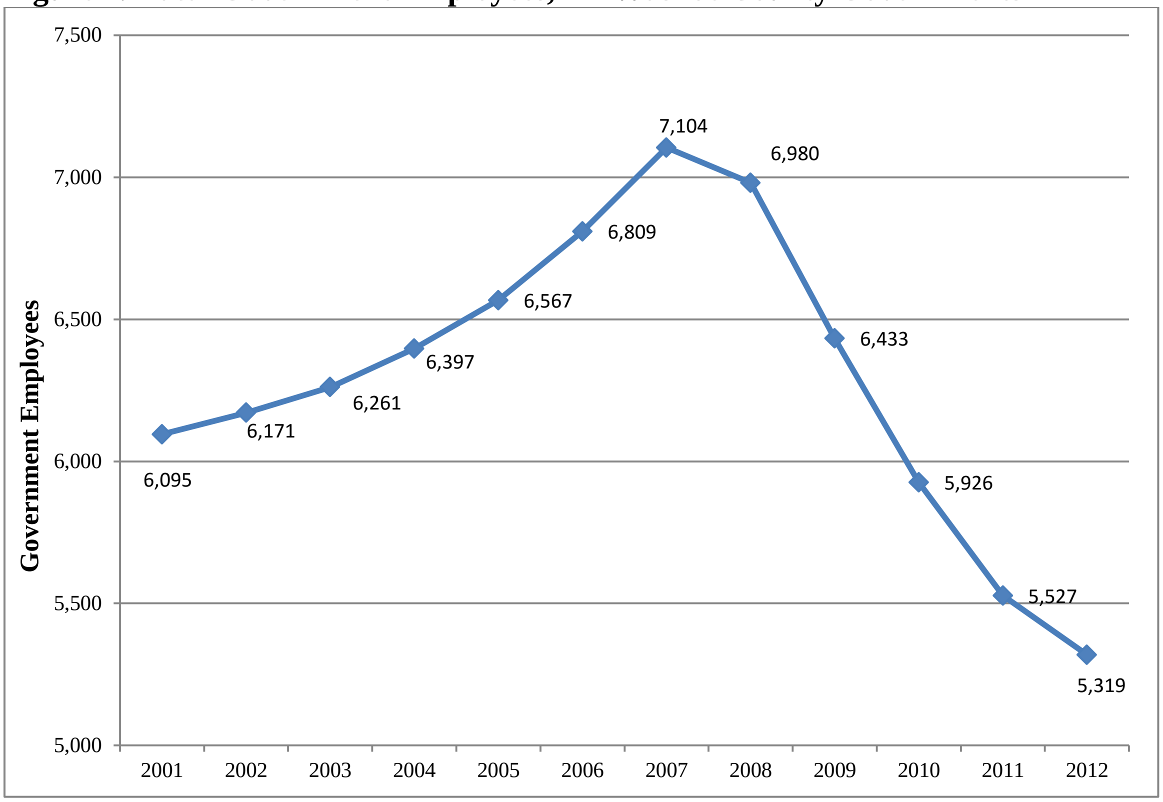
Source: Center for Regional Studies, University of Nevada, Reno. All data are in nominal terms.

The number of local government employees in the Washoe County region also decreased starting in calendar year 2007 through 2012, the latest year for which data is available

[1] All fiscal years discussed throughout this paper are shown in year-end format. For example, fiscal year 2006-2007 is shown as FY 2007. Fiscal years for local jurisdictions discussed in this paper extend from July 1 of Year 1 to June 30 of the next year.

through the Bureau of Labor Statistics (BLS). A total of 7,104 Public Administration-Local Government employees were working in Washoe County in 2007, this number dropped to 5,319 by 2012, a 25.1 percent decrease (BLS 2014).

Figure 2. Local Government Employees, All Washoe County Governments



Source: "Quarterly Census of Employment and Wages." Bureau of Labor Statistics. Data for All Employees, Public Administration-Local Government, Washoe County.

The recession, with its impact on the real estate market and home values, employee layoffs in the public and private sectors, and declining national and local economies, had a serious effect on the local governments' ability to generate revenue and fund public services. This also impacts the local economy as local governments provide important services to their citizens, including police, fire, road and street maintenance, utilities, and other services.

It is important for local governments to be able to forecast and control their revenues and expenditures in order to continue to fund their operations. However, many local governments do not have local expertise to create forecasting models and more importantly, have little access to appropriate, consistent, long-term, quality data necessary for such modeling.

This paper proposes to improve the fiscal planning process for local governments in three ways. First, an econometric revenue forecasting model was developed for the Cities of Reno and Sparks, and Washoe County to help forecast assessed property values and taxable sales, which generate the majority of revenues for these entities. Second, a leading economic indicator index was developed to help forecast the overall economic performance of Washoe County's economy. Finally, a fiscal impact analysis model was developed for Washoe County to determine impacts of future growth on the County's budget.

For each of the three models, existing methodologies for creating forecasting models are compared to find the most appropriate methodology for the Reno-Sparks area given its relatively small size and lack of access to much of the data necessary for forecasting. Additionally, Nevada's unique taxation and funding system, including property tax assessment, dependency on gaming revenue, lack of income tax, and more are considered in the selection of the appropriate methodology for each forecast model.

Though it focuses on the Washoe County region as a case study, the goal of this paper is to determine whether modeling techniques can be used for small locations with limited data, and, if so, identify these techniques. The Washoe County is used due to the author's familiarity with the region, its economic interactions, and local sources of data.

CHAPTER 1:
FORECASTING MODELS FOR LOCAL GOVERNMENT REVENUES FOR THE WASHOE COUNTY REGION

1. Introduction

This Chapter is the result of a Department of Economics Fellowship funded by a joint-venture between the University of Nevada, Reno and Cities of Reno and Sparks and Washoe County. The purpose of the Fellowship was to create an econometric model of the relationship between local government revenue and various leading variables to forecast future revenues as described in this Chapter.

The problem statement, methodology overview, research questions, and significance associated with this chapter are discussed in this Introduction section. Literature Review, Methodology, Findings, and Conclusion/Future Work sections follow the Introduction section of this chapter.

1.1 Problem Statement

As discussed above, local government operations are vital to the health of a region. In order to operate effectively, local governments must be able to plan for future revenues, growth, and demand for services. The problem is that the Cities of Sparks and Reno, and Washoe County currently lack tools to forecast tax revenues, limiting their ability to plan for future operations.

Historically, revenues for the three entities have been projected during the budgeting process based on staff experience with historical revenues and their relationship to economic conditions. Finance departments of each entity also rely on statewide projections and historical growth to project revenues for each budget period. The process is impressive in its level of expertise, and understanding of the economy and the tax system involved. However, this process may be augmented with an econometric model to provide another level of information for forecasting.

1.2 Methodology Overview

This chapter will attempt to apply economic and econometric theory by creating a revenue forecasting model for local governments in the region. As it is the goal of all land-grant institutions like the University of Nevada, Reno to extend academic expertise to the community, this chapter proposes to do this by connecting economic theory to real world analyses and solutions.

The paper researched techniques available for the creation of an econometric revenue forecasting model for the local governments of the City of Reno, City of Sparks, and Washoe County (local governments), determined sources of data available to create these models, collected relevant data, created econometric models and compared these models based on their forecasting ability. This was done using local and national data and modeling methodologies used by other researchers in similar models. This is discussed in greater detail in the Methodology section of this chapter.

1.3 Research Questions

There are a number of research questions on which this paper is based. These include:

1. What sources of tax revenue for the three entities should be forecasted?
2. What local and national variables could be used to forecast these revenue sources, given the need for a strong relationship between dependent and independent variables, variable accuracy, and variable availability?
3. Which of these variables can work as leading indicators or which variables are available as future projections?
4. Should tax revenues be projected as base values (the value to which a tax rate is applied) or as actual revenues to the public entity?
5. What type of a modeling technique is most appropriate given selected dependent and independent variables?
6. What type of a modeling technique will result in a model with the least amount of error between actual and predicted dependent variable?
7. What type of training and resources will be required of the three entities to use the resulting model for future forecasts?

1.4 Significance

The significance of this paper is in its ability to provide local governments in the Washoe County region with an ability to forecast their major tax revenues into the future. Washoe County is used as a case study for this paper due to the author's familiarity with the region's tax structure, economic interactions, and local data sources. However, on a broader scale, the paper compares multiple modeling methodologies for a forecasting model for a small geographic area with data constraints and can be used for data-constrained small regions across the US. The paper shows the benefits and shortfalls of these methodologies in creating usable and accurate forecasting models for these jurisdictions and for similar small jurisdictions.

2. Literature Review

Given the mandate in many states of a balanced budget for state and local governments, the ability to accurately budget expenditures against incoming revenues is an important aspect of government operations. It becomes even more important in times of economic instability, as revenues are more difficult to predict when historical trends are broken. Despite this importance, few local governments utilize econometric modeling or other formal techniques for forecasting their revenues. A national survey of 290 local finance officers found that over 75 percent of local governments did not utilize formal revenue forecasting (Beckett-Camarata 2006). This is summarized in the table below.

Revenue Forecasting Methodologies Utilized by Local Governments

Forecasting Technique	Percent Response	
	Yes	No
Regression	23.8	76.2
Exponential Smoothing	9	91
Moving Averages	36.2	63.8
Box-Jenkins	2.4	97.6
Trend-Line	48.6	51.4
Classical Decompositions	9	91
Econometric	20	80
Judgmental	75.9	24.1

One of the reasons is that formal forecasting models are much more difficult to create for smaller areas than they are for state and federal entities. There are a number of reasons for this. First, business cycles and economic conditions are often different for local economies than they are for the national or state economies. Since they are typically more specialized than the larger regions, local governments experience business cycles that have different cycles and frequency than national cycles. This makes it difficult to use more available national and state data to mimic performance at the local level. Additionally, and, usually more importantly, small areas typically lack data required for formal forecasting models. A model requires variables based on timely, frequent, and reliable data. Historical data for many variables or any data for those variables is often unavailable at the local government level (Weller 1999).

Not only is the creation of a formal forecasting model for Washoe County's local governments difficult due to the County's size, Nevada's unique economy and taxation system add another level of difficulty. According to a paper by Thomas Cargill (1988), there are five characteristics of Nevada's regional economy that make it unique and interesting to study. These include the State's dependence on the gaming industry as its economic base, the centralization of the majority of economic activity in two major population centers (Las Vegas and Reno/Sparks), the large percentage of Nevada land owned by the Federal government, market saturation for the gaming industry in the State, and finally, high rates of employment growth throughout the state (Cargill 1988).

Not included in Cargill's paper, but even more important is the unique approach Nevada takes in assessing its property values. Until recently, Indiana and Nevada were the only two states in the Unites States using the replacement cost minus depreciation approach to value improvements for property tax purposes. The Indiana Supreme Court in 1998 found this practice to be unconstitutional and, starting in 2002 Indiana began using the market value approach to value its improvements (Purdue 2006).

As a result, Nevada is now the only state in the nation to use this approach to value improvements. This means that improvements (buildings) are valued based on the cost to rebuild them today, according to construction data from the Marshall Swift database, minus the amount of depreciation of this value based on the age of improvements (1.5 percent per year times the age of the property for 50 years, with a maximum depreciation of 75 percent of improvements value). Land, however, is valued using the market approach, which is the value of the land on the open market. The replacement cost approach typically results in lower values than the market value approach and Nevada law requires that if the value arrived at using the replacement approach exceeds market value, market value be used (NTA 2011).

Further complicating the system is the abatement of property tax bills introduced by AB (Assembly Bill) 489 in 2005. According to this legislation, the property tax bill for an owner-occupied residential property cannot increase by more than 3 percent per year and more than 8 percent per year for commercial and non-owner-occupied residential properties. The difference between the actual property tax bill increase and the one allowed by AB 489 is banked annually (abated) and used during times when the actual property tax bill does not increase as much as capped by AB 489 (NTA 2011).

As a result, Nevada's property tax system is very difficult to model. The system not only combines multiple methods for valuation (replacement cost minus depreciation for improvements and market value for land), it creates property tax bills that may have little relationship to actual market conditions. Property tax forecasting is a difficult undertaking and is even more difficult given Nevada's unique assessment system.

During the literature review of the subject few relevant paper discussing the forecast of property tax revenue were found. One paper discussed models used by the New York City Office of Management and Budget to forecast taxable assessed values and resulting property tax revenue for the City. The models discussed in the paper were complicated, utilizing revenue projections by other departments and multi-step modeling processes. This type of model was difficult to reproduce given local resources. Additionally, these models relied heavily on using economic measures to arrive at market values of properties, which are used as basis of property assessment in New York (NYCOMB 2012). The Nevada property tax assessment system is based on both replacement and market values, so the New York models are not directly relevant. It is likely that most property tax and assessed value forecasting models created for non-Nevada jurisdictions will not be directly applicable to Nevada jurisdictions.

In the second property tax related paper reviewed, Sexton (1987) discusses the importance of property tax revenue to local government budgets. Despite this importance, local governments do not typically have statistical or econometric models for revenue forecasting, relying instead on trend models which do not take into account changes in economic and demographic changes in the region. Sexton compared the results of three forecasting models using statistical/econometric techniques to those of using the trend methodology for 1981 to 1983 for Minnesota counties. The three techniques included 1) traditional income elasticity models measuring the relationship between income and property tax base, 2) structural econometric model incorporating supply and demand factors associated with property tax valuation, and 3) an ARIMA model using the Box Jenkins methodology which forecasts property tax based in terms of current and past values. Sexton uses property tax base, not property tax revenue as the forecasted variable to account for changes in property tax rates. The paper found that the structural model is superior to other models for single- and multiple-year forecasts and all three models outperformed the trend model typically used for local governments (Sexton 1987).

While there few studies on property tax modeling, there were a number of Nevada-based and national studies for forecasting other revenues. In the paper mentioned above, Cargill and Morus (1988) created a model of the Nevada economy using eight variables. Three variables represented economic activity: total industrial employment, taxable sales, and gross gaming revenues. California civilian employment was also included due to the State's proximity to Nevada and interconnectedness of Nevada and California's industries. Finally, four national variables were included: real gross national product, the annualized rate of inflation measured by the GNP deflator, total civilian employment, and the 6-month commercial paper rate. While this model measured the overall economy, it provided an important list of local and national variables believed by the authors to influence Nevada' economy.

Cargill and Morus used a vector autoregression (VAR) time series methodology to create their model. They found that the VAR methodology allowed for a creation of a relatively simple forecasting model for a regional economy that incorporated both theory and flexibility. The performance of this model as a forecasting model was found to be promising and performed better than traditional approaches to modeling and forecasting.

According to Cargill (1988), a VAR model represents a vector of variables as a general autoregressive structure in which the relationship between a number of variables and their past values is employed. The general mathematical structure of a VAR model is:

$$Y(t) = D(t) + B_1 Y(t-1) + \cdots B_m Y(t-m) = e(t) \qquad (1)$$

where Y is an n x 1 vector of variables. 0 is an n x 1 vector of deterministic components
B is an n x n matrix of coefficients
e is an n x 1 vector of residuals
m is the lag length

In other words, historical value of the variable is used to forecast the same variable (Cargill 1988).

In their forecasting model of gross gaming revenue, Cargill and Eadington (1978) used California personal income (prior to the introduction of gaming in California much of gross gaming revenue in Nevada was generated by California residents), a dummy variable for economic conditions (1 during recession, 0 otherwise), and a dummy variable for the energy crisis between 1973 and 1974, which is not relevant to this study.

Cargill and Eadington compared a regression model of gaming revenue in three regions in Nevada to an ARIMA forecasting model. The regression model for gross revenues had the following general form.

$$\ln GGR = a_0 + a_1 \ln CPY + a_2 \ln CED + a_3 ED \qquad (2)$$

where:

GGR is gross gaming revenues, seasonally adjusted.
CPY is California personal income, seasonally adjusted.
CED is current economic conditions, equaling 1 during recession and 0 otherwise.
ED is energy crisis, equaling 1 from 1973-III to 1974-IV, 0 otherwise.

The Cochrane-Orcutt method was utilized as the model showed serial correlation. In reviewing the results of this model, Cargill and Eadington found that it was difficult to determine whether the significant results of the model were due to a true cause-and-effect relationship among the variables or coincidental changes in the variables over time. As a result, the Box Jenkins ARIMA methodology was used to estimate another model for forecasting gaming revenue. The general form for this model was:

$$(1 - \varphi_1 B - \cdots \varphi_1 B^p)(1 - \varphi_1' B - \cdots \varphi_1' B^{p1})(1 - B^s)^{d1}(1 - B)^d \acute{Z}_t =$$
$$\theta_0 + (1 - \theta_1 B - \cdots \theta_q B^q)(1 - \theta_1' B - \cdots \varphi_q' B^{q1}) a_t \qquad (3)$$

where $\acute{Z}_t = Z_t$ if d>0 or d_1>0 and $\acute{Z}_t = Z_t - \mu$ if $d = d_1 = 0$.
The Box-Jenkins method required that Z_t be stationary, or that it can be reduced to a stationary series by differencing. Converting time series to a stationary form has not proved to be a difficult problem in practice with economic data. The parameters of the equation are:

$\varphi_1, \ldots.., \varphi_p$ are the regular autoregressive parameters,
$\varphi_1', \ldots.., \varphi_p'$ are the seasonal autoregressive parameters,
μ is the mean of the series,
θ is the deterministic trend constant,
$\theta_1, \ldots..., \theta_q$ are the regular moving average parameters,
$\theta_1', \ldots..., \theta_q'$ are the seasonal moving average parameters,
d is the number of regular differences,
a is the order of the seasonal difference, and
d_1 is the number of seasonal differences.

The comparison of the two models found that the Box-Jenkins forecasting techniques provided short term projections which were as good as or better than those based on the regression methodology (Cargill 1978).

A model forecasting taxable sales in Washoe County by Hester and Reed (no date) was based on a single economic variable, nominal gross national product (GNP). The model also contained three dummy variables for the inclusion of food in taxable sales, which was in effect between 1956 and 1979 and is not relevant to the taxable sales model, a dummy variable for a higher tax rate, and a dummy variable for the first quarter of the year. Data for the model was obtained through a national subscription source.

Hester and Reed's single equation multiple regression model for forecasting taxable sales in Washoe County is the closest to the econometric modeling goal. The model, which was estimated using the Ordinary Least Squares (OLS) methodology and its results are shown below.

$$\begin{aligned}\text{CETX\$.NVQ} = &\underset{(5.298)}{-309.30304} + \underset{(31.009)}{0.68036696}\,\text{GNP\$.USQ} + \underset{(3.032)}{125.41212}\,\text{DUMTXF.NVQ} \\ &\underset{(2.5156)}{-102.19986}\,\text{DUMTXR.NVQ} \underset{(10.294)}{-72.086432}\,\text{DUMQONE.NVQ} \qquad (4)\end{aligned}$$

$$R^2 = 0.944$$

where
CETX$.NVQ is the nominal taxable sales in Nevada,
GNP$.USQ is the nominal gross national product,
DUMTXF.NVQ is the dummy variable for inclusion of food in taxable sales (1956.1 to 1979.1=1, 0 otherwise),
DUMTXR.NVQ is the dummy variable for higher tax rate (1956.1 to 1981.2=1, 0 otherwise),
DUMQONE.NVQ is the dummy variable for first quarter (first quarter =1, otherwise 0).

Unfortunately the model showed a high level of errors after two and a half years of forecasting. The error in the model was due to the magnitude of error from the use of the multiple regression technique, not due to error in the national forecast. In other words, while the GNP projections were not necessarily wrong, they were not effective at predicting taxable sales in Nevada. It was decided that the cost of subscribing to the national forecasting services was not justified by this model (Hester).

Another model was created for Washoe County, this one by Hester and Rosen (1981). The model attempted to cover the entire Washoe County economy with 80 overall equations, 47 identities, and 33 stochastic equations. This included 36 race and sex equations, wage, personal income, per capital personal income, gross regional product, total establishment-based employment, total household-based employment, the number of unemployed, total population, and labor force aggregates. The stochastic equations were used to estimate sector wage rates, Social Security contributions, residential adjustment to personal income, sector output levels, sector employment levels (excluding Federal government), and unemployment rate. The model was also estimated using an ordinary least squares (OLS) regression methodology and the Cochrane-Orcutt GLS (generalized least squares) regression methodology where serial correlation was present (Hester 1981).

Balcilar et al (2013) created forecasting models for gross gaming revenue and taxable sales in Nevada using a number of linear and non-linear models. Linear models included vector autoregressive (VAR), Bayesian VAR (BVAR), vector error-correction (VEC), and Bayesian VEC (BVEC) models. Non-linear models include semi-parametric (SP), non-parametric (NP), smooth transition autoregressive (STAR), and artificial neural network (ANN) models.

The non-linear models are complex models and are not considered in this paper. For linear models, Balcilar found that VEC models generally provided the best forecasting performance on average across various forecast horizons. The VAR model dominated other methodologies at the longer run horizon. The BVEC models did not perform well relative to the VEC, RVEC, or VAR models in any of the attempted scenarios (Balcilar 2013).

There have been a number of relevant forecasting models outside of Nevada. A model in King County, Washington (2010) was created to forecast taxable sales using a two-step error-correction model. The benefit of this model was that it combined both cyclical and trend forecasting in a single model. The first step of the model estimated the trend equilibrium relationships in the variables. Below is a simple example of the model using one independent variable X.

$$\ln Y_t = \alpha_1 \ln Y_{1t} + \alpha_2 + u_t \tag{5}$$

where
$\ln Y_t$ is the natural log of sales and use tax base,
$\ln Y_{1t}$ is the natural log of a predictive variable (e.g., personal income) which have available projections from a forecasting services,
α_1, α_2 are the estimated coefficients, and
u_t is the deviation of sales tax base from trend equilibrium at time t.

The second step of the model was to estimate cyclical turning points of data using residual data estimated in step one as a long-run trend component.

$$\Delta\ln Y_t = B_1 \Delta \ln X_{1t-1} + B_2 \Delta \ln Y_{t-1} + B_3 + y u_{t-1} + \varepsilon_t \tag{6}$$

where
$\Delta\ln Y_t$, $\Delta \ln Y_{1t-1}$, $\Delta \ln Y_{t-1}$ are variables from equation (5) in rate-of-change form,
$u_{t-1} = \ln Y_{t-1} - \alpha_1 \ln Y_{1t-1} - \alpha_2$ is the deviation from trend equilibrium in the previous year,
B_1, B_2, B_3 are estimated coefficients.

The final model allowed forecasting to a k[th] period: (King 2010).

$$\ln Y_{T+k} = \ln Y_{T+k-1} + B_1 \Delta \ln X_{1T+k-1} + B_2 \Delta \ln Y_{t-1} + B_3 + y[\ln Y_{T+k-1} - \alpha_1 \ln X_{1T+k-1} - \alpha_2] \quad (7)$$

Fullerton (1989) estimated sales tax revenue in Idaho. His model estimated sales tax receipts as impacted by Idaho's' wage and salary disbursements, price deflator for personal consumption expenditures, and dummy variables for quarters one through three. Fullerton suggested a composite model combining two methodologies, an econometric model and an ARIMA model. According to Fullerton, these composite forecasts were found to outperform both base-line forecasts. The final econometric model had the following shape:

$$TAX_t = b_0 + b_1 WSD_t + b_2 PC_t + b_3 Q_1 + b_4 Q_2 + b_5 Q_3 + U_t \quad (8)$$

where
t are quarters 1, . . . , T,
TAX_t are sales tax receipts,
WSD_t are Idaho wage and salary disbursements,
PC_t is the implicit price deflator for personal consumption expenditures,
Q_i are dummy variables for quarters one through three, and
U_t is the disturbance term.

The second forecast model was the Box-Jenkins univariate ARIMA technique. The general form of the ARIMA equation was as follows:

$$T_t = [Q_0 + Q(B)Q^s(B)U_t / [(1 - B)^d (1 - B^s)^D P(B) P^s(B)] \quad (9)$$

where
T_t represents the stationary working series calculated for the quarterly sales tax observations,
Q_0 is the constant term,

B is the backshift operator,
B^s is the seasonal backshift operator,
Q(B) is a moving average polynomial of order q,
$Q^s(B)$ is a seasonal moving average polynomial of order q^s,
U_t is the error term,
d is the degree of regular differencing required to induce trend stationarity in the working series,
D is the degree of seasonal differencing required to induce stationarity in the working series,
P(B) is an autoregressive polynomial of order p,
$P^s(B)$ is a seasonal autoregressive polynomial of order ps.

The conclusion of the paper was that in spite of the fact that both the econometric and ARIMA projections were accurate, the composite predictions were superior at every step length forecasted (Fullerton 1989).

The model for the Central Ohio Transit Authority (COTA) was one of the simplest; projecting regional taxable sales using a single variable of employment for the two counties making up the region. COTA used a simple time series econometric model to estimate taxable sales in its region. Two models were first created by COTA, one using employment as an independent variable and another using both employment and per capita income. The employment and per capita income model had a better fit and is shown below.

COTA taxable sales (in millions of dollars) = -14,241.86 + (0.294 * MSA Per Capital Income) + (0.030 * Franklin and Delaware Employment) (10)

The adjusted R^2 result of the model was 0.9921, indicating a good fit. Additionally, the coefficients on the employment and per capita personal income variables were significant at the 95 percent level and had t-statistics of 5.94 and 4.56, respectively, indicating that there was a correlation between employment, per capita personal income, and taxable sales (COTA 2006).

In California, the State of California Franchise Tax Board (CFTB 2014) used California wages and salaries, California unemployment rate, U.S. vehicles, California housing permits, and U.S. Consumer Goods Deflator variables to forecast state taxable sales. CFTB used a multi-regression model to determine the statistical relationship between quarterly taxable sales amounts and various economic variables provided by the Economic Research Unit (ERU). Economic variables were forecast using information provided by ERU researchers and various departments. The appropriate sales tax rate was then applied to forecasted values to estimate sales tax revenues (CFTB).

To forecast total State-level revenues and revenue from smaller components (sales tax, income tax, and corporate tax) in California, Krol (2010) used the logarithm of the tax revenue data as a dependent variable and the following independent variables: seasonal dummy variables, real GDP, real personal income (U.S. and California), and real personal income in the Far West census region, aggregate coincident business cycle index constructed by the Federal Reserve Bank of Philadelphia, consumer price index, real price of West Texas Intermediate crude oil, real defense expenditures, the interest rate spread, a tech sector index, California real price of housing, state coincident index, and state unemployment rate (Krol 2010). This is a more detailed list than may be relevant for this study's model as the forecast model included all California state revenues including franchise tax, sales tax, corporate tax, and more.

Finally, in predicting Seattle taxable sales, Kirn (2007) used regional personal income and regional employment rate variables. In Florida, the Washington Economics Group, Inc. (WEC 2008) used real per capita income, Consumer Sentiment Index, population, and monthly dummy variables to forecast Florida taxable sales by type (durable, nondurable, auto, tourism, business and building sales).

A review of other less relevant studies provided a list of additional independent variables that can be used in an econometric model to forecast assessed values and taxable sales. These variables included both national and local sources such as US Index of Leading Indicators, US housing permits, US employment, S&P 500, money supply, manufacturers' orders of consumer goods, local employment, unemployment, wages, airport enplanement/deplanement, visitor volume, claims for unemployment, help wanted ads, corporate filings, building permits, housing days on market, home prices, new electrical connections, motor vehicle registrations, gaming revenue, and consumer goods price deflator. Many models also included a national or leading economic index as a variable.

Overall, the above literature review further emphasized the importance of revenues for local government operations and the growing demand for econometric models to help forecast these revenues. As found in a number of the above papers, the previously used trend models are useful in providing a ball-park revenue estimate, but econometric models provide a more accurate forecasting model by considering, in some cases historical performance of revenues, but also other economic and demographic variables. All models have certain advantage and disadvantages to be considered. For example, the structural model provided some of the most accurate results, but required large quantities of data, which may not be available at the local government level. Other methodologies, such as the ARIMA, require much less data, but are difficult to use for forecasting purposes without access to statistical software and some experience.

Additionally, the majority of the above papers modeled tax base rather than tax revenue as the forecasted variable. This allows the model to exclude the impact of tax rate and assessment changes, reducing potential model errors. This is consistent with the methodology used in this paper, as discussed in the next section.

3. Methodology

According to Kavanagh and Iglehart (2012), there are five main steps in creating a forecasting model, as described below. The research and analysis utilized in this chapter is described for each of these steps.

1. **Define the Problem**-What issues affect the forecast and presentation?
2. **Gather Information/Data Compilation**-Obtain statistical data, along with accumulated judgment and expertise, to support forecasting.
3. **Conduct a Preliminary/Exploratory Analysis**-Examine data to identify major drivers and important trends. This establishes basic familiarity with the revenue being forecast.
4. **Select Methods**-Determine the most appropriate quantitative and qualitative methods.
5. **Implement Methods**-Use the selected methods to make the long-range forecast (Kavanagh 2012)

3.1 Define the Problem

The primary objective of this paper is to help improve local government operations by adding some degree of certainty to their revenue forecasts. Having a reliable forecast of future revenues would allow each local government to better budget expenditures, including the provision of services to its citizens and the undertaking of major new and maintenance projects. Of no less importance is creating a model that is easy understand and use, and one based on variables that are updated frequently, are reliable, and are easy to find.

While the paper uses Washoe County local government as the case study, findings for the paper's sales tax model can be applied to any small jurisdiction in the United States.

Based on extensive literature search and conversations with Dr. Tom Harris, my Dissertation Committee Chair, Dr. Mark Nichols, and analysts from the State Budget office and Legislative Counsel Bureau, two issues were discovered that helped shape the type of revenues included in the forecast models.

First, it was determined that local government revenues are difficult to model as a single dependent variable. Local government revenues are made up of multiple sources and uses, which makes it difficult to decide whether to include all revenue sources, whether to include only restricted or unrestricted revenues, etc. The ideal methodology would be to create an econometric model for each revenue source (sales tax, property tax, building permits, fines and forfeitures, etc.). However, due to lack of historical data for each of the revenue sources and the large number of these revenue sources, it was decided to focus on two major revenue sources for the three local governments-property tax and sales tax revenue.

While these two sources do not cover all revenues for the three jurisdictions, they make up a high portion of the operating and debt budgets for the entities. For the City of Reno, property tax revenue was budgeted to make up 27.3 percent of General Fund revenue and 27.4 percent of total Governmental Fund Types and Expandable Trust Funds revenue in FY 2013-14. Consolidated tax revenue, of which sales tax revenue is a major component, was budgeted to make up 27.5 percent of all General Fund revenue in FY 2013-14 (Reno Budget 2014). For the City of Sparks, property tax revenue was budgeted to make up 34.7 percent of total General Fund revenue (only fund receiving property tax revenue), with Consolidated tax budgeted to make up another 35.2 percent of total General Fund revenue in FY 2013-14 (Sparks Budget 2014). For Washoe County, property tax revenue was budgeted to make up 49.7 percent of General Fund revenue and 42.9 percent of total Governmental Fund Types and Expandable Trust Funds revenue in FY 2013-14. Consolidated tax revenue was budgeted to make up 27.7 percent of all General Fund revenue in FY 2013-14 (Washoe Budget 2014).

Second, as tax rates and tax assessment methodologies have changed over the years, multiple dummy variables or other methods would have to be utilized to capture these changes, further complicating the model. Sales and property tax revenues from year to year are impacted by more than economic variables, they are also impacted by changes in tax rates and changes in assessments, such as the addition of abatements to property tax revenue introduced by AB 489 in 2005. In order to avoid the impact of these tax and policy changes on the econometric model, it was decided to model assessed values (from which property tax revenues are estimated) and taxable sales (from which sales tax revenues are estimated), rather than the final government revenues. Taxable sales and assessed values are referred to, throughout this analysis, as base levels or base amounts, rather than revenue amounts.

As discussed above, there have been numerous forecast models in and outside of Nevada estimating base amounts rather than actual revenue levels. Balcilar et al (2013) created models forecasting Nevada gross gaming revenue and taxable sales rather than gaming license and sales tax revenues. Shonkwiler (1992) also estimated Nevada gross gaming revenues, as did Cargill and Eadington (1978). Hester and Reed (no date) estimated taxable sales in Washoe County, though their model included a dummy variable for the change in sales tax rates and Kirn (2007) estimated national taxable sales.

There are also a number of forecasting models used by State and local governments utilizing base levels as opposed to revenue amounts as dependent variables for forecasting. The Sales and Use Tax model used in King County, Washington (2010) includes all retail sales and other taxable activity, to which an appropriate tax rate is then applied. This is also done by the Central Ohio Transit Authority with its Taxable Sales Forecast model (COTA 2006). Similar models forecasting taxable sales are used by governments in California (CFTB 2014) and Florida (WEC 2008).

Based on this, two types of revenue models were created. The first model focused on assessed value for each local government. This is because economic impacts behind assessed value, such as market values of land and addition of new construction vary by local jurisdiction. As each jurisdiction's assessed value is reported separately by the Washoe County Assessor and Department of Taxation, a separate model for each jurisdiction was possible to create.

In Nevada, properties are typically appraised using the replacement cost method for structures, minus a depreciation amount which increases annually as improvements age. To this appraised or taxable value, a ratio of 35 percent is applied to arrive at assessed value. Each jurisdiction's tax rate per $100 of assessed value is applied to arrive at the property tax payment amount (property tax revenue). This amount cannot increase by more than 3 percent for primary residences and up to 8 percent for commercial and non-primary residential properties (AB 489). By modeling assessed values, the analysis will exclude any complications due to changes in property tax rates or abatement of property tax payment.

The second model focuses on forecasting taxable sales. Similar to assessed values, taxable sales are a less complex dependent variable to model as it does not include any changes in sales tax rates by jurisdictions or changes in the distribution ratios of sales tax revenues to jurisdictions. As sales tax revenue for the County is collected for the entire county and distributed to various jurisdictions based on a complicated formula of population, assessed valuation and more (Consolidated tax), a single taxable sales model was created for all three jurisdictions.

3.2 Data Compilation

The information gathering stage included two steps. The first was a comprehensive review of literature regarding revenue forecasting models across the nation. The purpose of this review was to determine variables and techniques used by these models that could be applied to the Washoe County models. A summary of these findings is shown in the Literature Review section of this chapter.

The second step was to determine appropriate local and national variables based on data availability for the region. This included the creation of a list of appropriate variables based on the assessment of property and sales taxes in Washoe County and availability of data sources locally and nationally. To this end, I met with Dr. Tom Harris and Dr. Mark Nichols at the University of Nevada, Reno and Josh Wilson, Washoe County Assessor. Additionally, I contacted representatives of the City of Sparks, City of Reno, Washoe County and Truckee Meadows Regional Planning Agency, as well as representatives of the Nevada Department of Taxation. Data was also collected from other sources including the Center for Regional Studies at the University of Nevada, Reno, Nevada Department of Employment, Training and Rehabilitation, Reno-Sparks Convention and Visitors Authority, Nevada State Demographer, Bureau of Labor Statistics, Conference Board (Consumer Confidence Index), Yahoo Finance (Stock Market Index), Bureau of Economic Analysis and many other sources.

Not all variables used in the papers discussed in the Literature Review section of this chapter are relevant to assessed value and taxable sales models, some include data that is no longer useful (such as inclusion of food in taxable sales and energy crisis impacts) and not all data is available for Washoe County jurisdictions. These and other variables have been reviewed for relevancy and fit within the econometric models and the models with the most accurate predictive ability were selected. To keep the models easy to maintain and use by city and county representatives, only variables for which data is readily available and does not require a high level of adjustments is used in the models.

It should be noted that the majority of variables considered for the taxable sales model were available quarterly, allowing for four times more observations than annual data. Taxable sales data, the dependent variable, was actually available monthly, though data for very few independent variables was available that frequently. A few annual variables, such as population and county-level personal income were converted to quarterly basis.

For the property tax model, assessed values, the dependent variable, are determined annually, which set the annual frequency of all assessed value models. Additionally, assessed value data for Washoe County and its jurisdictions was available starting 1990 and most independent variables had data through 2013, which limited data available for modeling to 24 observations, compared to 96 observations for the taxable sales model. This limited the types of modeling that could be done for the assessed value models. Finally, City of Sparks building permit data was not available until 1997, further limiting the number of observations available for modeling purposes if this variable was to be used.

Variables for each model were first selected based on economic theory, the understanding of the forces that may impact each revenue source. For both assessed value and taxable sales models, variables dealing with the local economy and those indicating the health of the national economy were considered. The table below shows a list of many of the variables considered for each model and for which data were collected, the Findings section of the paper discusses these variables and the selection of the final variables for each model in more detail.

Table 1. List of Variables for Which Data was Collected

Dependent Variable	
Assessed Value	*Taxable Sales*
Independent Variables	
Median Single Family Home Price	Quarterly Dummy Variable
Median Vacant Land Value/Acre	Dummy Variable for Sales Tax Rate Changes
Washoe County Employees	Consumer Price Index Data
Building Permit Value	County Personal Income
Building Permit Number	State Personal Income
Building Permit Square Footage	Regional Personal Income
Commercial Construction Price Index	California Personal Income
National GDP (Nominal and Real)	US Personal Income
County Personal Income	County Population
County Population	Regional Population
Total Square Feet of Improvements	Regional Personal Income per Capita
Square Feet of Improvements Added	County Employment
Producer Price Index-Construction	County Unemployment Rate
Average Age of Structures	Regional Total Wages
Recession Dummy Variable	County Total Wages
US Building Permit Units	County Visitors
US Gas Prices	National GDP (Nominal and Real)
US Gold Prices	Consumer Confidence Index
Value of Manufacturing New Orders	Stock Market Price Index
National Wages and Salaries	US Gas Prices
National Population	US Gold Prices
National Wages per Capita	Value of Manufacturing New Orders
National GDP per Capita	
Consumer Price Index	

Local data for the assessed value models were collected separately for Cities of Sparks and Reno, and Washoe County, if available. Taxable sales local data were collected for the County as a whole. Much of the data, especially those related to industry, such as employment and wages, were difficult to collect due to the change from the Standard

Industrial Classification (SIC) to the North American Industry Classification System (NAICS) industry codes which occurred in 2001. Both systems are used to identify various industries, the SIC was discontinued in 2001, leaving NAICS as the primary industry classification system. Due to this change, some data series required manual collection from various archived data files, rather than from automated historical databases.

3.3 Conduct a Preliminary/Exploratory Analysis

Once the data were collected, the next step was to choose the appropriate methodology to create a forecasting model. A review of literature was helpful in determining the types of methodologies utilized for similar models. This was discussed in the Literature Review section of this chapter.

Many of the models reviewed during the literature search process focused on using forecasted independent variables for a certain period to arrive at forecasts of dependent variables for that period. For example, forecasted population, wages, and other data for 2015 are used to forecast 2015 taxable sales. This requires access to fee-based forecasting services or use of national and local projections, as available. Few local projected variables are available, with the exception of some employment projections made by the Department of Employment, Training, and Rehabilitation and population projections by the State Demographer's Office.

Another solution for this timing issue is to create multi-equation models forecasting all relevant variables for the assessed value and taxable sales models and then plug these variables into the final forecast model. As the goal of this exercise is to arrive at simple and usable models for the local governments, the use of fee-based services or multi-equation models will render the models expensive and difficult to maintain. As a result, all models are based on lagged variables, using historical data to forecast future amounts, rather than using forecasted future variables. Effectively, the models find independent variables that can be considered "leading" indicators for the dependent variables and use these variables to forecast future dependent variables.

3.4 Select Methods

There are four basic approaches to economic forecasting based on time series data 1) single equation regression models, 2) simultaneous-equation regression models, 3) autoregressive integrated moving average (ARIMA models), and 4) vector autoregression (VAR) models (Gujarati 1995). All of these methodologies have been used by researchers to create forecasting models as discussed above.

Each model has its strengths and weaknesses. Single equation regression, ARIMA, and VAR techniques are considered for the taxable sales and assessed value forecasting models as described in the Findings section below. The simultaneous-equation regression models are not considered in this paper. These models involve estimating two or more equations in a model jointly. For example, one equation would estimate regional wages and then use these estimates in another equation to estimate taxable sales.

The advantage of using simultaneous equation models is that it provides more information than single equations, such as providing forecasts of regional wages, so variables in the taxable sales model would not have to be lagged. However, the major disadvantage of this system is its complexity, requirement for more data, and its sensitivity to model specification errors. If errors are made in the first model specification, they are built upon in the subsequent models (Thornton 2014). As the goal of this analysis is to arrive at forecasting models that are simple to use and use readily available data, simultaneous-equation regression models are not included.

3.5 Implement Methods

The implementation of appropriate methods for each model (taxable sales and assessed values), as well as the resulting models, are summarized in the Findings section below. Conclusions and lessons learned from the modeling process are summarized in the Conclusion section of this paper.

4. Findings

As discussed above, four basic approaches to economic forecasting are available:

1. Single Equation Regression Models
2. Simultaneous-Equation Regression Models
3. Autoregressive Integrated Moving Average (ARIMA) Models
4. Vector Autoregression (VAR) Models

The use of each of three approaches (with the exception of the simultaneous-equation regression models) to forecasting taxable sales and assessed values for Washoe County's local governments, and the resulting models are discussed below. Multiple models are estimated on the idea that combined forecasts provide better predictive results than any single forecast.

According to Armstrong (2001) forecasting accuracy is improved when forecasts are combined from methods that differ substantially and draw from different sources of information. There are a number of formal procedures to combine forecasts. The simplest is the equal weights rule, which assigns equal weights to all available forecast amounts. If known, models with lower error results should be given higher weights, weighing the forecasted amounts of that model at a higher level than other models.

Combining forecasts has been shown to be particularly useful when one is uncertain about the situation (such a future economic performance), uncertain about which methods are most accurate, and to avoid large forecasting errors. Armstrong found that compared to errors of individual forecasts, combined forecasts reduced errors for out-of sample forecasts by 12.5 percent, ranging from 3 to 24 percent (Armstrong 2001).

As a result, forecasts produced by the multiple models described below should be combined to arrive at a joint forecast amount. Additionally, each forecast should be reviewed from a "30 thousand foot view" to ensure that forecasted amounts make sense from a qualitative, experienced standpoint. For example, a forecast of high growth in taxable sales without changes in the market (population, income, new retail venues) may not make sense and may indicate an error in the model. These models cannot replace the experienced opinion of local government finance representatives; they are just another tool in their tool box. Other projections, such as those made by the Nevada Economic

Forum, Washoe County Consensus Forecast, and other sources should also be considered as part of the combined forecast.

It is particularly important to carefully review forecasts of these models as econometric models tend to have a difficulty predicting shocks. Designed to find relationships among variables and based on historical relationships among these variables, these models do not capture effects of one-time events (unless included as a dummy variable), changes in policy or human behavior, or substantial changes in the economic make-up of the region.

For example, there has been much discussion that taxable sales did not decrease as strongly and recovered quicker than expected due to the fact that during the recession some homeowners chose or were forced to default on their mortgages and due to backlogs, banks were not evicting residents for long periods of time, in some cases, years. As a result, some area residents were not making mortgage payments and effectively living in their homes rent free. This created additional disposable income to be spent in the economy, boosting taxable sales and/or preventing sales from declining. It is likely a one-time occurrence and would not be captured by a typical econometric model. Again, it is important to consider these factors when dealing with forecasts from econometric models.

Another example is the construction and operation of the proposed Tesla gigafactory outside of Washoe County. The operation of the gigafactory is likely to attract numerous new residents to the area as Tesla fills its estimated 6,500 new operating employees and thousands indirect and induced employees. Promised higher wage levels and operations by new industries, including Tesla and its suppliers, are likely to shift spending trends in the region, impacting taxable sales. Demand for homes and commercial space may increase prices in the area, impacting assessed values. If these impacts are sufficiently different than the impacts experienced in the Washoe County region historically and on which these models are based, the forecast models outlined in this paper may not capture these impacts completely.

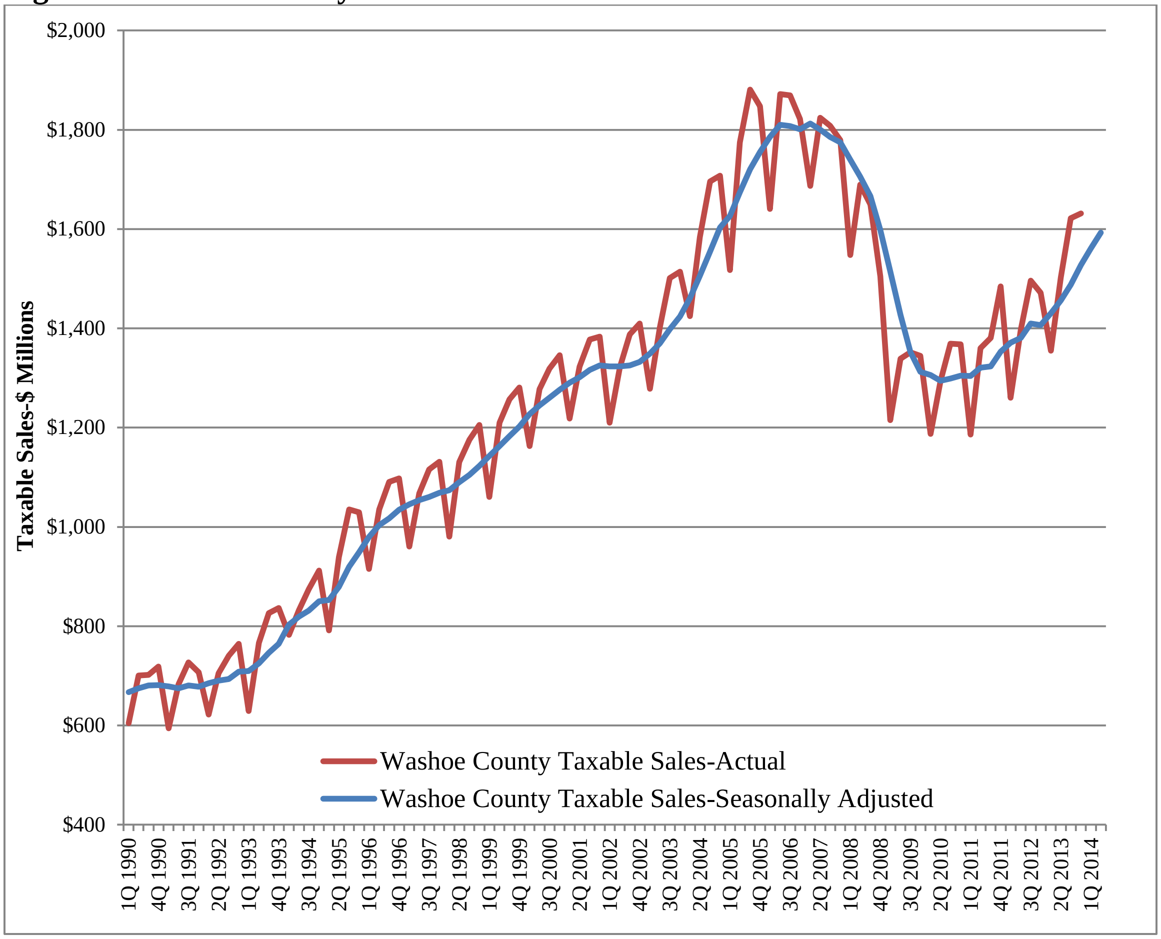
Models utilizing various techniques are summarized below for taxable sales and assessed values. All models were estimated using the Stata version 13 software, a software widely used by the University of Nevada, Reno in teaching econometric techniques and available for use by UNR students. Unless otherwise stated, all data are shown in nominal terms.

4.1 Taxable Sales Models

Washoe County taxable sales are an important component of revenue for local jurisdictions within the county. Taxable sales are the source of sales tax revenue for the jurisdictions and as discussed above, sales tax revenue makes up a major part of local revenues.

As shown in Figure 1 below, taxable sales for the county grew steadily through 2007 due mainly to population growth in the region. Sales declined after 2008, with sales levels in some quarters of 2010 and 2011 falling below 2002 levels. The table also shows taxable sales are subject to seasonality, with highest sales occurring in 3Q or 4Q of each year and lowest in 1Q of the year. The Figure also shows Washoe County taxable sales adjusted for seasonality using a moving average methodology to show the non-seasonality changes in the series over time.

Figure 1. Washoe County Taxable Sales



Source: Monthly Taxable Sales Statistics, NV Department of Taxation for 2010-2014. Historical data from Center for Regional Studies, UNR and Dr. Harris, Center for Economic Development, UNR.

The goal of a forecasting model is to attempt to estimate future taxable sales levels to improve the local governments' ability to budget their operations and capital projects in the future. As mentioned before, this model does not estimate sales tax revenue, but rather taxable sales. A current sales tax rate and distribution amount should be applied to the taxable sales forecast by this model to arrive at sales tax revenue for each jurisdiction. Below is a discussion of the applicability of each of the three forecasting methodologies to taxable sales and resulting models.

4.1.1 Single Equation Regression Model

A regression analysis is a useful forecasting tool as it uses a relationship between two or more independent (explanatory) variables and the dependent variable to predict the dependent variable. Single equation estimation involves estimating either one equation in the model, or two or more equations in the model separately. An Ordinary Least Squares (OLS) is one of the most common techniques used in this type of regression. OLS is a statistical technique which attempts to find the function which most closely approximates the data (a "best fit") (Thornton 2014).

In this case, the analysis attempts to determine a relationship between Washoe County's quarterly taxable sales (dependent variable) and multiple independent variables. As discussed above, data for multiple variables were collected and analyzed to determine their relationship to the county's taxable sales. The model is conducted using quarterly data as these data are available for most of the relevant variables and the use of quarterly data produces more observations for the model, which is expected to increase model accuracy.

As discussed in Table 1 above, data for a number of local, regional, and national variables were collected for this analysis. These variables were developed through the literature review process and interviews with local government representatives and academic faculty. Variables were collected based on the economic theory that taxable sales in Washoe County are a product of spending by local residents and visitors to the area. As a result, variables are divided into two areas 1) variables that correspond to the health of the local economy (representing local spending) and 2) variables that correspond to the health of the national economy (representing visitor spending).

Spending by businesses is also represented by these two types of variables, local and national economic health.

It should further be noticed that time series data often have correlations issues as variables change similarly over time. To avoid any correlation issues associated with inflation and to provide a comparable analysis across different time periods, all financial data in the analysis was adjusted for inflation to 1Q 1990 using Consumer Price Index data published by the US Bureau of Labor Statistics. This helped resolve a number of correlation and cointegration issues associated with the data.

All independent variables are lagged 4 quarters. As also discussed above, this allows to capture any lags in independent data releases and provide a future forecast of taxable sales since no forecasts of independent variables are available. The model will generate a taxable sales forecast amount in 1Q 1990 dollars, as all variables are adjusted to this timeframe. To make the forecast applicable to the period for which taxable sales are forecast, they must be adjusted by the inflation factor for that period compared to 1Q 1990. Inflation rates are forecast at least one year into the future by the Federal Reserve Bank of Philadelphia in its "One-Year-Ahead and 10-Year-Ahead Inflation Forecasts from the Survey of Professional Forecasters." These inflation forecasts can be used to adjusted forecasted taxable sales amounts to present day dollars.

Also, as common with time series data, many of the above variables are highly correlated to each other and using more than one of these variables may cause correlation-related issues in the model (multicollinearity). This is despite even having inflation-adjusted data. As a result, one of the goals of the model was to find a combination of national and local variables with the least amount of correlation among each other, using a correlation table in Stata.

The following local variables were considered for the model based on their theoretical economic relevancy to taxable sales: Washoe County personal income (copersinc), county population (pop), county employees (empls), county unemployment rate (unempl), and state personal income (nvinc). Due to Washoe County's close proximity to smaller counties, the county acts as a shopping center for these counties, especially for larger durable products, such as vehicles, furniture, and more. As a result, the analysis also considered regional variables, such as regional population (regpop), regional employment wages (regwages), regional personal income (regpersinc), and regional income per capita (reginccap). For the purposes of this paper, the region is defined to include Carson City, Churchill, Douglas, Lyon, Storey, and Washoe Counties. A correlation matrix, and later econometric modeling showed a better relationship between these regional variables and taxable sales, than Washoe County only variables. These regional variables are used in the model to represent the health of the local economy.

The majority of national variables, including visitors to the Reno-Sparks area (visitors), California personal income (cainc), national GDP (gdp), national personal income (natinc), stock market price index (stock), gas prices per gallon (fuel), gold prices per ounce (gold), and value of manufacturing new orders (manuf) not only have a relationship with taxable sales, but with many other local and national variables. As a result, the inclusion of these variables may also lead to multicollinearity issues. The national variables selected for the final model, visitors, had the lowest relationship to other variables and the use of this variable in the final model provided better results than other national variables as shown in Table 2 below. Additionally, this variable is consistent with economic theory that an increase in visitors to the area will increase taxable sales through their spending.

Numerous models using multiple permutations of various variables were considered for the final taxable sales model. Table 2 shows some of the most relevant resulting models. It should be noted that versions of a log-level and log-log models were also considered. While some of these models yielded good results, the use of a log version of a dependent variable in this case may be not accurate. Additionally, as the goal of the study is to create an easily updatable forecast model, the use of a level-level model provides the easiest model format.

As discussed above and shown in Table 2, multiple versions of local and national variables, adjusted for inflation were tested and compared based on the resulting model's R^2, significance of resulting coefficients, and MAPE (discussed later in this section) results. Structural variables, such as seasonal dummy variables for Quarters 1-3 were also tested and found to be significant if included in the model. The sign of these variable coefficients in the final model follows economic theory in that 4Q typically results in highest level of taxable sales, with 1Q-3Q having a lower level of sales, therefore, negative coefficients. Overall, the final model has one of the highest R^2 results, lowest MAPE score, all significant coefficients, and correct signs of coefficients. Some of the other models, such as the model using GDP instead of visitors had a number of coefficients with unexpected signs, such as the negative sign on the GDP coefficient and positive signs of the seasonal dummies, all of this goes against economic theory.

This is likely due to GDP's high correlation to the Regwages variable. Signs inconsistent with economic theory are highlighted in red in the table.

Table 2. Comparison of Select Alternative Variables Considered for Final Model

Final Model							
Dependent	**Constant**	**Regwages ($millions) (4 lags)**	**Visitors (thousands) (4 lags)**	**Quarter 1**	**Quarter 2**	**Quarter 3**	
Taxsales ($millions)	-534.0000***	0.3567***	0.8375***	-53.8000**	-124.0000***	-217.0000***	
	R^2	*0.8062*	***MAPE***	*6.7013%*			
Final Model w/out Seasonality							
Dependent	**Constant**	**Regwages ($millions) (4 lags)**	**Visitors (thousands) (4 lags)**				
Taxsales ($millions)	-197.0000**	0.4008***	0.4215***				
	R^2	*0.7342*	***MAPE***	*8.0798%*			
Final Model w/ Regpop instead of Regwage							
Dependent	**Constant**	**Regpop (thousands) (4 lags)**	**Visitors (thousands) (4 lags)**	**Quarter 1**	**Quarter 2**	**Quarter 3**	
Taxsales ($millions)	-925.0000***	1.2635***	1.1492***	-110.0000***	-226.0000***	-347.0000***	
	R^2	*0.7739*	***MAPE***	*7.7079%*			
Final Model-w/out National Variable							
Dependent	**Constant**	**Regwages ($millions) (4 lags)**	**Quarter 1**	**Quarter 2**	**Quarter 3**		
Taxsales ($millions)	279.0000***	0.4188***	49.10000	29.0000	44.7000		
	R^2	*0.6351*	***MAPE***	*9.5002%*			
Final Model w/ Consconf							
Dependent	**Constant**	**Regwages ($millions) (4 lags)**	**Visitors (thousands) (4 lags)**	**Consconf (4 lags)**	**Quarter 1**	**Quarter 2**	**Quarter 3**
Taxsales ($millions)	-429.0000***	0.3688***	0.6666***	0.7048	-55.4000**	-97.7000***	-166.0000***
	R^2	*0.8111*	***MAPE***	*7.0122%*			
Final Model w/ Consconf instead of Visitors							
Dependent	**Constant**	**Regwages ($millions) (4 lags)**	**Consconf (4 lags)**	**Quarter 1**	**Quarter 2**	**Quarter 3**	
Taxsales ($millions)	78.5000	0.4170***	2.3402***	-55.7000**	13.0000	35.4000	
	R^2	*0.7672*	***MAPE***	*6.9312%*			
Final Model W/ GDP Instead of Visitors							
Dependent	**Constant**	**Regwages ($millions) (4 lags)**	**GDP ($millions) (4 lags)**	**Quarter 1**	**Quarter 2**	**Quarter 3**	
Taxsales ($millions)	372.0000***	0.8497***	-99.4701***	18.5000	84.5000***	84.1000***	
	R^2	*0.7261*	***MAPE***	*7.6537%*			
Final Model w/ Regperinc instead of Regwages							
Dependent	**Constant**	**Regperinc ($thousands) (4 lags)**	**Visitors (thousands) (4 lags)**	**Quarter 1**	**Quarter 2**	**Quarter 3**	
Taxsales ($millions)	-569.0000***	31.8431***	1.0170***	-111.0000***	-202.0000***	-305.0000***	
	R^2	*0.7906*	***MAPE***	*7.2305%*			

After considerable analysis as described above, a regression model was developed to forecast quarterly taxable sales for Washoe County. The structure for the final model is shown below:

$$\text{Taxsales}_t = \alpha + \beta_1 \text{Regwages}_{t-4} + \beta_2 \text{Visitors}_{t-4} + \beta_3 DQ_{1t} + \beta_4 DQ_{2t} + \beta_5 DQ_{3t} \quad (11)$$

where:
Taxsales are quarterly taxable sales for Washoe County for quarter t. This variable is adjusted for inflation to 1Q 1990 using the Consumer Price Index (CPI). Source: Monthly Taxable Sales Statistics, NV Department of Taxation for 2010-2014. Taxsales are shown in millions of dollars. Historical data from Center for Regional Studies, UNR and Dr. Harris, Center for Economic Development, UNR.
http://tax.nv.gov/Publications/Monthly_Taxable_Sales_Statistics/
CPI data from Bureau of Labor Statistics. http://www.bls.gov/cpi/
Regwages are employment wages for the area's consumption region (Washoe County, Churchill County, Douglas County, Lyon County, Storey County, and Carson City). Data for county-level wages is typically released two quarters back, second quarter 2014 data is the latest data currently available. As a result, at least a two quarter lag was required. However, to compensate for quarterly trends, if any, in the data, and for any delays in data reporting, the model lags these data by 4 quarters. Regwages are shown in millions of dollars. This variable is adjusted for inflation to 1Q 1990 using the Consumer Price Index (CPI). Source: 1990-2001 data from Bureau of Economic Analysis, Data Files which are available by quarter. 2002-Present data from Nevada Department of Employment, Training and Rehabilitation (DETR), Quarterly Employment & Wages. Data for all industries and all covered employment.
http://www.nevadaworkforce.com/cgi/dataanalysis/AreaSelection.asp?tableName=Industry
CPI data from Bureau of Labor Statistics. http://www.bls.gov/cpi/
Visitors are visitors to the Reno-Sparks area, quarterly. This data is typically available one-month behind. However, the data shows some seasonality, as a result, a 4-quarter lag is used. Visitors are shown in thousands. Source: Estimated Visitor Counts to Reno-Sparks and Washoe County Area, RSCVA. http://www.visitrenotahoe.com/about-us/finance-accounting

DQ_1 through DQ_3 are structural dummy variables representing the quarter for which taxable sales are forecast. For DQ_1, the amount of 1 represents that taxable sales are being forecast for the 1st Quarter, 0 if otherwise. For DQ_2, the amount of 1 represents that taxable sales are being forecast for the 2nd Quarter, 0 if otherwise. For DQ_3, the amount of 1 represents that taxable sales are being forecast for the 3rd Quarter, 0 if otherwise.

Since the model in equation 11 is based on time series data, variables within this model must be tested for stationarity, and if non-stationary, they should be cointegrated. The Dickey-Fuller test for stationarity indicated that most variables in the model (taxsales and visitors) are stationary and regwages are non-stationary at all three levels of critical values (1 percent, 5 percent, and 10 percent).

Because one of the variables are non-stationary, they must be cointegrated in order to proceed with the analysis, otherwise they are unrelated variables and the result of the regression will not be accurate. To test whether these variables are cointegrated, the analysis estimated residuals of the regression model and then conducted the Dickey-Fuller test on the residuals. The Dickey-Fuller test showed that even though some of the variables in the model are non-stationary, they are cointegrated and therefore can be used in this model.

Another problem that faces a time series regression equation is serial correlation. The Breusch-Godfrey option can test for serial correlation in a model. The test for this model indicated that the model did not have serial correlation and the use of the basic Ordinary

Least Squares (OLS) technique would yield an optimal model. Using the OLS technique the final adjusted estimated model is as follows:[2]

$$Taxsales_t = -534.0 + 0.3567Regwages_{t-4} + 0.8375Visitors_{t-4} - 53.8DQ_{1t}$$
$$(105.00)^{***} \quad (0.0278)^{***} \quad (0.0961)^{***} \quad (24.40)^{**}$$

$$- 1.0069DQ_{1t} - 1.0069DQ_{1t} \qquad (12)$$
$$(29.90)^{***} \quad (38.50)^{***}$$

$$R^2 = 0.8062$$

This model predicts approximately 81.0 percent of the quarterly change in Washoe County taxable sales. All but one (DQ_1) estimated coefficients are significant at the 1 percent, 5 percent and 10 percent levels of significance and all signs of coefficients are appropriate, as it is expected that increases in regional wages and area visitors will have a positive effect of the county's taxable sales. Dummy seasonal variables all have negative coefficient signs due to the decline in taxable sales from the fourth quarter.

In- and out-of sample predictions are made using the model and the Mean Absolute Percentage Error (MAPE) is estimated for each model. The formula for the MAPE estimate is provided below.

$$\frac{1}{n}\sum\left|\frac{Actual - Forecast}{Actual}\right| * 100 \qquad (13)$$

where n is the number of observations.

[2] Values in parenthesis are standard errors associated with above coefficients. Asterisks following each standard deviation number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.

The MAPE method is a relative measure which expresses errors as a percentage of the actual data. Its biggest advantage is that it provides a way to judge the significance or importance of errors. For example, an error of 10 of the actual value of 100 (10 percent error) is more important than an error of 10 with the actual value of 500 (2 percent error). This relativity allows MAPE results to be compared across methods and forecasting horizons and series. MAPE methodology is popular with academicians and practitioners and is appropriate to use for forecasting model results (Makridakis 1995).

Predictions based on the model are made for the entire period of the available data Q1 1990 to Q4 2013 (in-sample estimate), and for a three-year out-of sample period Q1 2011 to Q4 2013. To estimate the out-of sample period, the econometric model was estimated without data for the most recent 3-year period and forecasts were created for the 3-year period using the resulting model.

An out-of sample forecast is an important test of a model's predictive ability. While creating the model using all available data and waiting until data for the new period becomes available is the best way to test a model's forecasting ability, this methodology is time consuming. However, not performing an out-of sample error estimate is also not ideal as in-sample error estimates are typically much lower as these are made within the model whose whole purpose is to create the best fit to the data. Using an out-of sample analysis by dropping latest variables is a good test of the model's forecasting ability, and allows for comparison among different models.

The results of the taxable sales values forecast by the model are summarized below, compared to actual sales values. The econometric model has a MAPE result of 6.7013% using all in-sample data and an out-of sample MAPE estimate of 3.3093%.

Figure 2. Washoe County Actual and Predicted Taxable Sales

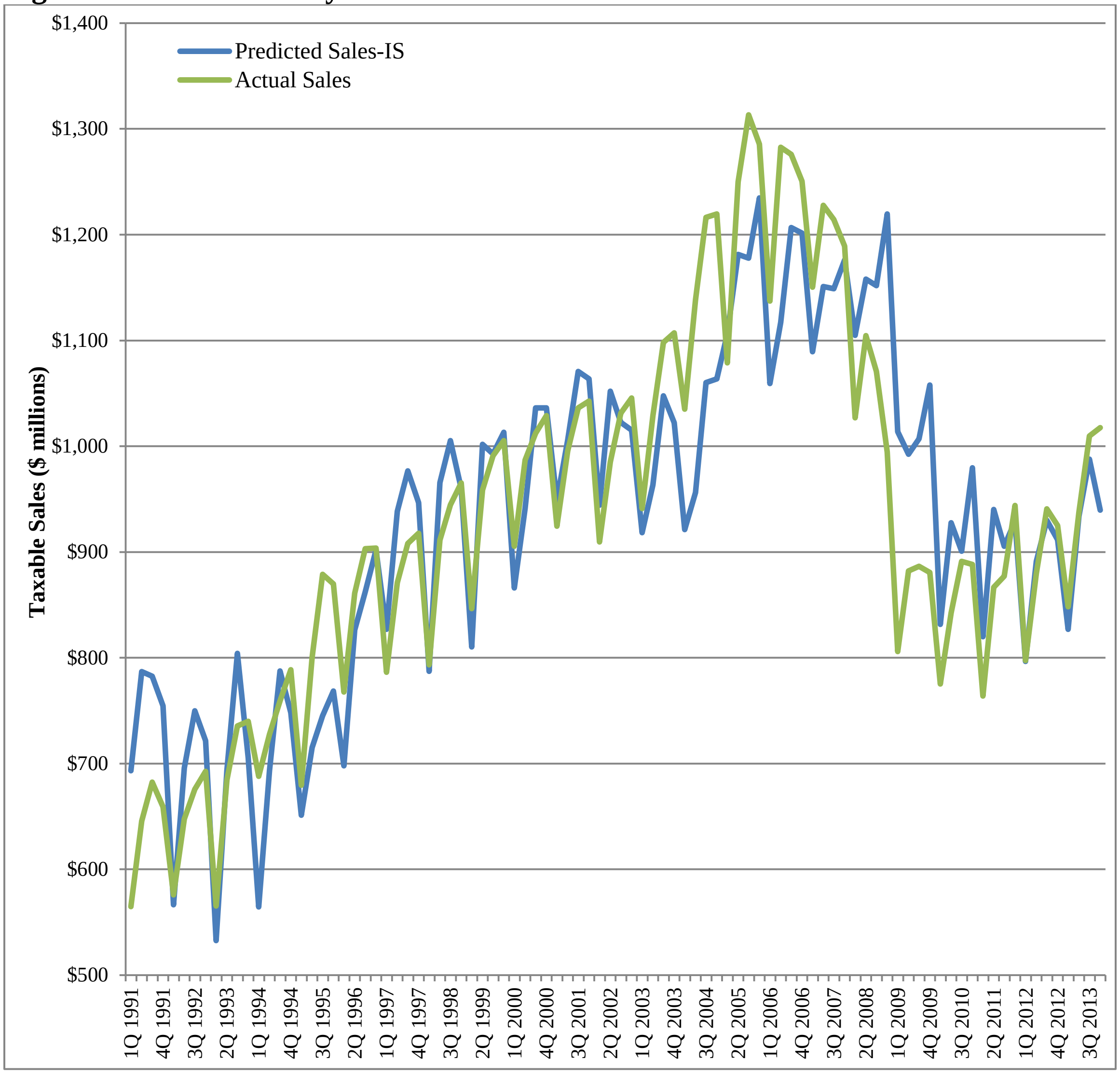


Figure 2 above shows the comparison between actual sales and those predicted by the model. The model shows a close relationship between predicted and actual sales prior to 2004 and starting in 2012. Predicted sales underestimated the growth in the economy prior to the recession and the decline during the recession, likely due to the shock these events created in the economy.

Figure 3. Washoe County Actual and Predicted Taxable Sales (LN) In-and Out-of Sample

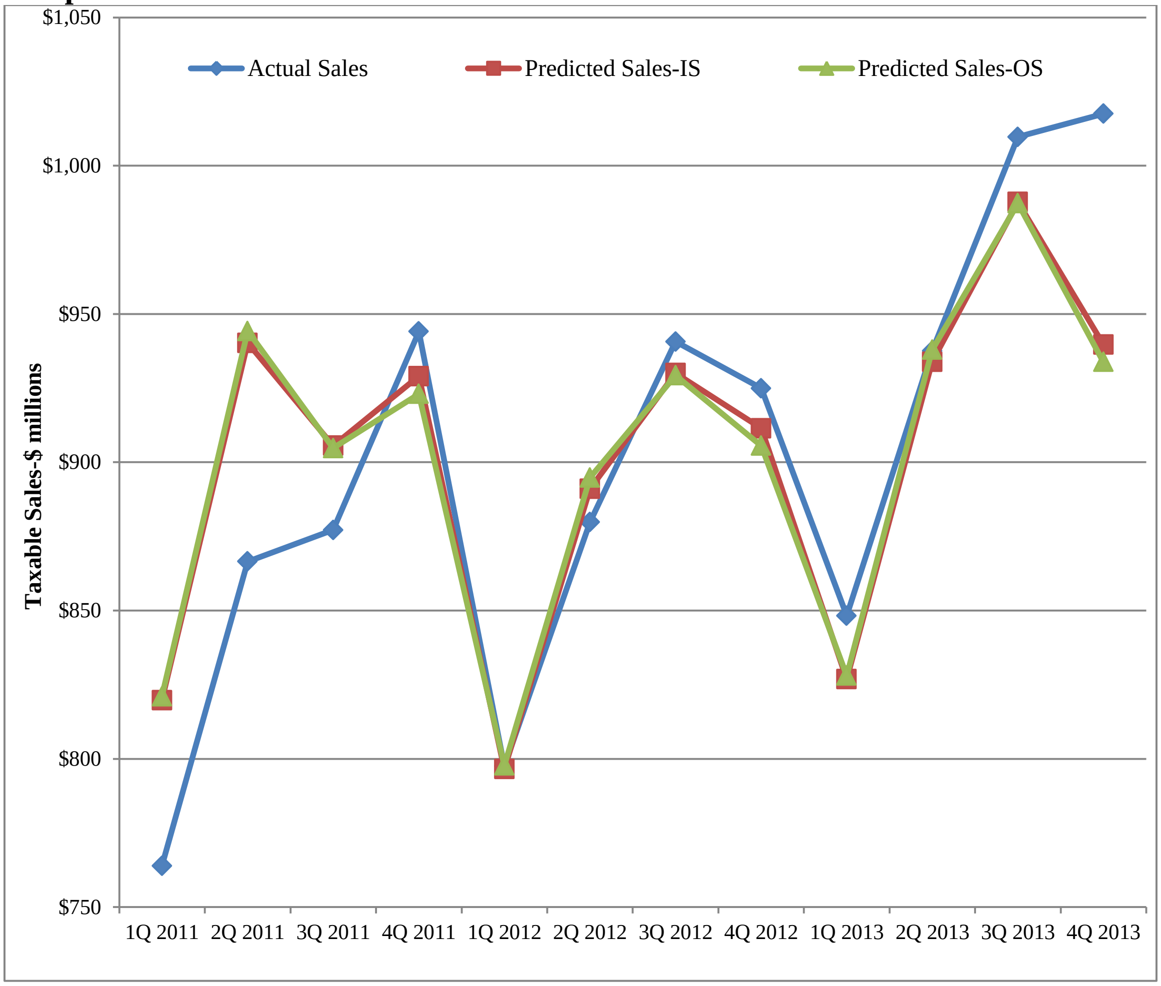


Figure 3 shows a comparison of actual and in- and out-of sample predictions for taxable sales for the latest three-y ear period (2011-2013). Predicted and actual sales look closest starting in 4Q 2011, thought the 3Q and 4Q 2013 actual sales are higher than predicted by both models. Actual and out-of sample taxable sales for the three-year period are shown below.

Table 3. Comparison of Actual and Predicted Sales

Forecast Period	Actual Sales	Predicted Sales*	Error
1Q 2011	$ 763,913,629	$ 821,104,600	7.49%
2Q 2011	866,557,874	944,232,845	8.96%
3Q 2011	877,173,102	904,773,527	3.15%
4Q 2011	944,072,655	923,054,930	2.23%
1Q 2012	797,526,793	797,705,099	0.02%
2Q 2012	879,874,417	894,829,336	1.70%
3Q 2012	940,695,617	929,286,208	1.21%
4Q 2012	924,910,824	905,560,564	2.09%
1Q 2013	848,265,169	828,017,482	2.39%
2Q 2013	937,561,475	937,933,940	0.04%
3Q 2013	1,009,694,821	987,338,181	2.21%
4Q 2013	1,017,492,338	933,852,915	8.22%
Average			**3.31%**

*using out-of sample statistics

Some interesting lessons learned from the review of these variables are summarized below. These provide areas for local governments to consider in their economic development and growth efforts:

1. The graph of taxable sales indicates taxable sales show a seasonal trend, with highest sales occurring in the 3^{rd} or 4^{th} quarter of the year and lowest sales in the 1^{st} quarter. This is supported by the resulting OLS model which shows taxable sales are typically lower in the first 3 quarters of the year.

2. Regional wages, population, and personal income have a stronger relationship to Washoe County taxable sales than Washoe County wages, population, and personal income alone. In this case, the term region defined as including six counties-Carson City, Churchill, Douglas, Lyon, Storey, and Washoe. This indicates county taxable sales are also impacted by disposable spending in surrounding counties.

3. Majority of taxable sales in the county are impacted by local spending, with national variables, including visitors, GDP, national income, etc. having lower correlation factors to taxable sales.
4. Washoe County unemployment rates are not highly correlated to taxable sales, indicating that non-wage income is available in the county for these purchases and further confirming the finding of impacts of other counties on Washoe County's sales, as those counties face different employment impacts.
5. California personal income is related to taxable sales and is as almost as closely related to taxable sales as Nevada personal income and as related as GDP. This shows that California resident wealth is an important factor for Washoe County sales.

Some of the issues faced in the collection and analysis of variables are summarized below.

1. Not all data are readily available or are difficult to collect. For example, population data is available annually; data is translated to quarterly terms by distributing annual population growth equally to each quarter. County personal income data from the Bureau of Economic Analysis (BEA) is also available annually only.
2. Another example is wage data which is readily available starting in 2002. However, due to changes between SIC and NAICS industry codes in 2001, data prior to 2001 must be collected manually from Bureau of Labor Statistics (BLS) data files available by quarter and by county.
3. Not all data is available immediately, creating lags between projection period and data availability. For example, Bureau of Economic Analysis (BEA) data for county personal income for 2013 was released in November 2014. Forecasts for 2015 and

after will have to include a lag of 2 years if using personal income data. The model included these lags in order to ensure that data is available to create relevant forecasts. In addition to personal income, examples of lags include visitor data which is usually lagged 2 quarters, taxable sales are lagged 4 quarters, consumer confidence index 1 quarter, and national and state personal income and GDP, also 2 quarter. County wages are lagged 4 quarters.

4. Many of the variables, especially the economic variables, such as wages, income, and GDP variables were shown to be highly correlated with each other, also resulting in issues in selecting a proper model and significance of estimated coefficients. This reduced the variables that could be used in one model, national and local economic variables could not be combined into a single model without manipulation of data. This also made creating a model more difficult.
5. Impacts of changes in sales tax rates for Washoe County were also considered. These were found to be mostly not highly related to taxable sales and excluded from the model. This may be due to the fact that consumers are not sensitive or unaware to changes in sales tax rates. Additionally, the exact effective date of some rate changes was difficult to pinpoint or fell within a quarter, making the exact impact of these rate changes difficult to determine.
6. A dummy variable for the presence of recessionary conditions was also considered. This was found to be not highly related to taxable sales. However, it is difficult to pinpoint the exact start and end of each recession, as local recessionary periods do not match national periods. For example, according to the Bureau of Labor Statistics, the recent recession started December 2007 and ended in June 2009. However, the

region experienced recessionary impacts past 2009, with high unemployment, low construction, and lagging real estate market.

7. Using quarterly historical data allowed for the creation of four times the observations than annual data. However, while some data sources were available for an extended historical period, others were not available for this period. As a result, the analysis begins in the first quarter 1990, to ensure all data were available.
8. Ideally, a multiple equation model should be created for Washoe County, showing taxable sales by component (retail, automobiles, restaurants and bars, etc.). This is because each sales component is driven by its own variables, with some items being necessary items, while others are luxury items. Focusing on the variables driving each taxable sales component would likely lead to a more accurate model.
9. Similarly, breaking taxable sales into visitor versus local resident sales would also likely pinpoint related variables and create a more accurate model. However, historical data for taxable sales by component is not available, nor is data for the source of taxable sales (visitors versus locals). As a result, a combined model for all taxable sales in Washoe County is used.

4.1.2 Autoregressive Integrated Moving Average (ARIMA) Model

An ARIMA model is another technique utilized to create forecasting models. To use this methodology, data must either be stationary or become stationary after one or more differencing. Taxable sales data as reported is not stationary using the Dickey Fuller test. These data are also not stationary over a time trend.

Taxable sales data does become stationary, according to the Dickey Fuller test after differencing. Differencing the data d times to make it stationary is the “integrated” (I) portion of the ARIMA model, the other areas include lags of the stationarized series in the forecasting equation, called "autoregressive" (AR) terms and lags of the forecast errors, called "moving average" (MA) terms. An ARIMA model is classified as an "ARIMA (p,d,q)" model, where:

- p is the number of autoregressive terms,
- d is the number of differences needed for stationarity, and
- q is the number of lagged forecast errors in the prediction equation (Gujarati 1995).

There are four steps to consider when creating an ARIMA model.

1. *Identification*-Finding the appropriate values of p, d, and q. This is usually performed through trial and error and comparison of various models and their Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) results. AIC and BIC results measure the relative quality of a statistical model for a given set of data and are estimated in Stata for each proposed model. Multiple versions of the ARIMA models were ran through Stata and three models with the lowest AIC and BIC scores were selected.
2. *Estimation*-Using Stata, parameters of the ARIMA model are estimated for each of the three selected models. This includes model coefficients and various error and significance statistics. It should be noted that due to the stationarity of the data, the full ARIMA model was used, including the I (differencing component).
3. *Diagnostic Checking*-Having chosen three ARIMA models based on their Information Criteria results and estimated their parameters, the model with the best fit to the data and best forecasting ability was then selected. In- and out-of sample

predictions were made using each of the models and the Mean Absolute Percentage Error (MAPE) estimated for each model.

Predictions based on each of the three models were made for the entire period of the available data Q1 1990 to Q4 2013 (in-sample estimate), and for a three-year out-of sample period Q1 2011 to Q4 2013. To estimate the out-of sample period, the ARIMA model was estimated for each p, d, q set without data for the most recent 3-year period and estimates were created for the 3-year period for each model. The results of the estimated parameters of each model, along with MAPE results are summarized in Table 4 below.

Table 4. Summary of ARIMA Models

ARIMA (p d q)		Coefficient	Std. Err.	P>|z|	AIC	BIC	MAPE-Total IS	MAPE-3 Yrs IS	MAPE-3 Yrs OS
taxsales ARIMA (3 1 1)	Constant	9,334,859	3,984,453	0.01900	3695.585	3710.908	3.86%	4.29%	4.22%
	AR.l1	-0.95048	0.05393	0.00000					
	AR.l2	-0.73006	0.08401	0.00000					
	AR.l3	-0.77780	0.06398	0.00000					
	MA.l1	0.92671	0.04711	0.00000					
	Sigma	62,000,000	3,828,338	0.00000					
taxsales ARIMA (3 1 2)	Const	9,391,863	4,316,375	0.03000	3689.947	3707.824	3.67%	3.30%	3.43%
	AR.l1	-0.80205	0.06529	0.00000					
	AR.l2	-0.97545	0.03134	0.00000					
	AR.l3	-0.77070	0.06899	0.00000					
	MA.l1	0.35864	0.07529	0.00000					
	MA.l2	0.71925	0.05811	0.00000					
	Sigma	59,700,000	3,410,913	0.00000					
taxsales ARIMA (3 1 3)	Const	9,327,193	4,466,437	0.03700	3641.422	3661.853	2.86%	2.65%	2.85%
	AR.l1	-0.99635	0.01368	0.00000					
	AR.l2	-0.99444	0.01615	0.00000					
	AR.l3	-0.99680	0.00636	0.00000					
	MA.l1	0.87819	0.08692	0.00000					
	MA.l2	1.07266	0.12000	0.00000					
	MA.l3	1.08880	0.10660	0.00000					
	Sigma	39,100,000	4,249,540	0.00000					

where

MAPE Total IS-is the MAPE result for the entire in-sample period (Q1 1990 to Q4 2013)

MAPE 3 Yrs IS-is the MAPE result using the in-sample model for the past 3 years only (to be comparable to out-of sample results)

MAPE 3 Yrs OS-is the MAPE result for the 3 out-of sample years (Q1 2011 to Q4 2013) using the model for Q1 1990 to Q4 2010

The table indicates that the ARIMA (3 1 3) structure yields the lowest AIC/BIC results and has all significant coefficients.[3] It has the lowest in-sample and out-of sample MAPE result of the three models at 2.86% and 2.85% respectively. Figure 4 below shows the comparison between actual sales and those predicted by the model.

Figure 4. Washoe County Actual and Predicted Taxable Sales [4]

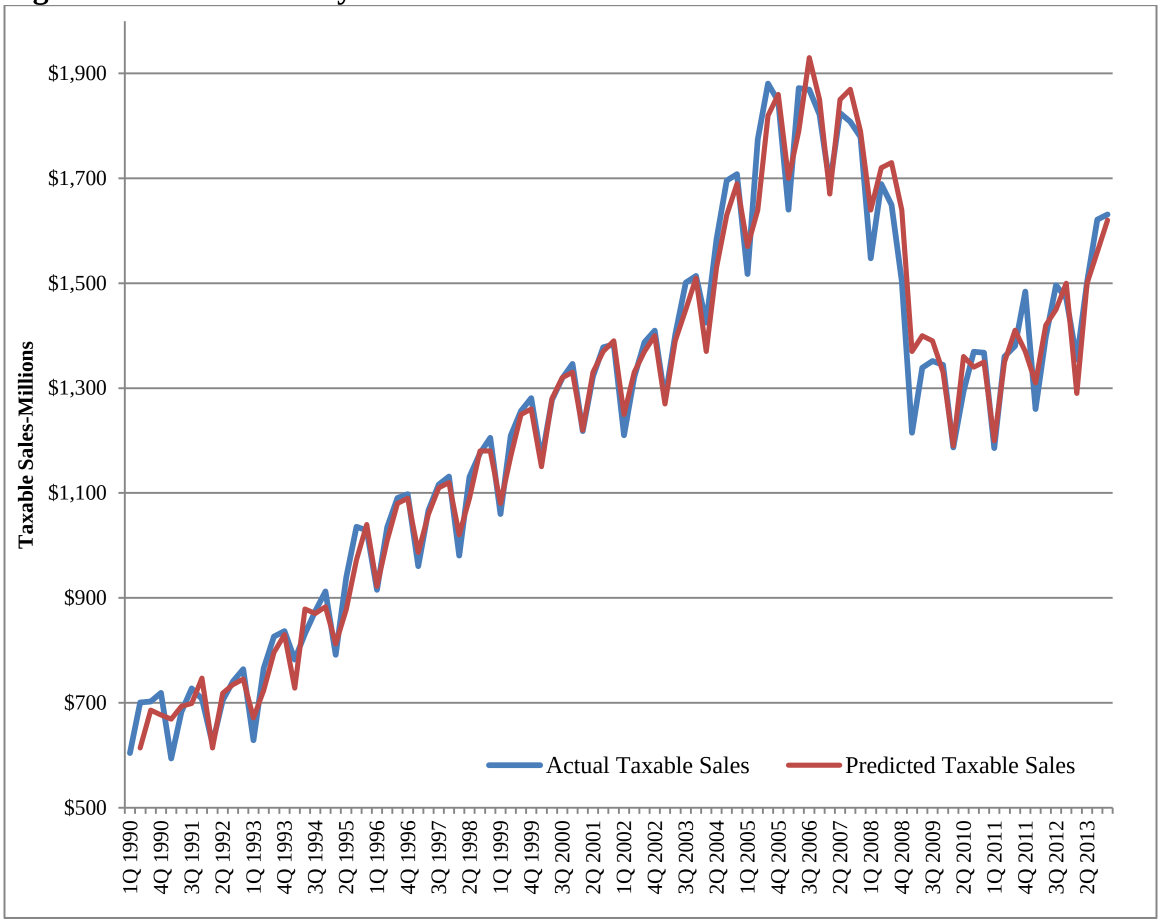


Figure 5 shows a comparison of actual and in- and out-of sample predictions for taxable sales. There is much fluctuation between the actual and predicted sales during this period, though the in- and out-of sample estimates are consistent.

[3] A coefficient is considered significant if its P>|z| result is less than the 95 percent confidence level of t=5 percent or 0.05. For example, a P=0.25400 >0.05 and is, therefore not statistically significant.

[4] Actual and Predicted taxable sales are shown in real terms, adjusted for inflation to 1Q 1990.

Figure 5. Washoe County Actual & Predicted Taxable Sales In-and Out-of Sample[5]

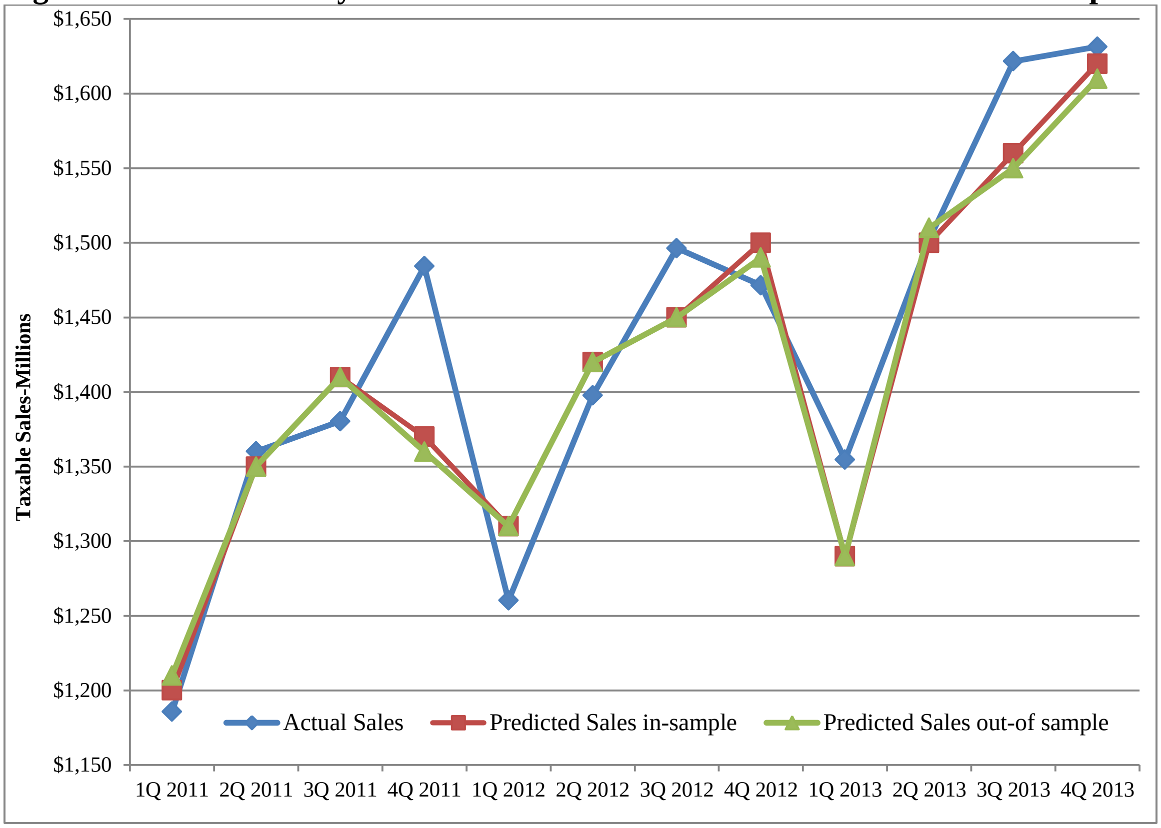


Table 5 shows the model's out-of sample predictions between 2011 and 2013.

Table 5. Comparison of Actual and Predicted Sales

Forecast Period	Actual Sales	Predicted Sales*	Error
1Q 2011	$ 1,185,763,988	$ 1,210,000,000	2.04%
2Q 2011	$ 1,360,197,500	$ 1,350,000,000	0.75%
3Q 2011	$ 1,380,443,163	$ 1,410,000,000	2.14%
4Q 2011	$ 1,484,290,208	$ 1,360,000,000	8.37%
1Q 2012	$ 1,260,233,258	$ 1,310,000,000	3.95%
2Q 2012	$ 1,397,638,295	$ 1,420,000,000	1.60%
3Q 2012	$ 1,496,313,063	$ 1,450,000,000	3.10%
4Q 2012	$ 1,471,538,398	$ 1,490,000,000	1.25%
1Q 2013	$ 1,354,602,287	$ 1,290,000,000	4.77%
2Q 2013	$ 1,502,272,388	$ 1,510,000,000	0.51%
3Q 2013	$ 1,621,669,443	$ 1,550,000,000	4.42%
4Q 2013	$ 1,631,353,532	$ 1,610,000,000	1.31%
Average			**2.85%**

*using out-of samples statistics

[5] Actual and Predicted taxable sales are shown in real terms, adjusted for inflation to 1Q 1990.

4. *Forecasting*-Having selected the final model; forecasts of taxable sales for Washoe County were made using the Stata model. Using the Stata software is the best way to use these forecasting models. As Stata may not be available to local government representatives and as the model will have to be re-created in Stata every year or a file reused, the chances of this model not being utilized or for making an error in the re-creation of the model are high. As a result, it is recommended this model is not used, unless Stata software is available to each local jurisdiction and a person familiar with Stata is used to forecast revenues using this model.

4.1.3 Vector Autoregression (VAR) Model

A Vector Autoregression (VAR) is an *n* equation, *n* variable model in which each variable is in turn explained by its own lagged values, plus (current) and past values of the remaining *n-1* variables. A model using regional wages and taxable sales variables was created using this methodology. However, the resulting model had a MAPE result of 162.95% using all in-sample data and an out-of sample MAPE estimate of 169.67%. The resulting in- and out-of sample error amount is too high to yield useful predictions, a model utilizing the VAR technique is not created in this paper.

Table 6 compares the results of the models developed using the ARIMA and OLS methods. The table shows the ARIMA model has the lowest MAPE scores, but is difficult to use for forecasting. The OLS model is the simplest to implement and yields good predictive results, it is the best methodology for forecasting taxable sales.

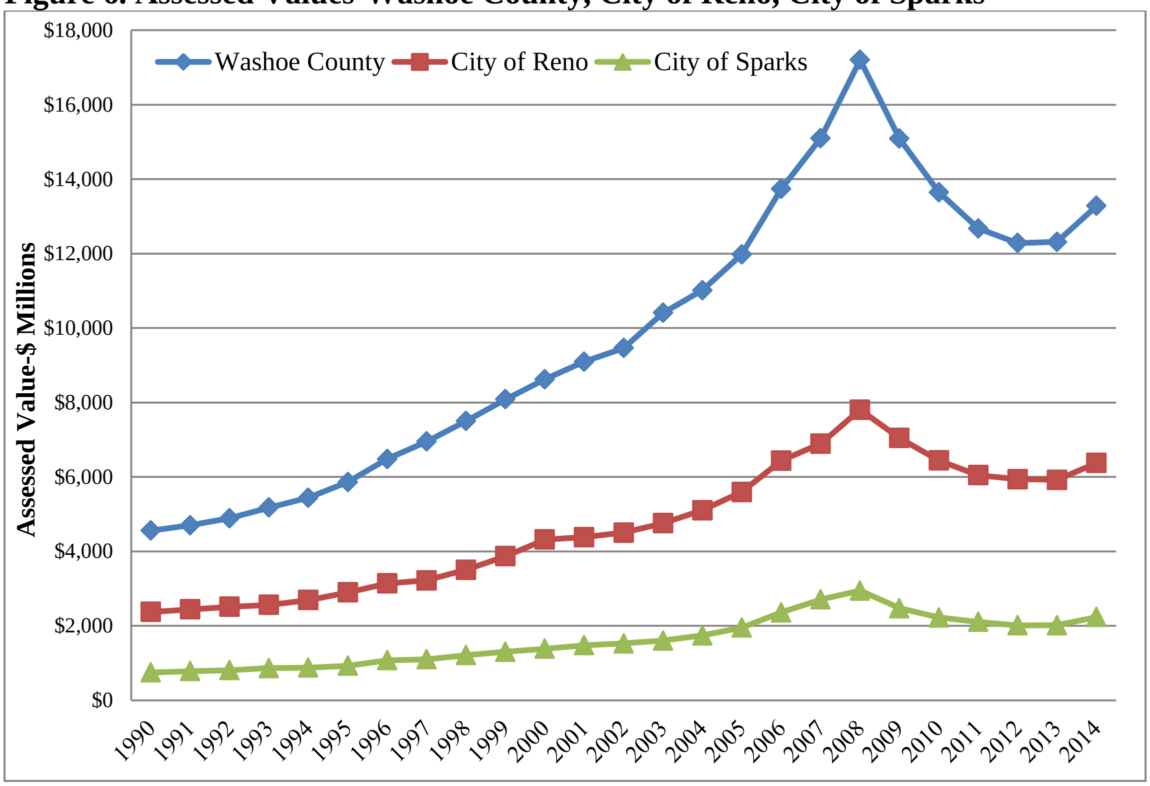
Table 6. Comparison of Single Equation and ARIMA Model Performance-Taxable Sales

	R^2	IS MAPE	OS MAPE
Single Equation Regression	0.8062	6.70%	3.31%
ARIMA	NA	2.86%	2.85%

4.2 Assessed Value Models

Washoe County property tax revenues are also an important component of revenue for local jurisdictions within the county. Assessed values are the source of property tax revenue for the jurisdictions. As shown in Figure 6 below, assessed values for the county grew steadily through 2008. Assessed values declined considerably between 2008 and 2013, though the impact of this decline on local governments was somewhat mitigated by the abatement reserves resulting from AB 489. Assessed values were showing a slight increase by 2014.

Figure 6. Assessed Values-Washoe County, City of Reno, City of Sparks



Source: “Local Government Finance Redbook.” Nevada Department of Taxation.

It should be noted that assessed value data is reported on fiscal year basis (June 30 to July 1). All other variables used in the analysis are available for calendar year; to match these variables; assessed values are assigned to the fiscal year beginning year. For example, assessed values for FY 1990-1991 are assigned to 1990.

The goal of a forecasting model is to attempt to estimate future assessed value levels to improve the local governments' ability to budget their operations and capital projects in the future. As mentioned before, this model does not estimate property tax revenue, but rather assessed value for each jurisdiction. A current property tax rate and abatement percentage can be applied to the assessed values forecast by this model to arrive at property tax revenue for each jurisdiction.

Below is a discussion of the applicability of each of the three forecasting models to assessed values and resulting models and methodologies, where appropriate. Findings for the City of Reno is discussed in this paper, models for City of Sparks and Washoe County are shown in Appendix A.

4.2.1 Single Equation Regression Model

A regression analysis is useful forecasting tool as it uses a relationship between two or more variables independent (explanatory) variables and the dependent variable to predict the dependent variable. Single equation estimation involves estimating either one equation in the model, or two or more equations in the model separately (Thornton 2014). In this case, the analysis attempts to determine a relationship between Washoe County's annual assessed values (dependent variable) and multiple independent variables. As discussed above, data for multiple variables were collected and analyzed to determine their relationship to the county's assessed values. The model for each jurisdiction is created using annual data as these data are available for most of the relevant variables, though the use of annual data leads to fewer observations than quarterly or monthly data. With data available between 1990 and 2013, only 24 observations are included in the model, which may limit the model's predictive abilities.

Three separate models were created, one for each jurisdiction (City of Reno, City of Sparks and Washoe County). Though many of the same independent variables are used for each model (county-wide and national data), the magnitude of the relationship of each variables to the jurisdiction's assessed value is different and is, therefore, estimated separately. Two issues associated with all three models must first be discussed.

First, it should be noted for all three models that the Nevada property tax system adds a complication to the ability to forecast assessed values for the region and the State. Few assessed value or property tax revenue forecasting models were found during the literature search process for the paper. None utilized the replacement cost approach, as this is done only in Nevada. Nevada's use of replacement cost approach to value improvements and market value for land creates two different methodologies for valuation and would require two separate sets of variables, one to model improvement values and another land values. Additionally, the Marshall Swift construction index used to value improvements is based on historical information and is already dated if used to obtain a current year value. Finally, the addition of a depreciation discount to assessed valuation is another piece of the model that must be considered. These factors increase the difficulty of creating a forecasting model for assessed values in the State, a task already difficult due to the lack of substantial historical data.

Second, the majority of independent variables were highly correlated not only to assessed value (dependent variable), but also to each other. Using two or more of these variables in a regression model would result in multicollinearity of the model. Multicollinearity occurs when two or more predictors in the model are correlated and provide redundant information about the response. Even extreme multicollinearity (so long as it is not perfect) does not violate OLS assumptions. OLS estimates are still unbiased and BLUE (Best Linear Unbiased Estimators). However, multicollinearity does cause high standard errors for coefficients and coefficients may have the "incorrect" sign or unrealistic magnitudes. An incorrect sign in a model typically occurs when an estimated coefficient signifies a relationship between a dependent and independent variable that is opposite of economic theory. For example a negative sign for the coefficient for the county employees variable would indicate that when county employment increases county assessed values decline. This is inconsistent with economic theory.

It is often thought that a major cause of multicollinearity is shortage of data, using too few observations. This may be the case for these models. However, as additional historical data cannot be obtained, three solutions exist. One is to drop one of the correlated variables, which cannot be done since the majority of relevant variables are correlated with each other. Two-transform correlated variables using percentages, per capita, natural log, lagging, differentiation or any other technique. This was done in this case by adjusting financial variables by inflation 1Q 1990 using Consumer Price Index data published by the US Bureau of Labor Statistics to arrive at "real" levels of these variables and by adjusting variables by population to arrive at "per capita" levels. Finally, if the goal of the model is for prediction purposes only and not to estimate the relationship between multiple dependent variables, ignoring multicollinearity is recommended, as it does not change the forecast amount, just the relationship between dependent variables. Once adjusted, however, multicollinearity issues in these models are reduced (Greene 2012).

The single equation regression model for the City of Reno is discussed below. Results for City of Sparks and Washoe County are shown in Appendix A.

As discussed in Table 1 earlier in the paper, data for a number of local, regional, and national variables were collected for this analysis. These variables were developed through the literature review process and interviews with local government representatives and academic faculty. All variables considered are supported by economic theory that assessed values in the City of Reno are a product of new assessed value added in each year and an adjustment to existing assessed values due to the increase in the market value for land and replacement value (construction costs) of improvements. Additionally, as existing structures age, a depreciation component must be included.

As a result, variables are divided into three areas 1) variables that correspond to the health of the local economy (representing demand for new construction and local land market), 2) variables that correspond to the health of the national economy (representing construction cost changes and national drivers of land market), and 3) weighted average year built of all residential and commercial structures (representing a reduction in assessed value resulting from structure depreciation based on age). A structural dummy variable for the recession was also considered.

All independent variables are lagged 2 years. This allows the model to capture any lags in independent data releases and provide a future forecast of assessed values since no forecasts of independent variables are available. The model will generate an assessed value forecast amount in 1990 dollars, as all variables are adjusted to this timeframe. To make the forecast applicable to the period for which assessed values are forecast, they must be adjusted by the inflation factor for that period compared to 1990. Inflation rates are forecast at least one year into the future by the Federal Reserve Bank of Philadelphia in its "One-Year-Ahead and 10-Year-Ahead Inflation Forecasts from the Survey of Professional Forecasters." These inflation forecasts can be used to adjust forecasted assessed value amounts to present day dollars. Assessed value forecasts will also be provided in "per capita" levels and must be multiplied by population to arrive at total value. Population projections for Washoe County are available from the Nevada State Demographer's Office.

For local variables, the model considered Washoe County personal income (copersinc), county population (population), county employees (employees), total square feet of improvement in the City of Reno (sqfttotl), square feet of improvements added in the current year (sqftadd), value of building permits for City of Reno in the current year (buildperm), weighted average year built of all City of Reno structures for the current year (age), sales value of single family units sold in the City of Reno (sfvalue), and sales value per acre of vacant land sold in Washoe County (landvalue).

All of these variables were tested for significance to be included as a local variable in the model. Some of the results are summarized in Table 7 below. It should be noted that though the weighted average age of structures (age) variable shows to be correlated to assessed values, the positive sign of the correlation and the positive sign of estimated coefficients when included in the model is of concern, since one would expect an inverse relationship between structure age and assessed values. This makes sense since the amount of assessed value depreciation is often less than the amount of overall assessed value increase and therefore, the relationship between age and assessed value is difficult to determine. As a result, the age variable is not included in the model.

For national variables, GDP (gdp), national salaries and wages (natwage), and national population (natpop) variables were highly related to assessed values. Construction cost index (costindex) is slightly less related, as are gas prices (gas) and new manufacturing orders (manuf). A variable for national building permitted units was also considered. The dummy variable for the recession (recessd) is not highly related to assessed values. This is likely because the timing of the dummy variable corresponds to the national recession, which does not fit exactly to the recession experienced in Washoe County. The actual timing of this variable is difficult to determine. The inclusion of the recessd variable in the model resulted in a slightly increased R^2 and also a slightly increased MAPE score for the model as shown in Table 7 below. However, the sign of the recessd coefficient is positive, which is counterintuitive given the negative impact of recessions on economic factors.

Table 7 below shows the results of the final chosen model, along with a selection of other models created using various combinations of variables supported by economic theory and discussed throughout this analysis. Coefficients with unexpected signs are highlighted in red.

Table 7. Comparison of Select Alternative Variables Considered for Final Model

Final Model					
Dependent	**Constant**	**Copersinccap ($thousands) (2 lags)**	**USPerms (millions) (2 lags)**		
Avcap ($)	1000.6370	270.1113***	765.5000***		
	R^2	*0.7970*	***MAPE***	*4.8688%*	
Final Model w/ Recession Dummy					
Dependent	**Constant**	**Copersinccap ($thousands) (2 lags)**	**USPerms (millions) (2 lags)**	**Recession**	
Avcap ($)	1027.117**	260.0891***	880.9000***	297.1641	
	R^2	*0.8113*	***MAPE***	*4.8938%*	
Final Model w/ Natpop Instead of USPerms					
Dependent	**Constant**	**Copersinccap ($thousands) (2 lags)**	**Natpop (millions) (2 lags)**		
Avcap ($)	2930.175*	451.9237***	-20.7000**		
	R^2	*0.7903*	***MAPE***	*5.2985%*	
W/Population and SFValue					
Dependent	**Constant**	**Population (millions) (2 lags)**	**SFValue ($thousands) (2 lags)**		
Avcap ($)	6058.0670***	810.8000	21.2515***		
	R^2	*0.8652*	***MAPE***	*8.0819%*	
Final Model W/ Employees Instead of Copersinc					
Dependent	**Constant**	**Employees (thousands) (2 lags)**	**USPerms (millions) (2 lags)**		
Avcap ($)	2812.938**	26.566***	1258.3000***		
	R^2	*0.7201*	***MAPE***	*4.9449%*	
W/ Employees and Natwagecap					
Dependent	**Constant**	**Employees (thousands) (2 lags)**	**Natwagecap ($thousands) (2 lags)**		
Avcap ($)	3340.956*	23.1102	144.7237		
	R^2	*0.4197*	***MAPE***	*7.9159%*	
W/ SFValue and Sqftcap					
Dependent	**Constant**	**SFValue ($thousands) (2 lags)**	**Sqftcap (thousands) (2 lags)**		
Avcap ($)	3907.0060	20.9784***	4189.6980		
	R^2	*0.8701*	***MAPE***	*7.9462%*	

As discussed above and shown in Table 7, multiple versions of local and national variables, adjusted for inflation and per capita levels were tested and compared based on the resulting model's R^2, significance of resulting coefficients, and MAPE (discussed later in this section) results. The model with the best combination of high R^2, most significant coefficients, and lowest sample error results (MAPE) was selected as shown below:

$$AVcap = \alpha + \beta_1 Copersinccap_{t-2} + \beta_2 USperms_{t-2} \qquad (14)$$

where:

AV is the annual assessed value for City of Reno for year t. As discussed above, assessed value data is provided on a fiscal year basis. However, as these values are typically already available by the first part of the fiscal year (for example, FY 2014-2015 in 2014), the data is treated as belonging to that year. This variable is adjusted for inflation to 1Q 1990 using the Consumer Price Index (CPI). It is also a per capita variable, divided by Washoe County population. Source: Nevada Department of Taxation. "Local Government Finance Property Tax Rates For Nevada Local Governments-Redbook." http://tax.nv.gov/LocalGovt/PolicyPub/ArchiveFiles/Redbook/

Copersinc is the personal income for Washoe County. This data is available 1 to two years behind. Data is shown in thousands of dollars. This variable is adjusted for inflation to 1Q 1990 using the Consumer Price Index (CPI). It is also a per capita variable, divided by Washoe County population. CA1-3 Personal income summary, Local Area Personal Income & Employment, Bureau of Economic Analysis. http://www.bea.gov/regional/

USperms- is the new privately owned housing units authorized by building permits in permit-issuing places for the United States. These data are available monthly. Data is shown in millions of units. United States and Census Regions, United States Census Bureau. http://www.census.gov/construction/bps/uspermits.html

The Breusch-Godfrey test indicated that the model had no issues with serial correlation and an ordinary least squares (OLS) can be used to estimate the model. The final estimated model is as follows:[6]

---

[6] Values in parenthesis are standard errors associated with above coefficients. Asterisks following each standard deviation number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.

$$AVcap_t=1000.637+270.111Copersinccap_{t-2}+765.500USperms_{t-2} \quad (15)$$
$$(1102.115) \quad (44.700)^{***} \quad (255.900)^{***}$$

$$R^2=0.7970$$

This model predicts approximately 79.70 percent of the annual change in City of Reno assessed value levels. All estimated coefficients, with the exception of the constant, are significant at the 10 percent, 5 percent, and 1 percent levels of significance. The model's forecasting ability is measured by the its prediction errors as discussed below.

In- and out-of sample predictions are made using the model and the Mean Absolute Percentage Error (MAPE) was estimated for the model. The formula for the MAPE estimate is shown in equation 13 above. Predictions based on the model are made for the entire period of the available data 1990 to 2014 (in-sample estimate), and for a three-year out-of sample period 2012 to 2014. It should be noted that assessed value data is available for 2014 and while there is no full year data for 2014 for most independent variables, the use of lagged variables allows the model to forecast the 2014 assessed value and to compare it to actual 2014 value. To estimate the out-of sample period, the econometric model was estimated without data for the most recent 3-year period and estimates were created for the 3-year period using the resulting model.

The results of the assessed values forecast by the model for the City of Reno are summarized below in graph and table form, compared to actual assessed values. The econometric model has a MAPE result of 4.87% using all in-sample data and an out-of sample MAPE estimate of 4.58%.

Figure 7 below shows the comparison between actual assessed values and those predicted by the model. The model would have underestimated assessed values for the majority of the analysis period and especially during the recession. The model would overestimate the recovery in values since the recession starting in 2012. Actual and forecast assessed values for the three-year out-of sample period, in dollar terms are shown below.

Figure 7. City of Reno Actual and Predicted Assessed Values[7]

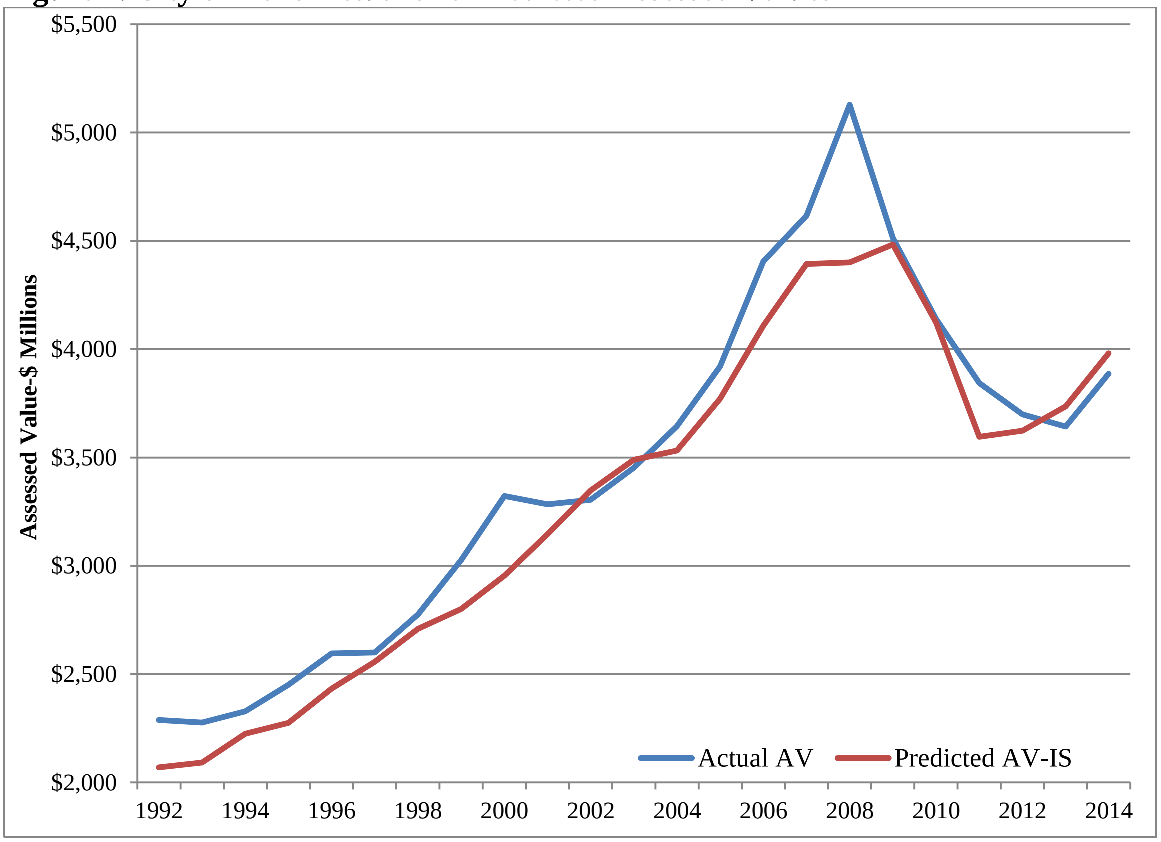


Table 8. Comparison of Actual and Predicted Assessed Values-City of Reno

Forecast Period	Actual AV	Predicted AV*	Error
2012	$ 3,699,116,840	$ 3,762,848,070	1.72%
2013	3,642,588,127	3,879,937,882	6.52%
2014	3,886,358,978	4,100,367,910	5.51%
Average			**4.58%**

*using out-of sample statistics

[7] Actual and Predicted assessed values are shown in real terms, adjusted for inflation to 1990.

Some interesting lessons learned from the review of the variables, and creation of the assessed value model are summarized below. These provide areas for local governments to consider in their economic development and growth efforts:

1. Age of structures is expected to be highly related to assessed values for all three jurisdictions and depreciation to be an important factor for local governments in projecting property tax revenues. However, the age variable is not strongly related to per capita real assessed value levels. The coefficient of the relationship is shown to be positive, which is counterintuitive and likely indicates issues with the variable data.

   The weighted average year built (age) of all commercial and residential improvements for the City of Reno in 2013 was estimated at 1978.075, 1984.736 for the City of Sparks, and 1987.132 for Washoe County. This indicates that City of Reno's structures are older and more depreciated; reducing the City's assessed value. Washoe County has the youngest, least depreciated structures.
2. Similar to taxable sales models, few projections are available for independent variables, with the exception of local population projections and national GDP projections. As a result, historical variables must be used to forecast assessed values. The majority of these variables are currently available for various quarters and months in 2014. No full year 2014 data for independent variables is available. To forecast 2015 levels, the model must include the latest available independent variable data, 2013. As a result, all variables are lagged two years in the models for all three jurisdictions.

3. Current year county personal income, population, and employment levels are all strongly related to current year assessed values, indicating local demand for construction and resulting growth in assessed values. However, some of the local variables did not perform as well when lagged and compared to current year assessed values. Table 9 below shows the relationships between assessed values and the three local variables, by lagged year.

Table 9. Correlation Matrix to Natural Log of Assessed Value, by Lag Time

	Current Year	**Previous Year**	**Two Years Back**
		County Employees	
City of Reno	0.9147	0.9420	0.9503
City of Sparks	0.8973	0.9216	0.9200
Washoe County	0.9157	0.9431	0.9473
		County Personal Income	
City of Reno	0.9561	0.9802	0.9736
City of Sparks	0.9377	0.9606	0.9480
Washoe County	0.9489	0.9733	0.9651
		County Population	
City of Reno	0.9513	0.9528	0.9522
City of Sparks	0.9223	0.9233	0.9215
Washoe County	0.9412	0.9427	0.9418

The table shows that for all three jurisdictions, county population correlation increases slightly in Year 2 (previous year) and drops slightly in Year 3 (two years back). This indicates that county population's relationship to assessed value increases as the variable is lagged once and decreases after two lags, even though the decrease is slight and the relationship between these variables remains strong.

Correlation coefficients for county personal income and employees also increases between current year and previous year and decreases slightly between previous year and two years back. County employment data, with the exception of the City of Sparks, shows an increase in correlation with each lagged year.

This finding is further supported by the Nevada State Demographer's methodology for estimating construction growth in the area. One of the variables used by the Demographer to project future construction is employment and employee wages. This is based on the assumption that employees receive wages which are spent in the local economy creating additional demand for goods and services. This increases the number and/or size of businesses in the area, attracting new employees, and increasing population. This results in increased construction in the area, resulting in more improvements and higher assessed values for each jurisdiction. As it takes time for the businesses to respond to the increased demand and for the new improvements to appear on the local government property tax rolls, the two year lag period is logical.

4. Some of the variables representing growth in the US economy, such as gold prices, gas prices, and new manufacturing orders, which would likely stimulate construction and increase construction prices, leading to an increase in assessed values of existing properties, are less related to assessed values than other national variables such as national population, national wages, and GDP.

Some of the issues faced in the collection and analysis of variables are summarized below.

1. Not all data are readily available or are difficult to collect. For example, wage and personal income data is readily available starting in 2002. However, due to changes between SIC and NAICS industry codes in 2001, data prior to 2001 must be collected manually from Bureau of Labor Statistics (BLS) data files by quarter and by location.
2. Not all data are available immediately, creating lags between projection period and data availability. For example, Bureau of Economic Analysis (BEA) data for county personal income for 2013 was released in November 2014. Forecasts for 2015 and after will have to include a lag of 2 years if using personal income data. The models include these lags in order to ensure that data is available to create relevant forecasts.
3. Many of the variables, especially economic variables, such as wages, income, and GDP variables were shown to be highly correlated with each other, also resulting in issues in selecting a proper model and significance of estimated coefficients. This reduced the variables that could be used in one model, national and local economic variables could not be combined into a single model without manipulation of data. This also made creating a model more difficult.
4. A dummy variable for the presence of recessionary conditions was also considered. This was found to be not strongly related to assessed values. However, it is difficult to pinpoint the exact start and end of each recession, as local recessionary periods do not match national periods. For example, according to the Bureau of Labor Statistics, the recent recession started December 2007 and ended in June 2009. However, the region experienced recessionary impacts past 2009, with high unemployment, low construction, and lagging real estate market.

5. Using annual historical data limited the number of available observations to be used. However, as assessed value data and many of the independent variables are available on annual basis, the use of annual data was required. Additionally, while some data sources were available for an extended historical period, others were not available for this period. As a result, the analysis begins in 1990, to ensure all data are available.
6. Much analysis was required to obtain data for certain variables. For example, the creation of average year built for all structures, total square feet of improvements, additional square feet of improvements, single family sales prices, and vacant land sales prices per acre required a large amount of analysis of Washoe County Assessor data, including multiple pivot tables, data clean-up, and weighted average value estimation.
7. Ideally, a multiple equation model should be created for each jurisdiction, showing assessed values by component (residential, commercial, industrial, etc.). This is because each value component may be driven by its own variables, with some values impacted more by the national and international construction markets and others by local prices and job availability. Focusing on the variables driving each assessed value component would likely lead to a more accurate model.
8. Similarly, breaking assessed values into new versus existing would also likely pinpoint related variables and create a more accurate model. New construction will be created by demand from local residents and businesses, these forces would be best represented by local variables in the model. Existing construction will be impacted by both local and national construction costs and land markets, thus requiring a mix of local and national variables.

9. Finally, models separating values of land versus improvements could also be used due to the difference in the assessment of the two components. However, as historical data for assessed values by component, new versus existing assessed values, or land versus improvements values are not available over a historical terms, a combined model for all assessed values by jurisdiction is used.

<u>4.2.2 Autoregressive Integrated Moving Average (ARIMA) Model</u>

An ARIMA model is another technique utilized to create forecasting models. To use the model, series must either be stationary or become stationary after one or more differencing. Assessed values for all three jurisdictions are not stationary using the Dickey Fuller test. These data are also not stationary over a time trend.

Assessed value data do become stationary at a 10 percent confidence level, according to the Dickey Fuller test after differencing. Differencing the data to make it stationary is the “integrated” (I) portion of the ARIMA model, the other areas include lags of the stationarized series in the forecasting equation, called "autoregressive" (AR) terms and lags of the forecast errors, called "moving average" (MA) terms. ARIMA models and the steps considered in creating these models were discussed in more detail in the above sections of this report. The below section described the use of these steps in the creation of the ARIMA model for assessed value for the City of Reno, City of Sparks, and Washoe County.

1. *Identification*- Multiple versions of the ARIMA models were ran through Stata for each jurisdiction and three models with the lowest AIC and BIC scores were selected.

2. *Estimation*-Using Stata, parameters of the ARIMA methodology are estimated for each of the three selected models. This includes model coefficients and various error and significance statistics. It should be noted that due to the stationarity of the data, the full ARIMA model was used, including the I (differencing component).

3. *Diagnostic Checking*- In- and out-of sample predictions were made using each of the models and the Mean Absolute Percentage Error (MAPE) was estimated for each model. Predictions based on each of the three models were made for the entire period of the available data 1990 to 2013 (in-sample estimate), and for a three-year out-of sample period 2012 to 2014 to be consistent with the single equation models. To estimate the out-of sample period, the ARIMA model was estimated for each p, d, q set without data for the most recent 3-year period and estimates were created for the 3-year period for each model. The results of the estimated parameters of each model for each jurisdiction, along with MAPE results are summarized below.

   It should be noted the both the in-sample and out-of sample errors for all three jurisdictions are considerably higher than those obtained using the single equation regression. This is likely because an optimal ARIMA model could not be created due to the limited number of observations. As a result, the ARIMA methodology may not be appropriate in this case and these models are not recommended to be used for future revenue forecasting.

   The results of the estimated parameters of each model for each jurisdiction, along with MAPE results, are summarized in Tables 10 through 12. Table 10 indicates that for the City of Reno the ARIMA (2 1 1) structure yields the lowest BIC results and has all but one significant coefficients.[8] It has the lowest in-sample and out-of sample MAPE result of the three models at 3.82% and 5.21% respectively.

Table 10. Summary of ARIMA Models-City of Reno

ARIMA (p d q)		Coefficient	Std. Err.	P>|z|	AIC	BIC	MAPE-Total IS	MAPE-3 Yrs OS
av ARIMA (2 1 1)	Constant	201,000,000	67,300,000	0.00300	974.5882	979.1302	3.82%	5.21%
	AR.l1	1.30069	0.33617	0.00000				
	AR.l2	-0.53079	0.42717	0.21400				
	MA.l1	-0.99999	0.24772	0.00000				
	Sigma	308,000,000						
av ARIMA (2 1 2)	Const	167,000,000	135,000,000	0.21700	974.3841	980.0616	4.13%	5.65%
	AR.l1	1.05034	0.28792	0.00000				
	AR.l2	-0.82061	0.28271	0.00400				
	MA.l1	-0.81011	0.40441	0.04500				
	MA.l2	0.99689	0.23601	0.00000				
	Sigma	288,000,000						
av ARIMA (3 1 1)	Const	222,000,000	33,400,000	0.00000	973.7572	979.4347	3.86%	6.96%
	AR.l1	1.08060	0.16251	0.00000				
	AR.l2	-0.11038	0.35670	0.75700				
	AR.l3	-0.37564	0.43589	0.38900				
	MA.l1	-0.99973	0.42052	0.01700				
	Sigma	274,000,000						

where, *MAPE Total IS*-is the MAPE result for the entire in-sample period (1990 to 2013) *MAPE 3 Yrs OS*-is the MAPE result for the 3 out-of sample years (2012 to 2014) using the model for 1990 to 2011.

Table 11 shows that for the City of Sparks the ARIMA (2 1 1) structure yields the lowest AIC/BIC results and has all significant coefficients. It has the second lowest in-sample and lowest out-of sample MAPE result of the three models at 4.87% and 8.68% respectively.

[8] A coefficient is considered significant if its P>|z| result is less than the 95 percent confidence level of t=5 percent or 0.05. For example, a P=0.25400 >0.05 and is, therefore not statistically significant.

Table 11. Summary of ARIMA Models-City of Sparks

ARIMA (p d q)		Coefficient	Std. Err.	P>|z|	AIC	BIC	MAPE-Total IS	MAPE-3 Yrs OS
av ARIMA (2 1 1)	Constant	81,600,000	15,300,000	0.00000	974.2557	978.9679	4.87%	8.68%
	AR.l1	1.36126	0.14885	0.00000				
	AR.l2	-0.66801	0.19235	0.00100				
	MA.l1	-1.00000	0.31295	0.00100				
	Sigma	125,000,000						
av ARIMA (2 1 2)	Const	85,200,000	18,200,000	0.00000	975.6168	981.5071	4.84%	9.59%
	AR.l1	1.52928	0.35882	0.00000				
	AR.l2	-0.82366	0.38784	0.03400				
	MA.l1	-1.33223	0.64549	0.03900				
	MA.l2	0.33230	0.60851	0.58500				
	Sigma	121,000,000						
av ARIMA (2 1 3)	Const	90,300,000	10,800,000	0.00000	976.341	983.4093	4.94%	15.64%
	AR.l1	1.66297	0.36215	0.00000				
	AR.l2	-0.90461	0.23791	0.00000				
	MA.l1	-1.68869	0.61137	0.00600				
	MA.l2	0.41164	0.73353	0.57500				
	MA.l3	0.29541	1.08309	0.78500				
	Sigma	108,000,000						

where, *MAPE Total IS*-is the MAPE result for the entire in-sample period (1990 to 2013) *MAPE 3 Yrs OS*-is the MAPE result for the 3 out-of sample years (2012 to 2014) using the model for 1990 to 2011.

Table 12 shows that for Washoe County the ARIMA (2 1 1) structure yields the lowest AIC/BIC results and has all but one significant coefficients. It has the second lowest in-sample and lowest out-of sample MAPE result of the three models at 3.62% and 7.25% respectively.

Table 12. Summary of ARIMA Models-Washoe County

ARIMA (p d q)		Coefficient	Std. Err.	P>|z|	AIC	BIC	MAPE-Total IS	MAPE-3 Yrs OS
av ARIMA (2 1 1)	Constant	458,000,000	138,000,000	0.00100	1057.016	1061.728	3.62%	7.25%
	AR.l1	1.30710	0.34673	0.00000				
	AR.l2	-0.55766	0.51868	0.28200				
	MA.l1	-0.99983	0.21148	0.00000				
	Sigma	713,000,000						
av ARIMA (2 1 2)	Const	504,000,000	103,000,000	0.00000	1057.061	1062.951	3.72%	8.24%
	AR.l1	1.63551	0.38219	0.00000				
	AR.l2	-0.87818	0.32846	0.00800				
	MA.l1	-1.57618	0.47869	0.00100				
	MA.l2	-0.57627	0.52853	0.27600				
	Sigma	654,000,000						
av ARIMA (3 1 1)	Const	485,000,000	119,000,000	0.00000	1057.080	1062.971	3.59%	10.09%
	AR.l1	1.13597	0.25075	0.00000				
	AR.l2	-0.20425	0.51650	0.69300				
	AR.l3	-0.30052	0.57448	0.60100				
	MA.l1	-0.99979	0.39151	0.01100				
	Sigma	670,000,000						

where, *MAPE Total IS*-is the MAPE result for the entire in-sample period (1990 to 2013) *MAPE 3 Yrs OS*-is the MAPE result for the 3 out-of sample years (2012 to 2014) using the model for 1990 to 2011.

4. *Forecasting*-no forecasting is done using these models due to the high model errors.

4.2.3 Vector Autoregression (VAR) Model

A VAR model was also created for the Cities of Reno and Sparks and Washoe County. However, the resulting model had a MAPE result of 138.9% using all in-sample data and an out-of sample MAPE estimate of 534.8% for the City of Reno. For the City of Sparks, the VEC model had a MAPE result of 137.72% using all in-sample data and an out-of sample MAPE estimate of over 6,000%. For Washoe County, the VEC model had a MAPE result of 109% using all in-sample data and an out-of sample MAPE estimate of 463%.

The resulting in- and out-of sample error amount is too high to yield useful predictions, a model utilizing the VAR technique is not created in this paper. Table 13 compares the results of the models developed using the ARIMA and OLS methods. The table shows the ARIMA model has the lowest in-sampe (IS) MAPE scores for City of Reno and City of Sparks, but higher out-of-sample (OS) MAPE scores for these jurisdictions. For Washoe County, the ARIMA model provides better OS results, but slightly higher IS error values. Overall, since the ARIMA model is difficult to use for forecasting, the OLS models are recommended as they are simplest to implement and yield good predictive results.

Table 13. Comparison of Single Equation and ARIMA Model Performance-Assessed Value

City of Reno			
	R^2	**IS MAPE**	**OS MAPE**
Single Equation Regression	0.7970	4.87%	4.58%
ARIMA	NA	3.82%	5.21%
City of Sparks			
	R^2	**IS MAPE**	**OS MAPE**
Single Equation Regression	0.9517	5.24%	5.05%
ARIMA	NA	4.87%	8.68%
Washoe County			
	R^2	**IS MAPE**	**OS MAPE**
Single Equation Regression	0.9740	3.56%	7.36%
ARIMA	NA	3.62%	7.25%

5. Conclusion

The following are the conclusions of this paper as they relate to the research questions posed at the beginning of the study. While the original goal of the paper was to create forecasting model for all local government revenues, it was found that such a model would be difficult to create due to multiple revenue sources and resulting variables. As a result, the paper focused on forecasting property and sales tax revenues, which make up over 50% of General Fund revenues for all three jurisdictions (City of Reno, City of Sparks, and Washoe County).

Furthermore, in reviewing similar studies and speaking with local government representatives, it was found that modeling base levels rather than actual revenues would reduce errors due to changes in tax rates and tax structures of these revenue sources. As a result, the final models forecast taxable sales and assessed values, not property and sales tax revenues.

Variables for all models were selected using the literature review process and augmented with local information. Due to the lack of forecasted data, all models utilized lagged versions of variables for forecasts. Three modeling techniques were compared and those with highest resulting R^2, significant coefficients, lowest MAPE scores, and simplest forecasts were selected. The three techniques included single equation regression, ARIMA, and VAR models.

Overall, there is a sizable difference between the “perfect” economic model and a “usable” economic model. A perfect model would be based on variables data that is stationary, easily available, forecast ahead to the prediction period, not related to other independent variables (multicollinearity), available for a sufficient historical period (multiple observations), and provide a strong relationship to the dependent variable. Much of the time dedicated to this analysis was spent trying to create as perfect of a model as possible, one with high R^2 results, significant variable coefficients, and low MAPE scores.

However, as discussed previously, forecasted information for the majority of independent variables is not available, requiring the lagging of independent variables. Some variables expected to have a strong relationship to the dependent variables were found to be unrelated. Other variables were too related to each other creating multicollinearity problems. Finally, some variables required a large amount of adjustment in order to be usable, making them difficult to reproduce for future forecasts. As a result, the models are not perfect, but are useful and simple to use for future forecasts.

Additionally, as discussed previously, these models are based on historical information (lagged variables), which may not be useful for forecasts during shocks. As these models were created by smoothing historical data, major shocks, such as the recent recession, may not be forecast by the models. As a result, these models should be used in addition to, not instead of careful, expert-based predictions by financial professionals within each jurisdiction.

An overlying conclusion of the paper is an agreement with other studies which find that creating forecasting models for small areas is a difficult undertaking. In the case of this paper two factors increased the difficulty of the modeling process. First, as described by Cargill (1988), Nevada has a unique economic system. The paper shows local revenues are impacted less by national factors than by local factors. Additionally, the multi-methodology property tax assessment system further complicates any local modeling. The property tax assessment system, through the multiple methodologies, depreciation, and abatement processes results in property tax bills that are not necessarily related to actual economic conditions. As such, it may be time to replace this system with one that is easier to implement, easier to model, and easier to understand. This, however, is as much of a public policy, as an economic effort.

Another difficulty behind creating a forecasting revenue model for a small region is lack of data. As seen in this paper, lack of future/projected variables requires the model to use lagged variables, missing some short-term economic conditions or delaying the prediction of these conditions. Some variables that may have improved the performance of the models, such as the Marshall Swift database which is used to estimate replacement value of structures are expensive to purchase, while others, such as the historical distribution of assessed values between new and existing values and of taxable sales between those made by residents versus visitors, are not available.

Additionally, those variables that are available, may not be available with the necessary frequency, such as annual assessed value data or for a sufficient historical period, such as City of Sparks building permit data, which is not available until after 1997. This lack of projected, frequent, detailed, and historical variables prevents one from creating a more robust forecasting model. It is expected that these issues would be more prevalent in smaller jurisdictions where the entities do not have the resources to purchase databases of variables, create and maintain complex simultaneous equation models, and collect and analyze their own data.

Despite these limitations, there are a number of interesting findings from this paper. For projecting taxable sales for Washoe County, a single equation model utilizing an OLS approach and the ARIMA approach yielded the lowest errors and can be used to forecast future taxable sales. However, as the ARIMA model can only yield results when used with the Stata software, the use of this model is not recommended without this software and a person familiar with the software. The VAR model was found to be too unreliable for future projections.

The single equation model (OLS) resulted in low MAPE scores and consistent predictions for forecasting assessed values for all three jurisdictions. The ARIMA model also yielded low MAPE scores, but is difficult to implement for future use. The VAR models resulted in high MAPE errors and are, therefore, not recommended for future use. Lack of historical data available for modeling (only 24 available observations) limited the accuracy of resulting models and created high MAPE scores, especially in the technique relying of lagged and differentiated variables, which further reduces the number of observations available for analysis. While it would have been ideal to create a composite forecast model based on a number of econometric techniques, only the single equation model technique was shown to be useful for future forecasts.

CHAPTER 2:
LEADING ECONOMIC INDEX FOR THE RENO MSA

1. Introduction

Local communities and governments across the US were strongly impacted by the recession. Having the ability to forecast economic cycles is an important benefit for these governments in helping them prepare for future growth or economic declines. A leading economic index looks at the ability of current economic variables to predict economic performance in the future. It is based on the idea that changes in some variables today lead changes in the economy in the future and by finding and modeling these relationships, economic cycles can be better modeled and predicted.

Using various econometric and composite techniques these leading indicators are combined into a single number that represents an economic level at a future date. The main output of the index is the change in that number, which indicates decline or growth in future economic activity. As with the revenue forecasting model in Chapter 1, the index depends heavily on the leading indicators used and their relationship to the selected coincident indicators. However, lack of data availability at the regional level is expected to present some issues in the creation of such an index.

The index discussed in this paper used the Washoe County region as a case study, as the author's familiarity with the area's economy and access to local data facilitated the creation of the index. However, the various methodologies used in the paper can be applied to multiple regions across the US, although relevant variables may differ by region.

While the goal of the economic index is to provide a short-term economic forecasting tool for Washoe County, the index would be remiss if it did not include Storey County. By definition, the Reno-Sparks Metropolitan Statistical Area (MSA) includes Washoe and Storey counties.[9] The majority of the population in the MSA is located in Washoe County, with 436,797 (99.1 percent of MSA population) residents residing in Washoe County in 2014 and only 3,974 in Storey County.[10] However, the proposed Tesla gigafactory, with a potential of 6,500 employees at buildout is located in Storey County and Storey County's Tahoe Reno Industrial Center (TRIC) is expected to continue to gain employment for the county. As the majority of Storey County employees live in Washoe County, 58.3 percent of all employees in 2013,[11] Washoe County's economy will be impacted by changes in Storey County. As a result, the index was created for the Reno-Sparks MSA, including data for both Storey and Washoe counties.

This chapter discusses the creation of a leading index for the Reno MSA, one similar to the well-known Conference Board Leading Economic Index and the Las Vegas leading index created by the Center for Business and Economic Research at the University of Nevada, Las Vegas, the index most closely related to the Reno MSA due to some its location in Nevada. Multiple other indices for small regions across the US are also available and were considered, as discussed Literature Review section of this paper.

[9] "Core Based Statistical Areas (CBSAs) and Combined Statistical Areas (CSAs), February 2013." US Census Bureau.
[10] "Population of Nevada's Counties and Incorporated Cities 2014 Final Certified Series." Nevada State Demographer.
[11] "Home Destination Analysis by Counties." OnTheMap, US Census Bureau.

1.1 Problem Statement

Currently no leading economic indices exist for the Reno MSA area. The Center for Regional Studies at the University of Nevada, Reno, through Hightower Advisors, a Las Vegas financial consulting firm, publishes The Stat Pack which includes Northern Nevada data such as Reno/Sparks MSA employment, Washoe County gross gaming revenue, Washoe County taxable sales, Washoe County existing single family home values and sales, and other economic variables (Stat Pack). However, the publication does not draw an overall conclusion regarding the Northern Nevada economy, nor does it provide any predictive value. Such an index would be helpful for local governments and businesses in Washoe County to forecast shifts in the county's economy, adjusting their expenditures, expansion, employment, and other planning efforts accordingly.

Similarly, the Consensus Forecast for Washoe County, of which the forecast for 2014-2034 is the latest available, uses a number of leading long-term forecasts from across the nation. The Consensus Forecast includes information from Global Insight, a national forecasting firm in Massachusetts that prepares national, state and county forecasts; Woods and Poole, a national forecasting firm in Washington, DC, that provides forecasts for every county in the United States, as well as state and national forecasts; Truckee Meadows Water Authority's Population and Employment Econometric Model; and the 2013 Nevada State Demographer's Forecast. Combining forecasts from these four sources, (1) population, (2) employment, and (3) income for Washoe County, are forecast over a 20-year timeframe (TMRPA 2014). While useful in forecasting long-term changes in the three variables, this forecast does not provide a picture of the changes in the economy as a whole.

1.2 Methodology Overview

The methodology for the index created in this paper is to collect a list of variables most likely to predict fluctuations in the Reno MSA economy. Similar to the econometric forecasting models described in Chapter 1, this process begins with a review of similar indices across the United States to create a list of variables. These variables were reviewed based on their applicability to the Reno MSA economy and the availability of historical data for these variables. Additional variables were added to the list if found to be unique to the Reno MSA economy and were not found through the literature review process. This is a common practice as many regions have a unique focus in certain industries, have unique demographic characteristics, or other variables that influence the regional economy.

Variables were then compared for their ability to predict turning points in the economy and their lead prediction ability. Finally, the selected variables were combined into an index as discussed later in this Chapter.

1.3 Research Questions

There are a number of research questions on which this paper is based. These include:

1. Is the index of leading indicators of value in the prediction of economic performance?
2. What variables can be used as a main indicator of Reno MSA's economic activity?
3. What other variables are available that correspond to the same turning points as the Reno MSA economy?

4. What is the difference (lead period) between the turning points of these variables and the economy?
5. Are there differences in appropriate variables for the Northern Nevada economy compared to Southern Nevada economy that require the creation of multiple indices, rather than one state-wide index?

1.4 Significance

The significance of this paper is in its ability to provide businesses, governments, and decision makers in the Reno MSA region with an ability to forecast changes in future economic conditions. A leading economic index will take into account existing economic conditions to predict economic conditions in the near future. This is a model currently lacking for the Reno MSA and for many other small regions which may benefit from obtaining some lead on the future performance of their economy.

2. Literature Review

An economy, whether global, national, or regional, is a combination of multiple variables working together to create up and down swings (cycles) in the overall performance of the economy. An economic index attempts to use relationships between these variables to help describe and predict economic performance. There are three types of economic indices: leading, coincidence, and lagging. A leading economic index is based on variables (indicators) that anticipate changes in the economy. The change in these indicators can be a signal of changes in the economy. For example, a growth in the money supply is a leading indicator; a peak in the growth of the money supply tends to lead a peak in the growth of the economy by about 1 to 2 years. A coincidence index is based on indicators that describe the economy at its current state. For example, a change in employment helps describe changes in the economy. Finally, a lagging index is based on indicators which follow changes in the economy. This can include changes in interest rates which typically change as a reaction to the economic changes (Dagnino 2003).

There are also two types of index methodologies, a composite index and an econometric index. Composite indices combine data from multiple data series using weighted averages, with weights assigned to data series using various quantitative and/or qualitative techniques. Econometric indices, on the other hand, use econometric techniques to measure the relationship between data series and use these relationships to arrive at an index number.

One of the most known leading composite indices is the Conference Board Leading Economic Index. The index is based on the methodology developed by the Department of Commerce and is a composite index, combining weighted indicators into a single number that changes over time. It is a national index, using variables such as average weekly hours for manufacturing, average weekly initial claims for unemployment insurance, manufacturers' new orders, consumer goods and materials, ISM® Index of New Orders, manufacturers' new orders of nondefense capital goods excluding aircraft orders, building permits for new private housing units, stock prices for 500 common stocks, Leading Credit Index™, interest rate spread for 10-year Treasury bonds less federal funds, and average consumer expectations for business conditions.

Table 1. US Composite Economic Indexes: Components and Standardization Factors

Leading Economic Index		Factor
1	Average weekly hours, manufacturing	0.2733
2	Average weekly initial claims for unemployment insurance	0.0328
3	Manufacturers' new orders, consumer goods and materials	0.0836
4	ISM® new orders index	0.1603
5	Manufacturers' new orders, nondefense capital goods excl. aircraft	0.0407
6	Building permits, new private housing units	0.0306
7	Stock prices, 500 common stocks	0.0394
8	*Leading Credit Index™*	0.0829
9	Interest rate spread, 10-year Treasury bonds less federal funds	0.1108
10	Avg. consumer expectations for business conditions	0.1456
Coincident Economic Index		
1	Employees on nonagricultural payrolls	0.5278
2	Personal income less transfer payments	0.2047
3	Industrial production	0.1469
4	Manufacturing and trade sales	0.1206
Lagging Economic Index		
1	Average duration of unemployment	0.0373
2	Inventories to sales ratio, manufacturing and trade	0.1256
3	Labor cost per unit of output, manufacturing	0.0501
4	Average prime rate	0.2960
5	Commercial and industrial loans	0.0967
6	Consumer installment credit outstanding to personal income ratio	0.1890
7	Consumer price index for services	0.2053

Source: The Conference Board website. www.conference-board.org

The Conference Board also provides coincidence and lagging indices. Variables for the leading, coincidence, and lagging indicators used by The Conference Board in its indices are summarized above. The table also shows the factor assigned to each indicator with the total factors for each index adding to 1.0 or 100 percent (The Conference Board 2015).

Another early index that created a base followed by many subsequent indices was created by Stock and Watson (1989). Similar to The Conference Board, coincidence and leading indices were created by Stock and Watson, along with a Recession Index, which estimated the nation's chances of entering a recession in the next six months. However, instead of using a composite methodology, Stock and Watson used an econometric approach with a vector autoregressive system. The resulting Leading Economic Index (LEI) incorporated the following variables: average weekly hours of production or non-supervisory workers in manufacturing, average weekly initial claims for state unemployment insurance, manufacturing new orders for consumer goods and materials industries, S&P 500 index, contracts and orders for plant and equipment, new private housing authorized index (building permits), vendor performance in terms of percent of companies receiving slower deliveries, change in sensitive materials prices, money supply, change in business and consumer credit outstanding, and change in manufacturing and trade inventories on hand and on order (Stock and Watson 1989).

This methodology is used by the Federal Reserve Bank of Philadelphia, which produces leading indexes for each of the 50 states. The Bank issues a release each month describing the current and future economic situation of the 50 states with special coverage of the Third District: Pennsylvania, New Jersey, and Delaware. The leading index for each state predicts the six-month growth rate of the state's coincident index and a number of leading indicators including state-level housing permits (1 to 4 units), state initial unemployment insurance claims, delivery times from the Institute for Supply Management (ISM) manufacturing survey, and the interest rate spread between the 10-year Treasury bond and the 3-month Treasury bill. Similar to Stock and Watson, this methodology uses a vector autoregression time series model to construct the index, with current and prior value of index variables used to determine future index values.

The above indices use similar indicators for their leading index with the difference being how the indicators are combined. The composite methodology (Conference Board) uses quantitative and qualitative decision making in determining the relationship between index indicators, while the econometric methodology (Federal Reserve and Stock and Watson) uses econometric techniques to determine these relationships (FRB 2015).

There are a number of arguments for using a composite leading index. Main reasons for using this methodology are discussed by Kurre and Riethmiller (2005). First, creating a set of leading indicators may be quicker and less costly than the creation of an econometric model. Second, a local composite index of leading indicators typically requires much less data, which is always a problem when dealing with local economies. Third, since econometric models are based primarily on past patterns, they tend to miss turning points. Fourth, compared to econometric models, leading indicators are simple and understandable, and the concept is familiar to most people given the visibility of The Conference Board Index (Kurre 2005).

A major criticism of the composite methodology is its lack of basis in economic theory. Especially as econometric techniques became more developed, the attack on the composite methodology on the basis of lacking in theory increased (Auerbach 1981). However, popularity of the composite index continues to this day.

In fact, a paper by Phillips (1999) comparing the real-time performance during a 10-year period of the Conference Board Leading Index to the interest rate yield curve and the Stock Watson Leading Index found that the Stock Watson index failed to predict or reflect the 1990-1991 recession, while strongest signals of the recession came from the

Conference Board index. The paper concluded that it is too early to discard the traditional leading index model, as currently produced by the Conference Board (Phillips 1999).

Many composite indices are created using the Conference Board methodology. However, this methodology is for a national index, using national data. Indices for smaller areas must make adjustments to fit local data availability and economic relationships. For example, in their attempt to create an index for the Erie, PA Metropolitan Area, Weller and Kurre (1999) found that local economies are more complicated that the national economy. Since local economies are typically more specialized than the nation, they are likely to experience business cycles different in timing and frequency from the national cycles. They suggested developing separate leading indicators for local areas to supplement national and state data.

Weller and Kurre (1999) compared a number of series as a single leading indicator or as a combination of national and local series based on five parameters: missed turning points, false turning points, length of the lead, consistency of the lead, and variability of the index. Series included Erie total employment, U.S. Index of Coincident Indicators, U.S. Index of Lea Erie manufacturing industries (Erie was found to be highly specialized in its manufacturing sectors). They found that no single or combined index provided perfect information, though some behaved better in some parameters than others. Overall, they concluded that a local leading index was possible to create, though more work needed to be done. They suggested including the following series in their next paper: local help-wanted advertising, purchasing managers' data at the local level, data for building permits and initial claims for unemployment, retail sales, and other series that have proved useful in other local areas (Weller and Kurre 1999).

Kurre and Riethmiller (2005) updated the previous Weller and Kurre model in 2005, choosing the following national and local series to forecast economic activity in the Erie metro area: on the national level- the US Index of Leading Indicators, US total employment, US housing permits, S&P 500, real money supply (M2), and manufacturer's new orders of consumer and capital goods. On the local level indicators included manufacturer's new orders of consumer and capital goods, average weekly hours in manufacturing, manufacturing employment, Erie International Airport enplanements, average weekly initial claim for unemployment insurance, and index of local help wanted ads (Kurre 2005).

Otrok and Whiteman's (1998) coincidence and leading indicator indices were constructed from four economic time series: the Midwest manufacturing index, average hourly earnings in manufacturing, average weekly hours in manufacturing, and total nonagricultural employment. These series are infrequently revised and are considered representative of series used in national economic indicators. They are updated monthly and have strong seasonal year-over-year growth rates (Otrok 1998).

Based in part on the US Composite Leading Index (the methodology also known as the Conference Board methodology), the Central Oregon Business Index (COBI) used local data to forecast local business activity. The COBI used the following local time series: new corporate filings for Deschutes County (seasonally adjusted), total enplanement and deplanement at Robert's Field (Central Oregon's regional airport, seasonally adjusted), estimated lodging revenue (seasonally adjusted, adjusted for inflation using CPI 1982=100), new initial claims of unemployment (seasonally adjusted), median housing days on market (seasonally adjusted), new permanent electrical connections (seasonally adjusted, used as a proxy for housing permits), *Oregonian* help-wanted ad volume (proxy for *Bend Bulletin*), total housing units sold. Indicators were seasonally and CPI adjusted, taken as month-to-month changes, and equalized for volatility (Connolly 2006).

The economic indicators for the Eau Claire Metropolitan Statistical Area (MSA) include a large number of local and national sources. This includes total employment for selected industries, labor force, unemployment, unemployment rate, average weekly initial claims for unemployment, help-wanted index, job openings received, electric power sales, new motor vehicle registrations, sales tax distribution, existing home sales, median price of existing homes, new business incorporations, bankruptcies, commercial building permits, single family residence building permits, US Composite Indexes of Leading and Coincident Economic Indicators, Wisconsin Composite Index of Leading Indicators, Mid-America and Minnesota Leading Economic Index, Midwest Urban Consumer Price Index, gasoline prices, personal income, and population (Jamelske 2004).

Not all small area leading indices are created using the composite approach. Clayton-Mathews and Stock (1999) used the Stock Watson methodology to create coincident and leading indices for the Massachusetts economy. The resulting leading index is a six-month ahead forecast of the coincident index, based on a regression on recent growth in the coincident index and a set of leading indicators. Coincident indicator series were chosen for the following criteria: co-movement with regional economic activity, high frequency, timeliness of availability, length of historical record, reliability, low noise, and robustness to revisions. The authors agreed that series matching all of these attributes are much more difficult to find at the regional rather than national level, resulting in less than ideal choices of series. The following series were considered for the coincident index: establishment employment, withholding taxes, sales taxes, the unemployment rate, household employment, and weekly hours in manufacturing. Household employment and weekly hours in manufacturing series were later dropped due to their lack of coincident relationships and the manufacturing's more promising relationship as a leading indicator.

For the leading index, the following series were considered: consumer confidence in New England, the spread between the 10-year Treasury Bond and 90-day Treasury Bill yields, help wanted advertising for Boston, the Bloomberg Massachusetts stock index, initial unemployment claims, housing permits, construction employment, motor vehicle sales tax collections, and weekly hours in manufacturing. Some of the series were transformed to better fit the index. The coincident index, help wanted ads, Bloomberg stock index, initial unemployment claims, housing permits, construction employment, and motor vehicle sales series were shown using their growth rates. Consumer confidence and average weekly manufacturing hours were shown in first differences (Clayton-Mathews 1999).

The Iowa Department of Revenue (IDR) created a leading indicator index for the State of Iowa. Using the Conference Board methodology, IDR created a coincident index, which was then used to create a leading indicator index. Iowa's coincident index initially considered establishment employment, withholding taxes, sales taxes, the unemployment rate, household employment, and weekly hours in manufacturing. IDR dropped withholding and sales tax indicators due to recent changes in tax rates and assessments, and household employment and weekly hours in manufacturing series due to their lack of coincident relationships and manufacturing's more promising relationship as a leading indicator. Leading indicators selected by IDR included agricultural futures price index, Iowa stock market index, yield spread, building permits, initial unemployment claims, average work hours, new orders index, diesel fuel consumption, delivery lead times, managers confidence index, and real estate transfer index (IDR 2006).

The leading index for Las Vegas, Nevada used a combination of composite and econometric approaches to arrive at their leading index. The index used the following criteria to arrive at its indicators:

1. Data Availability and Lags – Data needs to be updated frequently and have a long historical period of availability. Data must also be collected using a methodology that is not frequently revised.
2. Substitutability – Considers whether local data can be substituted for national data or proxy data used for unavailable variables.
3. Missed Turning Points and False Turning Points – An ideal series will never miss a turning point, but such series are rare.
4. Volatility – An extremely volatile series will make it harder to determine whether or not we are at a true turning point.

5. Length of the Lead – A four to six month lead is ideal, anything less doesn't serve a purpose and anything more becomes vague as the consistency of the lead will become variable.
6. Consistency of the Lead – If the length of the lead varies, it is difficult to predict when the economy will reach its peak or trough.

These criteria were used to arrive at the following variables for the Las Vegas index: Arizona and California Leading Indexes, M2 money supply, total McCarran enplaned and deplaned passengers, Las Vegas hotel and motel occupancy rate, S&P 500 Index, Clark County taxable sales, and Las Vegas visitor volume. The analysis used the Conference Board methodology to create a coincidence index, but found it lacking for the leading index. Instead, the index used an econometric approach to arriving at weights for its series, limiting index period to arrive at different weight factors and improve accuracy (Kennelly 2012).

This Las Vegas leading index replaced a previous index for Southern Nevada published by the Center for Business and Economic Research at the University of Nevada, Las Vegas. The previous index, Southern Nevada Index of Leading Economic Indicators (SNILI), has been cited and emulated in a number of publications reviewed for this analysis. SNILI included the following data series: residential building units permitted, residential building permit valuation, commercial building permits, commercial building permit valuation, taxable sales, McCarran Airport passengers enplaned/deplaned, gallons of gasoline sold, gross gaming revenue, visitor volume, convention held attendance, and convention booked attendance (Gazel 1995).

SNILI's eleven economic indicators were chosen from among almost 30 series based on criteria close to those used to build the national index of leading indicators (The Conference Board index). These criteria are similar to those used by the Las Vegas leading index, including:

1. Timing at revivals and recessions: how consistently the series led (or coincided, or lagged) at the successive business cycle turns;
2. Conformity to historical business cycles: how regularly the movements in the specific indicator reflected the expansions and contractions in the economy at large;
3. Smoothness: how promptly can a cyclical turn in the series be distinguished from directional change associated with shorter (mainly irregular) movements;
4. Currency or timeliness: how promptly available are the statistics and how frequently are they reported (Gazel 1995).

Based on these criteria, the selected series are weighted using The Conference Board methodology, with all series weighted at 1.0, with the exception of taxable sales, gross gaming revenues, and visitor volume, which are weighted at 1.1, giving them a higher importance in the index. The authors found that the index was also useful to forecast employment (four months, six months, and one year ahead) since typical (unrevised) employment data had a weaker performance as a forecasting variable than the index (Gazel 1997).

The SNILI was revised in 2005 to exclude the convention booked attendance series and to revise weights of remaining series from 1.0 and 1.1 to more variable weights (shown in parentheses): residential building units permitted (0.7), residential building valuation (0.9), commercial building permits (1.0), Commercial building valuation (1.4), taxable sales (1.0), air passengers enplaned and deplaned (1.0), sales of gasoline (gallons) (1.2), gross gaming revenues (1.4), visitor volume (1.1), and conventions held attendance (0.5) (Evenson 2005).

3. Methodology

As discussed above, multiple leading indices are created across the nation to help forecast economic performance. Many economists working on these indices agree that the issue of creating an optimal index becomes more difficult for state, and even more difficult for regional economies. These are the economies, however, that need these types of indices the most. Because regional economies don't follow national cycles perfectly, national indices do not provide a full measure of economic performance at the regional level. At the same time, fewer data series are available for each region than nationally and those series that are available typically have shorter historical periods, are noisier due to smaller sample sizes, may be unavailable in a timely matter, and/or have inconsistent data collection methodology (Clayton-Matthews 1999).

Furthermore, while nationally the Gross Domestic Product series can be used to represent coincident economic performance nationally, few such variables exist locally. Gross State Product (GSP) data is available at the state level. However, these data typically have release lag times of over a year and are available annually only. Personal income and employment series have also been used, though both are far from ideal (IDR 2006). Personal income data is typically available quarterly with a multi-month lag time.

Employment is typically available on a monthly basis with little lag time, but these data do not capture changes in the number of hours worked or productivity (Clayton-Matthews 1999).

The practice, therefore, in creating leading indices, is to either choose an inferior data series to represent the economy or create a coincident index of economic activity that combines a number of series. This was done for many of the indices described above. The leading index is then used to forecast the coincident index, which, in turn, represents the current state of the economy (IDR 2006).

The Las Vegas and SNILI indices serve as templates for the index introduced in this paper. Both are attractive as they are located in Nevada, they may share some similar statewide characteristics with the Reno MSA, though some local economic characteristics and drivers may differ. The SNILI index has been successfully used for over a decade and contains many local characteristics which may relate to the Reno MSA. The Las Vegas index is attractive as it utilizes a combination of composite and econometric techniques, which improves on the criticism of composite index not being grounded in theory. Other indices described above are also utilized to obtain a list of useful data series.

The index starts with the selection of appropriate variables (indicators) for the coincident and leading indices. The appropriateness of each indicator as a coincident or leading indicator is determined after variables are identified and series data is collected. In reviewing available literature on the topic, it was found that to be included in the index, indicators must be updated frequently and available for a long historical period, they should be able to predict economic performance in terms of predicting turning points, they should not be volatile, they should provide a lead for economic activity prediction (at least 6 months-worth of a lead time), and lead time must be consistent over time (Kennelly 2012).

The Las Vegas index includes the following indicators: Arizona and California Leading Indexes, M2 money supply, total McCarran enplaned and deplaned passengers, Las Vegas hotel and motel occupancy rate, S&P 500 Index, Clark County taxable sales, and Las Vegas visitor volume. The SNILI index includes residential building units permitted, residential building permit valuation, commercial building permits, commercial building permit valuation, taxable sales, McCarran Airport passengers enplaned/deplaned, gallons of gasoline sold, gross gaming revenue, visitor volume, and convention held attendance. Other indicators found through the Review of Literature process are summarized in Table 2 and 3 below.

Table 2 summarizes series used for multiple national and state indices. The table shows average weekly initial claims for unemployment insurance is the most used series for national and state indices, used by all but one of the sampled indices. The next highest used series are average weekly hours in manufacturing and building permits for private housing. These are used by seven of the eleven sampled indices. These indices may not be as relevant to the Reno MSA index as they are nationally and state-based indices. Table 3 summarizes commonly used series for a selection of local indices.

Table 2. Summary of National and State Indices and Data Series

Comparison of Leading Index Series	Conference Board (TCB 2015)	Stock Watson (Stock 1989)	All US States (FRB 2015)	Texas 1983 (Kurre 2005)	Texas 1988 (Kurre 2005)	Pennsylvania (Kurre 2005)	Illinois (Kurre 2005)	Massachusetts (Kurre 2005)	Wisconsin (Kurre 2005)	Pennsylvania/ New Jersey (Kurre 2005)	New York (Kurre (2005)	Count
Index Scope												
National and State Indices	National	National	State	State	State	State	State	State	State	State	State	
Series												
Average Weekly Initial Claims for Unemployment Insurance	X	X	X	X	X	X	X	X	X	X		10
Average Weekly Hours, manufacturing	X	X		X	X	X	X		X			7
Building Permits, new private housing units	X	X	X	X			X			X	X	7
Interest Rate Spread	X		X					X		X	X	5
Vendor Delivery Performance		X	X				X			X		4
US Index of Leading Indicators					X	X					X	3
Manufacturer's New Orders: consumer goods and materials	X	X										2
Manufacturer's New Orders: nondefense capital goods excl. aircraft	X	X										2
Stock Prices/S&P 500	X	X										2
Consumer Confidence Index (National/State/Local)	X							X				2
New Business Incorporations				X					X			2
State/Local Coincident Index								X		X		2
State/Local Stock Market Index					X			X				2
ISM New Orders Index	X											1
Leading Credit Index	X											1
Taxable/Retail Sales					X							1
Help-Wanted Ad Volume					X							1
Average Overtime Hours: manufacturing									X			1
Construction Employment								X				1
Motor Vehicle Sales								X				1
Oil Well Permits Issued					X							1
Oil Prices					X							1
Real Total Deposits at Commercial Banks				X								1
Texas Real Value of the Dollar					X							1
Job Openings									X			1
Number/Value of Residential Contract Awards						X						1
Change in Sensitive Materials Prices		X										1
Money Supply		X										1
Change in Business and Consumer Credit Outstanding		X										1
Change in Manufacturing and Trade Inventories		X										1

Table 3. Summary of Local Indices and Data Series

Comparison of Leading Index Series	New Orleans (Kurre 2005)	Ohio MSAs (Kurre 2005)	Milwaukee (Kurre 2005)	Flint (Kurre 2005)	Arkansas MSAs (Kurre 2005)	Erie MSA (Kurre 2005)	Erie MSA (Weller 1999)	Oregon (Connolly 2006)	So. Nevada (Evenson 2005)	Las Vegas (Kennelly 2012)	Count
Index Scope											
Local Indices	Local	Local	Local	Local	Local	Local	Local	Local	Local	Local	
Series											
Average Weekly Hours, manufacturing	X	X	X		X	X	X				6
Average Weekly Initial Claims for Unemployment Insurance		X	X	X	X	X		X			6
US Index of Leading Indicators		X	X		X	X	X				5
Residential Permit Valuation		X		X	X				X		4
Airport Passengers (enplaned/deplaned)				X		X			X	X	4
Help-Wanted Ad Volume	X		X			X		X			4
Building Permits, new private housing units						X		X	X		3
Stock Prices, 500 common stocks/S&P 500						X				X	2
Interest Rate Spread			X					X			2
Taxable/Retail Sales									X	X	2
Visitor Volume									X	X	2
Trade Weighted Nominal Exchange Rate: US and Europe	X		X								2
Money Supply						X				X	2
Total Employment						X	X				2
Manufacturer's New Orders: consumer goods and materials						X					1
Manufacturer's New Orders: nondefense capital goods excl. aircraft								X			1
Consumer Confidence Index (National/State/Local)								X			1
Commercial Building Permits									X		1
Commercial Permit Valuation									X		1
Sales of Gasoline (gallons)									X		1
Gross Gaming Revenue									X		1
Conventions Held Attendance									X		1
Oregon Weight Mile Tax								X			1
Non-farm Total Payrolls								X			1
US Index of Coincident Indicators							X				1
New Business Incorporations					X						1
Construction Employment					X						1
Motor Vehicle Sales		X									1
Oil Prices	X										1
Number/Value of Residential Contract Awards	X										1
Capital Expenditures of Purchasing Managers			X								1
Airport Freight Volume				X							1
Houses Sold/Housing Sales Volume				X							1
Offshore Rig Count	X										1
Mortgage Rates	X										1
Prime Interest Rate	X										1
Purchasing Managers New Orders Received			X								1
Purchasing Managers Purchased Material Inventories			X								1
Purchasing Managers Reported Backlog			X								1
US GNP	X										1
Vehicle Production			X								1
Weekly Earnings			X								1
Manufacturing Employment						X					1
Arizona/California Leading Indices										X	1
Hotel/motel occupancy rate										X	1

Table 3 shows that the most commonly used series for the select local indices are still average weekly hours in manufacturing and average weekly initial claims for unemployment. The US index of Leading Indicators is another common data series, creating a connection between local and national data. Residential permit valuation and number of permits, airport passengers, and help-wanted ad volume series are also commonly used. The remainder of series on the list are mainly made up of national data or series unique to each location, such as oil price data for New Orleans or auto manufacturing for Flint, Michigan.

Many of these and other indicators were reviewed for this paper to ensure data availability and predictability of these indicators. To come up with any additional indicators, a Location Quotient (LQ) analysis, as described below, was performed for Washoe County to determine whether some industry employment is more of a driver of the local economy than other industries. If high LQ values are found, indicators such as existing employment and predictions for employment growth in that economic sector (as reported by the Department of Employment, Training and Rehabilitation) may also be included in the model.

Data for various variables was collected through State and local government sources such as Nevada Department of Taxation, Nevada Department of Employment, Training, and Rehabilitation, Nevada Gaming Control Board, and the Center for Regional Studies at University of Nevada, Reno. National data were collected through the US Census Bureau, Bureau of Economic Analysis, and other sources.

A major difficulty in performing this analysis was expected to be the data collection process, including obtaining data that is frequently updated (preferable monthly or quarterly) and is available over a long-term historical period. Another potential difficulty was expected to be in identifying appropriate indicators and creating weights for these indicators. The paper relies on existing literature regarding similar indices, conversations with UNR professors and others who may have an understanding of the local economy and its relationship to various indicators.

3.1 Identification of Indicators

A location quotient analysis was performed for Washoe County to determine whether the county's economy is more dependent on some industries than others in terms of its employment. Location quotients (LQ) show which industries within a region are more strongly represented than they are in the nation as a whole. A location quotient is defined as the ratio:

$$LQ_i = (e_i/e)/(E_i/E), \qquad (1)$$

where e_i is area employment in industry i, e is total employment in the area, E_i is employment in the national economy in industry i, and E is total employment in the national economy.

An industry's location quotient of greater than 1.0 indicates the region is more specialized in that industry than the nation and is likely producing for export as well as local consumption. The greater the LQ value, the greater the specialization of the industry in the region compared to the nation and the greater the exported product or service outside of the region. Surplus or export employment in industry *i* can be computed by the formula

$$EX_i = (1 - 1/LQ_i)*e_i \text{ , } LQ_i > 1, \qquad (2)$$

which is easily shown to be the difference between actual industry employment in the area and the "necessary" employment in the area (as compared to the nation) (Schaffer 2010).

Industry specialization is also measured by comparing five-year trends of location quotients. Specialization of industries changes over time and it is possible that highly specialized industries may be actually decreasing in their specialization. Likewise, non-specialized industries may become more specialize over time. Table 4 below summarizes the location quotient results by NAICS code for major industries in Washoe County. A location quotient analysis for Storey County was not created as Storey County employment data was not published due to confidentiality issues associated with a small number of companies within some industries.

Table 4 shows that the highest percentage of county employment in 2014 was in the Accommodation and Food Services industry, with 17.82 percent of total county employment. The location quotient of 1.64 for this industry indicates this industry has a higher industry employee to total county employees ratio compared to the nation. The industry is slightly less specialized than it was in 2010, having experienced a decline in its LQ ratio of 4.62 percent between 2010 and 2014.

Table 4. Location Quotient by 2-Digit NAICS Code-Washoe County

		2014			2010			% Change in LQ (2010 to 2014)
NAICS	Description	County Employment	% of Total County Employment	Location Quotient	County Employment	% of Total County Employment	Location Quotient	
11	Agriculture, forestry, fishing and hunting	114	0.07%	0.06	140	0.09%	0.08	-22.72%
21	Mining, quarrying, and oil and gas extraction	167	0.10%	0.14	248	0.16%	0.26	-46.94%
22	Utilities	415	0.25%	0.52	499	0.32%	0.61	-14.98%
23	Construction	11,286	6.74%	1.27	8,956	5.71%	1.11	15.31%
31-33	Manufacturing	12,103	7.22%	0.69	10,810	6.90%	0.64	7.71%
42	Wholesale trade	8,913	5.32%	1.06	8,871	5.66%	1.10	-3.87%
44-45	Retail trade	21,989	13.12%	0.99	21,376	13.64%	1.00	-1.19%
54	Professional and technical services	9,667	5.77%	0.80	9,312	5.94%	0.85	-5.58%
55	Management of companies and enterprises	2,738	1.63%	0.88	3,304	2.11%	1.21	-27.36%
56	Administrative and waste services	14,494	8.65%	1.17	11,487	7.33%	1.05	10.86%
61	Educational services	1,972	1.18%	0.51	1,817	1.16%	0.50	1.88%
62	Health care and social assistance	21,021	12.54%	0.81	20,091	12.82%	0.84	-3.64%
48-49	Transportation and warehousing	10,997	6.56%	1.73	9,768	6.23%	1.68	2.97%
51	Information	2,008	1.20%	0.51	2,349	1.50%	0.59	-13.90%
52	Finance and insurance	5,591	3.34%	0.68	5,510	3.52%	0.68	0.58%
53	Real estate and rental and leasing	3,539	2.11%	1.20	3,335	2.13%	1.18	1.44%
71	Arts, entertainment, and recreation	5,204	3.11%	1.71	5,299	3.38%	1.89	-9.15%
72	Accommodation and food services	29,867	17.82%	1.64	28,244	18.02%	1.72	-4.62%
81	Other services, except public administration	5,384	3.21%	0.88	5,248	3.35%	0.82	7.27%
99	Unclassified	98	0.06%	0.31	91	0.06%	0.40	-23.23%
		167,567			**156,755**			

Source: National and Washoe County data from Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics. Data for calendar year 2010 and 2014.

The second largest employment sector in the county in 2014 was the Retail Trade sector with 13.12 percent of total county employees and an LQ ratio of 0.99. The LQ ratio indicates this industry is in line with the nation. The LQ ratio for the industry decreased slightly since 2010, indicating the industry is slightly less specialized than in the past, through still in-line with national employment ratios.

The third highest employment sector in the county in 2014 was the Health Care and Social Assistance sector with 12.54 percent of county employment and an LQ ratio of

0.81. This ratio decreased slightly since 2010 and continues to remain below the national rate of specialization.

Washoe County sectors with LQ ratios over 1.0 (specialized sectors) in 2014 were Transportation and Warehousing (LQ of 1.73), Arts, Entertainment and Recreation (1.71), Accommodation and Food Services (1.64), Construction (1.27), Real Estate and Rental and Leasing (1.20), Administrative and Waste Services (1.17), and Wholesale Trade (1.06). Of these, the Construction sector experienced the highest level of growth in its LQ ratio since 2010, increasing by 15.31 percent.

As discussed above, specialized sectors not only create employment through their operations, they also produce more products and services than necessary for local consumption, therefore creating exports outside of Washoe County. The importance of these sectors to the Washoe County economy should be considered in the creation of an economic index for the county.

Indicators related to these industries may include pounds of goods shipped in and out of the county, gasoline sales, tourism related data such as number of visitors and lodging occupancy, gaming revenue, taxable sales in all industries and retail and food/beverage industries specifically, number of single family homes constructed and/or sold, building permits, median home prices, commercial rental rates, commercial space occupancy, new business licenses issued, and more.

All series without index or percentage properties are adjusted for seasonality. Money-related series are also adjusted for inflation using the Consumer Price Index data for All

Urban Consumers, US City Average.[12] This series is used, rather than a more detailed West Coast data, as national data is available for a longer historical period than detailed data. Additionally, All Items index is used to be consistent across multiple series. All series are adjusted to a base of 1995 dollars as this is the first year of the index.

Once adjusted for inflation, some series are also adjusted for seasonality to exclude any seasonal changes and arrive at economic trends only. Seasonality adjustments are made using a moving average methodology as used in a number of other leading indices, including the Iowa leading index (IDR 2006). This simple seasonal adjustment methodology will ensure the index is easier to implement and update in the future. It should be noted, that seasonality adjustments to the indicators were also made using the X-13ARIMA-SEATS software created by the US Census Bureau.[13] The relationship between the coincident index and indicators adjusted using the X-13 ARIMA-SEATS software and the resulting leading index were similar to those created using indicators adjusted for seasonality with the moving average method. These findings are summarized in Appendix B of this paper. As the results of the two seasonality adjustments are similar, the simpler moving average methodology is used.

It should be noted that while some indicators have data available prior to 1994, due to some missing data for other indicators, 1994 is used as the first full year of data for all coincident and leading indicators (with the exception of some indicators such as visitors and occupancy, data for which is available for a short period only). As the moving

[12] "Consumer Price Index - All Urban Consumers." All Items, Not Seasonally Adjusted, US City Average. Bureau of Labor Statistics.

[13] "The X-13ARIMA-SEATS Seasonal Adjustment Program." US Census Bureau.

average methodology requires each variable to be based on that variable and previous 11 months of variables, 11 months of data is lost in this calculation. As a result, the first month of each index is January 1995, which is consistent with 1995 being the base year for inflation adjustment.

3.2 Coincidence Indicators

Similar to the Las Vegas leading index and a number of other indices discussed above, a coincident index is first created to represent the Reno MSA economy. This is because no single reliable variable exists to describe the regional economy and a use of multiple variables tends to yield a more accurate description of economic cycles. The power of an index to forecast or describe changes in the business cycle is derived from the combined relationships of its series. If one series may predict a business cycle change better than other series, a combination of these series increases the likelihood that the change will be observed (Connolly 2006).

Even the metropolitan gross product data available for the Reno MSA cannot be used as it is available on an annual basis only. For the leading index to be useful, it must be based on data available more frequently than annually. However, Reno MSA GDP data is useful to determine the relationship between proposed coincident indicators and area business cycles.

The Conference Board uses the following indicators in its coincident index: non-agricultural employees, personal income less transfer payments, industrial production, and manufacturing and trade sales (The Conference Board 2015). It should be noted that the data discussed in this section is considered on an annual basis for comparison purposes to MSA GDP and is, therefore, not seasonally adjusted. It is adjusted for inflation, if appropriate.

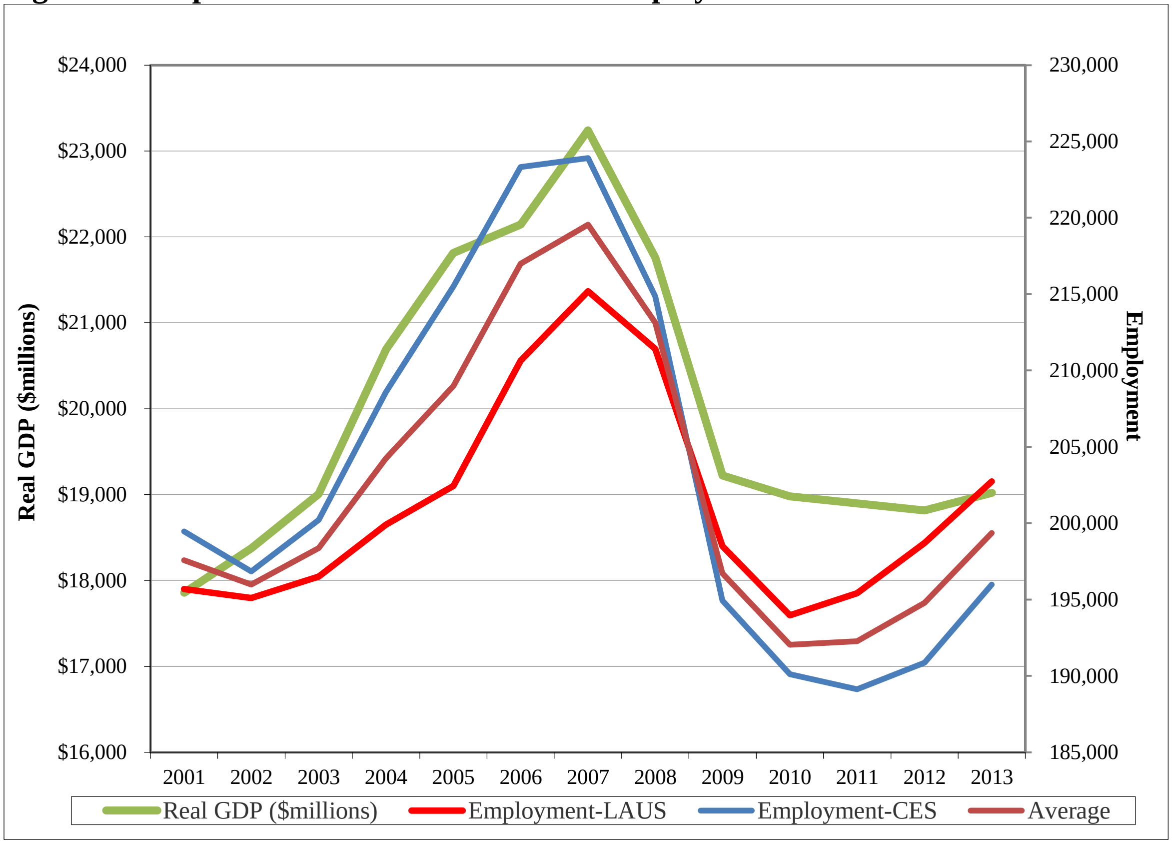
Employment

Employment is a popular coincident index indicator also used by the Iowa and the Las Vegas indices. Employment data from two sources, “Local Area Unemployment Statistics (LAUS)” and “Current Employment Statistics (CES)” by Bureau of Labor Statistics, is available for Reno-Sparks MSA on monthly basis and over a long-term historical period (starting 1990).

The Iowa index includes CES employment data, while the Las Vegas index, a combination of LAUS and CES data. While both measure employment in the area, each series utilizes a different methodology. CES counts jobs, while LAUS counts people. CES is based on place of work, while LAUS is based on place of residence. CES does not count self-employed and agricultural workers, LAUS includes both (DETR 2011). As a result, the two data series may result in different estimates of employment.

Figure 1 compares annual metropolitan gross product (GDP) data for the Reno MSA to annualized LAUS and CES employment data for Reno MSA. An average of the two data series is also included. Gross product data is available between 2001 and 2013, this is the period shown above. All three employment series show a strong coincident relationship with GDP data, with similar cycles, especially in the post-recession period. There is little difference in the shape of each series line, the main difference is in employment magnitude. As a result, a combination of CES and LAUS data, similar to that used in the Las Vegas index, was used as it helps smooth differences between the two series.

Figure1. Comparison of Gross Product and Employment Data Series



Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015.
3. Reno MSA employment data from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015.
4. Average employment data is the average of LAUS and CES series data.

Personal Income

Personal income data at the county level is not available on a monthly basis. Wage and hours worked data for Storey and Washoe County area is available only starting 2007, limiting the availability of historical data for this variable.

Industrial Production/Manufacturing Sales

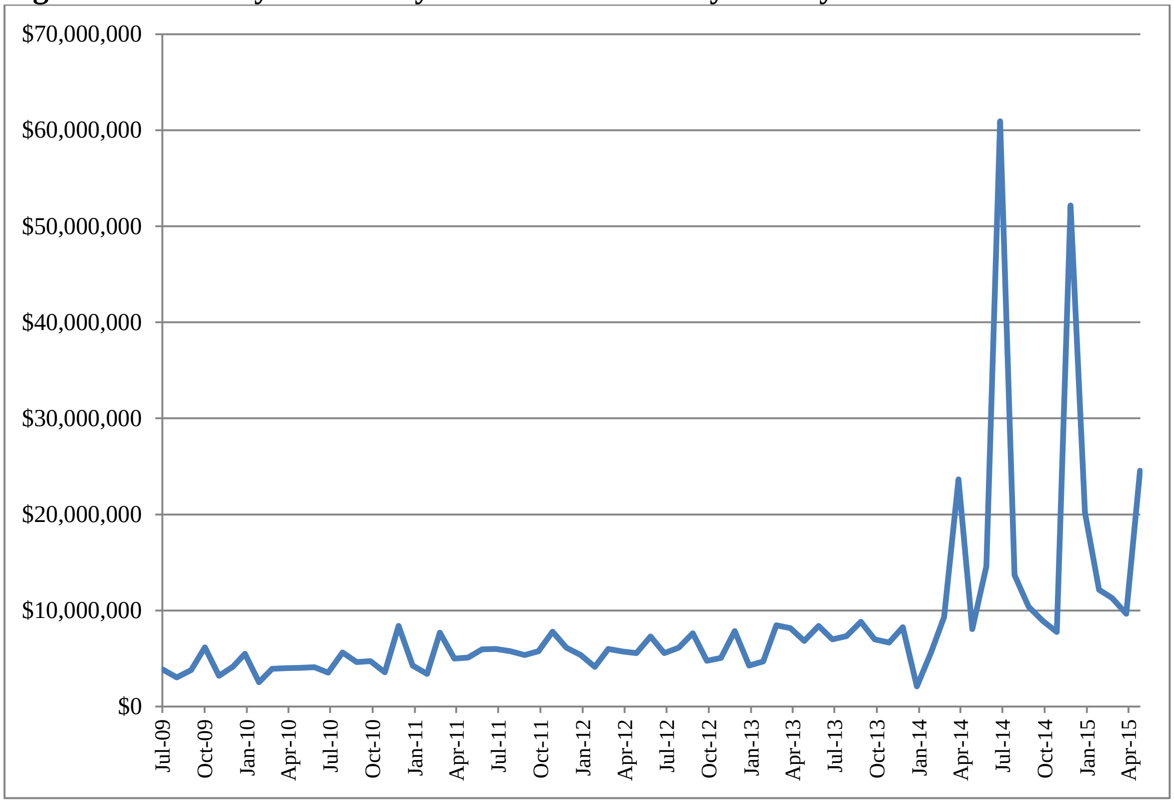
Industrial production and manufacturing sales may not be as relevant at the Washoe County level as nationally, as manufacturing employment in the county does not make up a large portion of total county employment and has a location quotient of 0.69 (Table 4). Additionally, these data are available nationally only, which reduces their importance for a Reno MSA index.

Trade (Taxable) Sales

Retail and Wholesale trade industries have a higher location quotient and a high percent of total county employment. Indicators for these industries should be included in the index and could be represented by taxable sales for the county. Taxable data for Storey and Washoe counties is available monthly and over a long-term period (starting in 1994).

It should be noted that only Washoe County taxable sales data was used in the leading index. Storey County does not have a high level of sustainable taxable sales, this is why the county is still a "guaranteed" county, which means it receives more sales tax revenue from the State than it generates within the county. However, due to the location of the TRIC park within the county, large commercial construction projects temporarily increase the county's taxable sales. These spikes in taxable sales are not sustainable, they occur only as the new business purchases construction materials and equipment, and typically do not recur. As a result, this is not an indicator of changes in the economy, but rather of a one-time construction or expansion project.

Figure 2. Summary of Monthly Taxable Sales-Storey County

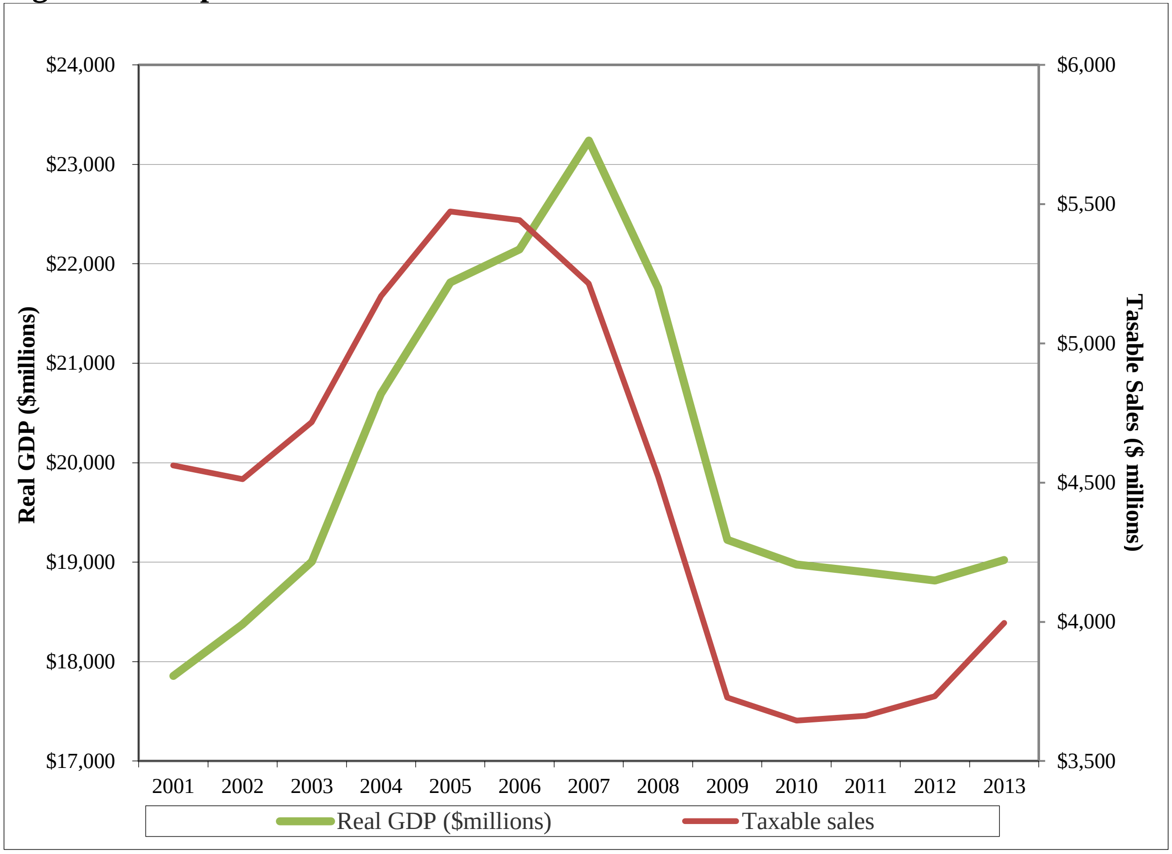


Source: Storey County taxable sales data from "Monthly Taxable Sales Statistics," State of Nevada Department of Taxation. Data is available monthly, 1994-May 2015. Data is not adjusted for inflation or seasonality.

Figure 2 shows many of these spikes have occurred recently as construction of the Tesla gigafactory progressed. The difference between spike and non-spike month taxable sales is high. Taxable sales in December 2014 were $52,176,826 compared to $8,266,310 in December 2013. This is not a seasonal trend that can be eliminated with a seasonality adjustment, nor an economic trend related to changes in the county's economy. As a result, the inclusion of Storey County taxable sales in the index may signal economic changes that may not occur. The exclusion of Storey County taxable sales data from the index is not expected to have a strong effect on the index. Prior to Tesla construction, Storey County taxable sales averaged 1.24 percent of Washoe County taxable sales.

The Iowa index initially focused on the number of employees, withholding taxes, sales taxes, withholding rates, household employment and weekly hours in manufacturing. All indices, except number of employees, were eventually excluded from the index for various reasons. Sales tax data was excluded due to its assessment based on the previous year's payments, which limits its economic coincident ability (IDR 2006). Both Las Vegas and SNILI indices use taxable sales in the leading index, instead of the coincident index. This is also true for Washoe County.

Figure 3. Comparison of Gross Product and Taxable Sales Series



Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Washoe County taxable sales data from "Monthly Taxable Sales Statistics," State of Nevada Department of Taxation. Data is available monthly, 1994-June 2015. Data is adjusted for inflation.

Figure 3 compares Reno MSA GDP to Washoe County taxable sales to determine if a coincident relationship exists. The Figure shows the series has more of a leading relationship between GDP and taxable sales. Taxable sales data are available through May 2015 as of August 2015, with June 2015 data published by the end of August, rather than beginning of the month as for other variables, a lag of three months. This will delay the update of the index by a few weeks. As data has more of a leading, rather than a coincident relationship to GDP, taxable sales series will not be used in the coincident index. This series was reviewed for use in the leading index. Based on the above review, employment (both LAUS and CES) series was used to create a coincident index for Washoe County.

3.3 Leading Indicators

3.3.1 Qualitative Series Selection

Similar to the above section, this section reviews commonly used series for a leading index. Table 3 above summarized top series used in a sample of ten regional indices, including two indices in the State of Nevada. The table indicated that average weekly hours in manufacturing was a top series, utilized by 6 out of 10 sampled indices. It is tied with the average weekly initial claims for unemployment insurance series, also used by 6 out of 10 indices. US Index of Leading Indicators was used by 5 out of 10 indices, residential permit valuation (4 out of 10), airport passengers (4 out of 10), help-wanted ad volume (4 out of 10), building permits for private housing (3 out of 10), stock prices/S&P 500 (2 out of 10), interest rate spread (2 out of 10), taxable/retail sales (2 out of 10), visitor volume (2 out of 10), trade weighted nominal exchange rate between US and Europe (2 out of 10), money supply (2 out of 10), and total employment (2 out of 10).

Multiple other series were used by individual indices and are not considered except when used by the Las Vegas or the SNILI indices. These include: commercial building permits and commercial permit valuation (SNILI), sales of gasoline (SNILI), gross gaming revenue (SNILI), conventions held attendance (SNILI), Arizona and California leading indices (Las Vegas), and hotel/motel occupancy rate (Las Vegas).

These indicators are evaluated using a criteria discussed by Gazel et al (1997) in the creation of the SNILI index, which include the following components. These components are similar to those discussed in the Las Vegas index and the Moore-Shishkin Criteria (IDR 2006).

1. Economic importance of the series/economic theory: This criterion determines whether the series relates to the regional economy.
2. Data Adequacy: This criterion focused on the overall quality of the data and its collection method, historical data availability, frequency of revisions, and consistency of methodology and data over time.
3. Data Timing: This criterion measures how well the series leads, lags, or coincided with the changes in the economy.
4. Cyclical variations: This criteria looks at the series' ability to conform to cyclical variations in the economy.
5. Data Smoothness: This criteria reviews smoothness of the series in terms of erratic variations and fluctuations (Gazel 1997).

It should be noted that the data discussed in this section is considered on an annual basis and is, therefore, not seasonally adjusted. It is adjusted for inflation, if appropriate. Due to the considerable length of the results of this analysis, these results are summarized in

Appendix C of this paper. Based on the analysis summarized in Appendix C, the following leading indicators should be used in the Reno MSA index:

- -Average Initial Claims for Unemployment
- -Single Family Homes Sold*
- -US Leading Index
- -Residential Building Permits
- -Airport Cargo*
- -Taxable Sales
- -S&P 500 Historical Prices*

**Relationship between this leading and coincident indicators is not clear and may require further testing*

<u>3.3.2 Quantitative Series Selection (Granger Causality)</u>

In addition to performing similar steps to narrow down a list of usable series for their leading index, creators of the Las Vegas leading index used Granger causality testing to determine whether a relationship exists between the coincident index variable and the series considered for the leading index (Kennelly 2012). This will also be conducted in this paper. It should be noted that when relevant, all coincident and leading indicators in this section have been adjusted for inflation using the CPI index and for seasonality using the moving average methodology.

Prior to testing for Granger causality, each series must be tested to determine if they are stationary and if not, cointegrated. The Dickey Fuller test is used to test all series for stationarity. Table 5 below shows the results of this test. The table shows some series are stationary at their original level (levels) while others are stationary when differenced (1^{st} diff). All of the series are stationary at either the original level or first difference.

All of the below series can be used to test for Granger causality in their relationship to average employment (coincident variable). A Granger causality test does not necessarily determine whether one variable causes another variable, but rather whether it Granger-causes the variable, that is whether variable x occurs before variable y, which is appropriate in this case. A variable x is said to Granger-cause a variable y if, given the past values of y, past values of x are useful for predicting y.

Table 5. Results of the Dickey Fuller Test for Stationarity[14]

Variable Name	Definition	Dfuller Levels	Dfuller 1st Diff
Empave	Average Employment-SA[15]	-5.038**	-
unempl	Ave Initial Claims for Unemployment-SA	-1.184	-3.983***
gaming	Taxable Gaming Revenue-SA, CPI[16]	2.056	-9.596***
sfhomes	Single Family Homes Sold-SA	-0.824	-6.329***
uslead	US Leading Index	-0.499	-10.942***
respermits	Residential Building Permits-SA	-0.760	-12.096***
compermits	Commercial Building Permits-SA	-1.279	-12.791***
taxsales	Taxable Sales-SA, CPI	-1.934	-4.926***
respermval	Residential Permits Valuation-SA, CPI	-0.624	-9.772***
compermval	Commercial Permits Valuation-SA, CPI	-1.629	-16.063***
gassales	Gasoline Sales-SA	-2.615*	-14.375***
passengers	Airport Passengers-SA	1.335	-5.384***
cargo	Airport Cargo-SA	-4.653***	-
sfprice	Median Sales Price-SA, CPI	-1.014	-18.926***
caind	California Index	-1.711	-13.440***
visitors	Visitors-SA	-0.345	-7.730***
stockprice	S&P 500 Historical Prices-CPI	-1.069	-2.686*
intrate	Treasury Note/ Federal Funds Rate Spread	-1.684	-12.228***
exrate	Trade Weighted U.S. Dollar Index	-1.022	-11.699***
moneysupl	US Money Supply-CPI	2.863	-9.620***
occrate	Occupancy Rate-SA	-0.086	-13.142***

A method for testing Granger causality is to regress y on its own lagged values and on lagged values of x, and test the null hypothesis that the estimated coefficients on the lagged values of x are equal to zero. Failure to reject the null hypothesis is equivalent to

[14] Asterisks following each test statistic number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.
[15] SA-seasonally adjusted
[16] CPI-adjusted for inflation

failing to reject the hypothesis that x does not Granger-cause y (Vargranger 2015). This was done in this case. X variables are the series considered for the leading index, while the y variable is represented by the average of LAUS and CES employment (average employment).

The analysis used lags of 1 month to 12 months to determine the relationship between each x and y variable over a year period. A review of comparable indices indicated a 4 to 6 month prediction time for a leading index is ideal. The 12 lags test is used to determine a long-term relationship between variables, though the 4 to 6 month lag is ideal.

Table 6. Results of the Granger Causality Test with Average Employment[17]

Variable Name	4 lags		5 lags		6 lags	
	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.
unempl	33.958	0.000***	32.004	0.000***	30.979	0.000***
uslead	40.718	0.000***	39.775	0.000***	39.114	0.000***
sfprice	17.052	0.002***	17.653	0.003***	21.584	0.001***
caind	31.819	0.000***	29.955	0.000***	28.807	0.000***
gaming	15.651	0.004***	15.118	0.010***	17.310	0.008***
sfhomes	24.077	0.000***	25.153	0.000***	25.794	0.000***
stockprice	21.137	0.000***	22.742	0.000***	22.100	0.001***
taxsales	16.978	0.002***	15.475	0.009***	15.981	0.014**
intrate	15.825	0.003***	17.499	0.004***	19.022	0.004***
gassales	12.473	0.014**	23.376	0.000***	24.019	0.001***
respermval	5.979	0.201	23.756	0.000***	25.930	0.000***
moneysupl	7.975	0.093*	18.396	0.002***	16.682	0.011**
passengers	12.533	0.014**	12.331	0.031**	15.944	0.014**
cargo	13.198	0.010**	12.384	0.030**	12.411	0.053*
compermits	8.846	0.065*	9.150	0.103	9.251	0.160
respermits	3.830	0.430	9.781	0.082*	15.349	0.018**
compermval	12.618	0.013**	11.101	0.049**	9.086	0.169
visitors	5.609	0.230	5.566	0.351	5.907	0.434
exrate	4.996	0.288	7.334	0.197	10.982	0.089*
occrate	3.819	0.431	3.486	0.625	8.759	0.188

[17] Asterisks following each probability number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.

Table 6 summarizes the results of the Granger causality relationship between each leading series and average employment. Only the results of 4 lags, 5 lags, and 6 lags are summarized. Results for all lags are summarized in Appendix D of this paper. The table summarizes the chi^2 result of the *vargranger* test in the Stata application, along with the probability statistic for the test. The null hypothesis of the test is that x variable does not Granger-cause y. For probability values of less than 0.05, as shown in Table 6, the null hypothesis would be rejected, indicating that the x variable does, in fact, Granger-cause y at the level of significance of 5 percent. For values probability greater than 0.05, the null cannot be rejected.

The table shows that all variables highlighted in green Granger-cause average employment at 1 percent, 5 percent and 10 percent confidence levels. Of these, average initial claims for unemployment (unempl), single family homes sold (sfhomes), US leading index (uslead), taxable sales (taxsales), and S&P 500 stock prices (stockprice) are the series chosen using the prior qualitative methodology. The residential building permit valuation (respermval) series is shown to have a better leading relationship to average employment than building permits issued. As a result, this series was considered instead of the building permit series, though the relationship of both series to employment at the 4-lag timeframe is not statistically significant.

However, five series excluded during the qualitative process were found to be related to average employment. These include gas sales (gassales), California leading index (caind), interest rate spread (intrate), median home sales price (sfprice), and taxable gaming revenue (gaming). Both the gas sales and California leading index series were found to be related to average employment during the qualitative selection process, but too volatile in the case of the California index and unclear in the case of gas sales. Given their Granger causality results, both series were considered in the leading index for the Reno MSA.

Three series, US money supply (moneysupl), airport passengers (passengers), and airport cargo (cargo) have a lower relationship with employment and are highlighted in orange. These indicators are also considered for the index as they show some relationship to unemployment, though at a lower level of significance than the indicators highlighted in green. Remaining series shown in Table 6 were found to be unrelated to average employment during the qualitative and quantitative testing processes.

3.4 Summary

Based on the above analyses, the coincident index for Reno MSA was based on a combination of LAUS and CES unemployment data for the Reno MSA. The leading index for the MSA will include average initial claims for unemployment, US leading index, median sales price of single family homes, California leading index, gaming revenue, single family homes sold, S&P 500 stock prices, taxable sales, interest rate spread, and gasoline sales. Valuation of residential permits, US money supply, and airport passengers and cargo will also be considered.

Table 7 below summarizes the variables suggested during the qualitative and quantitative selection processes and using the X-13 and moving average seasonal adjustment methodologies. As discussed above, the final leading index was created after considering indicators resulting from the quantitative analysis using the moving average methodology. This column is highlighted in green in Table 7.

Table 7. Comparison of Selected Leading Variables by Method

Indicators	Qualitative Method	Quantitative Method: X-13 Seasonality Adjustment	Quantitative Method: Moving Average Adjustment
Ave Initial Claims for Unemployment	X	X	X
Gaming Revenue			X
Single Family Homes Sold	X		X
US Leading Index	X	X	X
Residential Building Permits	X		
Commercial Building Permits			
Taxable Sales	X	X	X
Residential Permits Valuation		X	*
Commercial Permits Valuation			
Gasoline Sales		X	X
Airport Passengers			*
Airport Cargo	X		*
Median Sales Price		X	X
California Index		X	X
Visitors-SA			
S&P 500 Historical Prices	X		X
Treasury Note/ Federal Funds Rate Spread			X
Trade Weighted U.S. Dollar Index			
US Money Supply			*
Occupancy Rate			
*Variables also considered.			

4. Findings

The purpose of the leading index is to provide a forecast of future changes in the coincident index, which has been selected to represent the Reno MSA economy and its performance. Based on the above analysis, the leading index is able to provide a forecast of the changes in the coincident index approximately 4 to 6 months in the future.

Before creating the leading index, however, a coincident index must be created. It should be noted that both the coincident and the leading indices were created using the same approach pioneered by the US Department of Commerce and referred to, in this paper, as The Conference Board method, as this is the method used by The Conference Board to create and update its US Leading index. The construction of a composite index using this methodology follows five steps:

1. Calculate month-to-month changes for each series. Given a series $X_{i,t}$ the month-to-month change is represented by $r_{i,t}$, where i=1, 2, …n. For series in percent form,

$$r_{i,t} = X_{i,t} - X_{i,t-1} \tag{3}$$

   For all other series, a symmetric percent change can be computed as:

$$r_{i,t} = 200 * \left(\frac{X_{i,t} - X_{i,t-1}}{X_{i,t} + X_{i,t-1}}\right) \tag{4}$$

2. Adjust the month-to-month changes by multiplying them by the series' standardization factor, w_i. The results of this step are the monthly contributions of each series estimated as:

$$c_{i,t} = w_i * r_{i,t} \tag{5}$$

   Standardization factors w_i are estimated as the inverse of the standard deviation of each series, normalized across the series to equal 1.

3. Add the month to month changes for all series for each month. This is represented by:

$$S_t = \sum_{i=1}^{n} c_{i,t} \tag{6}$$

4. Begin estimating index values by setting first month to 100 (January 1995) and estimating the cumulative change of the index each month using the following formula:

$$Index_1 = 100$$

$$Index_2 = Index_1 * \left(\frac{200 + s_2}{200 - s_2}\right) = 100 * (\frac{200 + s_2}{200 - s_2})$$

$$Index_3 = Index_2 * \left(\frac{200+s_3}{200-s_3}\right) = 100 * \left(\frac{200+s_2}{200-s_2}\right) * (\frac{200+s_3}{200-s_3}) \quad (7)$$

5. Rebase the index to average 100 in the base year (1995). This is accomplished by multiplying each preliminary level by 100 and dividing by the average preliminary value over all month in 1995 (BCI Handbook 2001).

4.1 Coincident Index

The above methodology is used to estimate the coincident index for the Reno MSA. As discussed previously, employment data from the LAUS and CES sources is used as the two series comprising the index. Data for the index is available starting January 1994, through June 2015. A calculation of the moving average requires the use of data for February to December 1994. As a result, the base year for the index is 1995 as this is the first full year of data, with the first year of the index, 1995, is set to equal 100.

Figure 4 summarizes the resulting Reno MSA Coincident Index, comparing it to the two national economic contractions taking place during the analysis period. One contraction occurred between March 2001 and November 2001 and another between December 2007 and June 2009.[18] However, it should be noted that these are national contractions, their impacts on the Reno MSA have been stronger than their impact on the nation. This can be seen in Figure 4.

Figure 4. Reno MSA Coincident Index

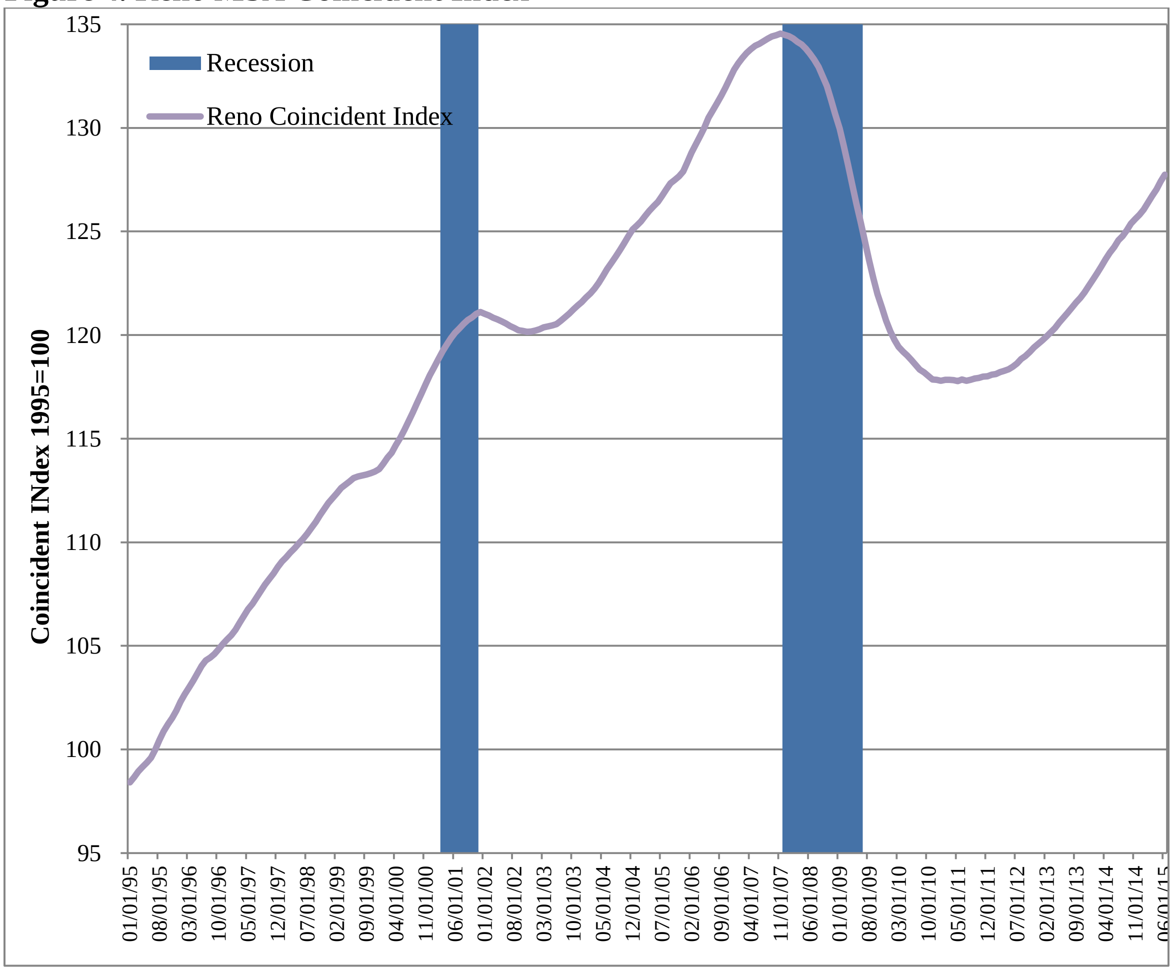


Figure 4 shows the index captures the beginning of the most recent recession, which started in 2007. The Reno recession lasted longer than the national recession due to local factors, such as a housing price bubble and the recession's impact on tourism. The figure also shows the coincident index does not correspond well to the 2001 recession. This,

[18] "US Business Cycle Expansions and Contractions." National Bureau of Economic Research. September 3, 2015.

however makes sense, according to Figure 5 below. The figure shows no impact of the 2001 recession on the Reno MSA real GDP. As a result, it makes sense that the coincident index does not correspond to the 2001 recession.

Figure 5. Reno MSA Real GDP

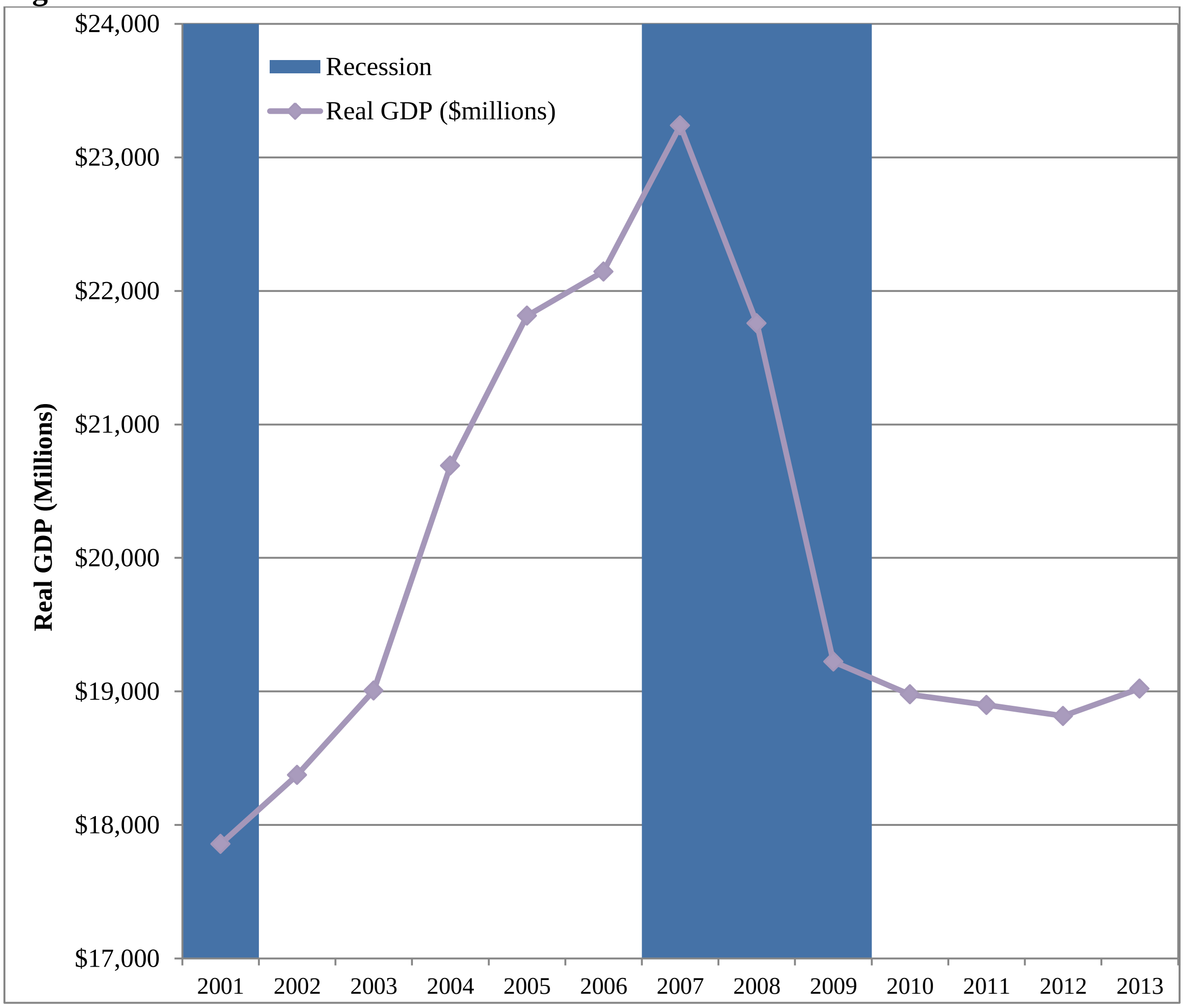
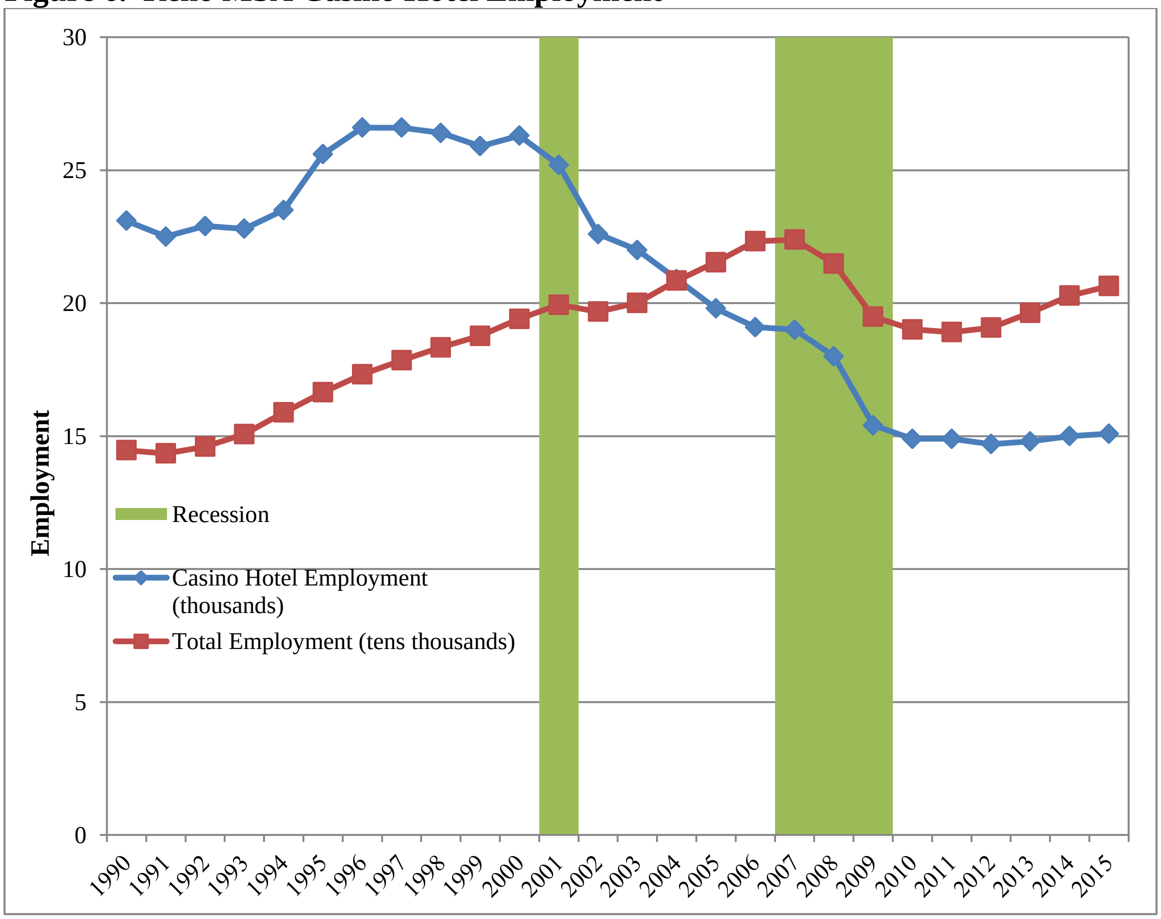


Figure 4 does show a decline in employment later in 2001. This decline in employment corresponds to decline in Casino Hotel industry employment experienced in the area due to the allowance of casino style tribal gaming in neighboring California by Proposition 1A, which was approved in 2000, with first casinos opening in 2001. Figure 6 below shows the changes in casino hotel employment between 1990 and 2015 (available through August 2015). The figure shows a large drop in casino hotel employment, which resulted in a drop in total employment for the MSA between 2001 and 2002, the years for which the coincident index shows a decline. Total employment subsequently recovered, but casino hotel employment continued to decline. It was this, rather than the national recession that lead to the employment decline in 2001 and 2002, which the coincident index correctly demonstrates.

Figure 6. Reno MSA Casino Hotel Employment



Source: "Current Employment Statistics (CES)." Nevada Department of Employment, Training, and Rehabilitation. Data for Reno MSA.

Figure 7 compares the annualized Reno Coincident Index to the area GDP between 2001 and 2013. The index does capture economic fluctuations shown by the GDP series and shows a mostly coincident relationship between the two series.

Figure 7. Comparison of Reno MSA Index and Reno MSA GDP

4.2 Leading Index

4.2.1 The Conference Board (Composite) Methodology

The leading index for the Reno MSA, Reno MSA Leading Index, was developed using the same methodology as the coincident index. As discussed above, the following series were included in the leading index: average initial claims for unemployment (seasonally adjusted), US leading index, median sales price of single family homes (seasonally and inflation adjusted), California leading index, taxable gaming revenue (seasonally and inflation adjusted), single family homes sold (seasonally adjusted), S&P 500 stock prices (inflation adjusted), taxable sales (seasonally and inflation adjusted), interest rate spread, and gasoline sales (seasonally adjusted). Valuation of residential permits (seasonally and inflation adjusted), US money supply (inflation adjusted), and airport passengers (seasonally adjusted) and cargo (seasonally adjusted) will also be considered. Of these, the average initial claims for unemployment index has an inverse relationship to the coincident index and will need to be adjusted accordingly with a negative sign for the index (BCI Handbook 2001).

As with the coincident index, data for the index is available starting January 1994, through June 2015. The base year for the index is 1995, with the first year of the index, 1995, set to equal 100.

Using the above indicators and The Conference Board composite index methodology as discussed above, Figure 8 shows the resulting leading economic index, compared to the coincident index for the Reno MSA and national recessions. The figure shows the use of all relevant variables highlighted in green in Table 6. The leading index does seem to forecast economic troughs and peaks, but does not follow the coincident index exactly.

Figure 8. Reno MSA Coincident and Leading Indices-Green Variables Only

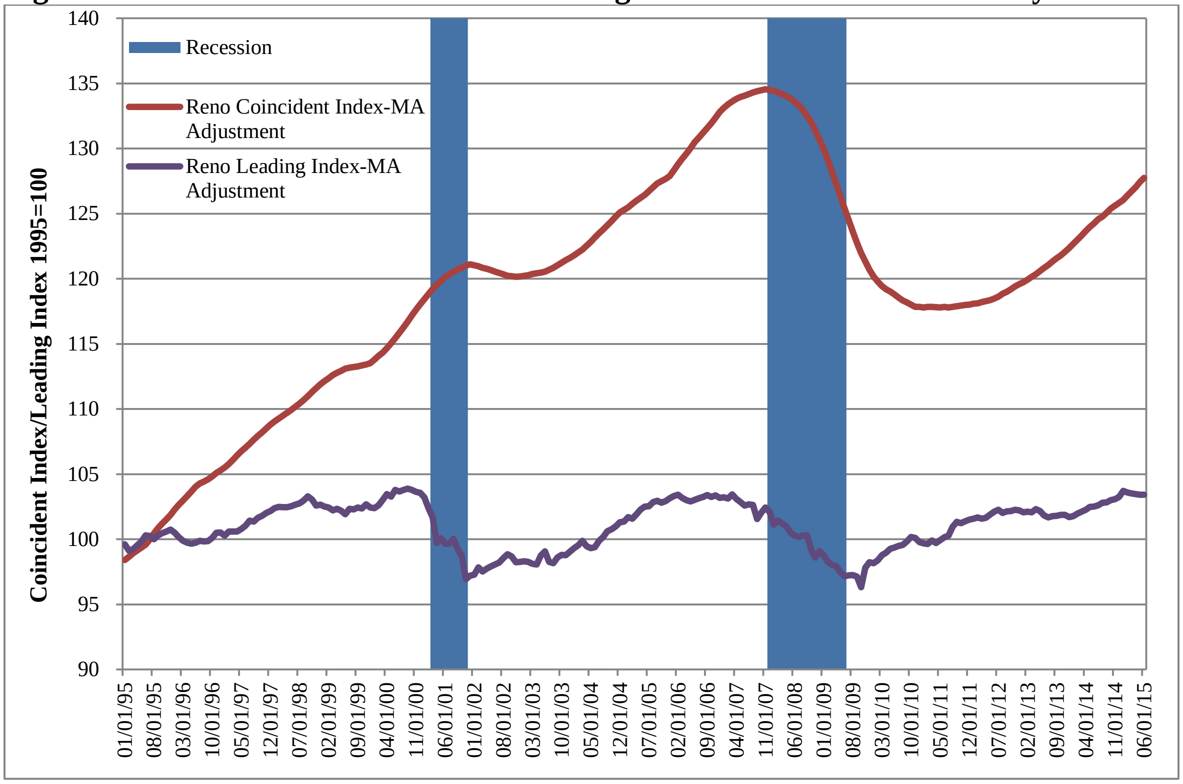


Figure 9. Reno MSA Coincident and Leading Indices-Green and Orange Variables

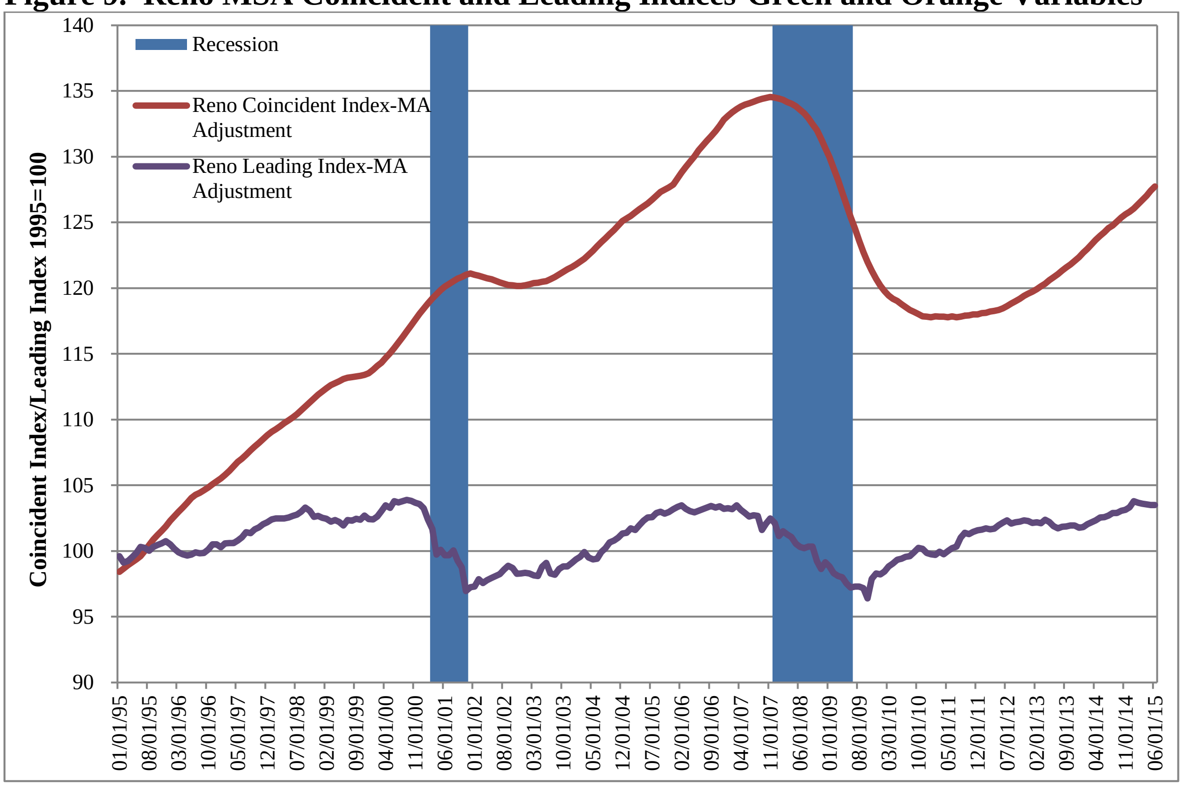


Figure 9 shows the leading index created using both green and orange variables. The graph shows little difference between indices using green only and green and orange variables. This is because orange variables show strong historic fluctuation and are assigned low weights for the index. It should be noted that MA-Adjustment in the legend of the graph refers to the moving average (MA) seasonality adjustment for the data, rather than the X-13 ARIMA adjustment, which was reviewed in this paper, but not used in the creation of the index.

While Figures 8 and 9 show a relationship between the resulting leading and coincident indices, the leading index may be improved. This was done, as recommended in a number of reviewed papers, by removing each series from the index to determine whether the relationship between the leading and coincident index improved. Eliminating the interest rate spread indicator, the variable with the highest resulting weight (.860913) raised the index closer to the coincident index. However, the resulting index had multiple unexplained fluctuations. Removing the California leading index variable, which during the discussion in Appendix C was found to have multiple historic fluctuations, removed a number of the fluctuations from the leading index. Removing the S&P 500 stock price indicator, which is included in the US leading index, and the money supply indicator further reduced fluctuations in the index.

Figure 10 shows the resulting leading index containing the remaining variables. The index shows sufficient lead time between the coincident and the leading indices. The index also begins to decline prior to national recession periods. The leading index does not miss turning points in the coincident index and seems to have no substantial false turning points. The magnitude of the leading index and its volatility are a concern with the resulting index. The peaks and troughs of the leading index are greater than those of the coincident index. The index also has a number of jagged edges and fluctuations, indicating some volatility.

Figure 10. Reno MSA Coincident and Leading Indices-Final Variables

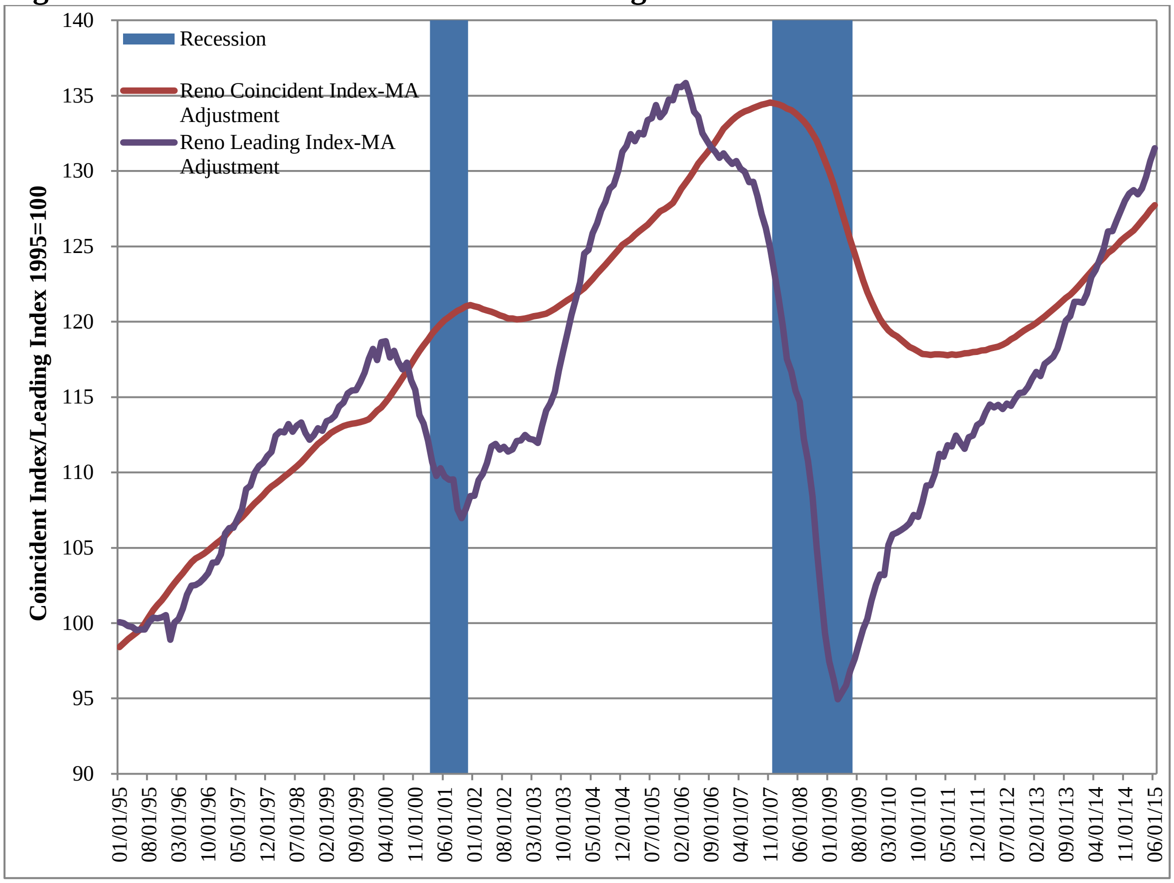


Table 8 shows the list of indicators used in the leading index and weights estimated using The Conference Board composite index. The table shows the US Leading index has the highest weight in the index (93.89 percent), followed by single family home sales (5.26 percent). Other variables have low weights, but are kept in the index due to their relationship to the coincident index.

Table 8. Reno MSA Leading Index Indicators and Weights

Indicator	Weight
Ave Initial Claims for Unemployment	0.0081828
US Leading Index	0.9388808
Median Sales Price	0.0001852
Gaming Revenue	0.0000006
Single Family Homes Sold	0.0526440
Taxable Sales	0.0000002
Gasoline Sales (gallons)	0.0000066
Residential Permits Valuation	0.0000005
Airport Passengers	0.0000938
Airport Cargo (pounds)	0.0000055
Total	**1.0000000**

According to Kennelly (2012), the initial Las Vegas leading index had a number of issues, including an inability to predict changes in the coincident index with a sufficient lead time. Adjustments were required to be made to the index to fix these issues. Kennelly did this by restricting his index to start after December 2001, the ending of the second to last recession. The reason for this was that the methodology relied less on historical economic conditions, which may have changed since the last recession, but still captured an entire economic cycle from trough to peak to trough (Kennelly 2012).

Restricting Reno MSA data to January 2002 and later data resulted in a very similar leading index. Figure 11 shows the leading index resulting from using date-restricted variables. The leading index is similar to that created using full data. The index still captures the turning points of the coincident index, but has the magnitude issues of the unrestricted leading index. The leading index increase shown in Figure 11 is much higher than that of the coincident index and the decrease is much lower.

Figure 11. Reno MSA Coincident and Leading Indices-Restricted Data

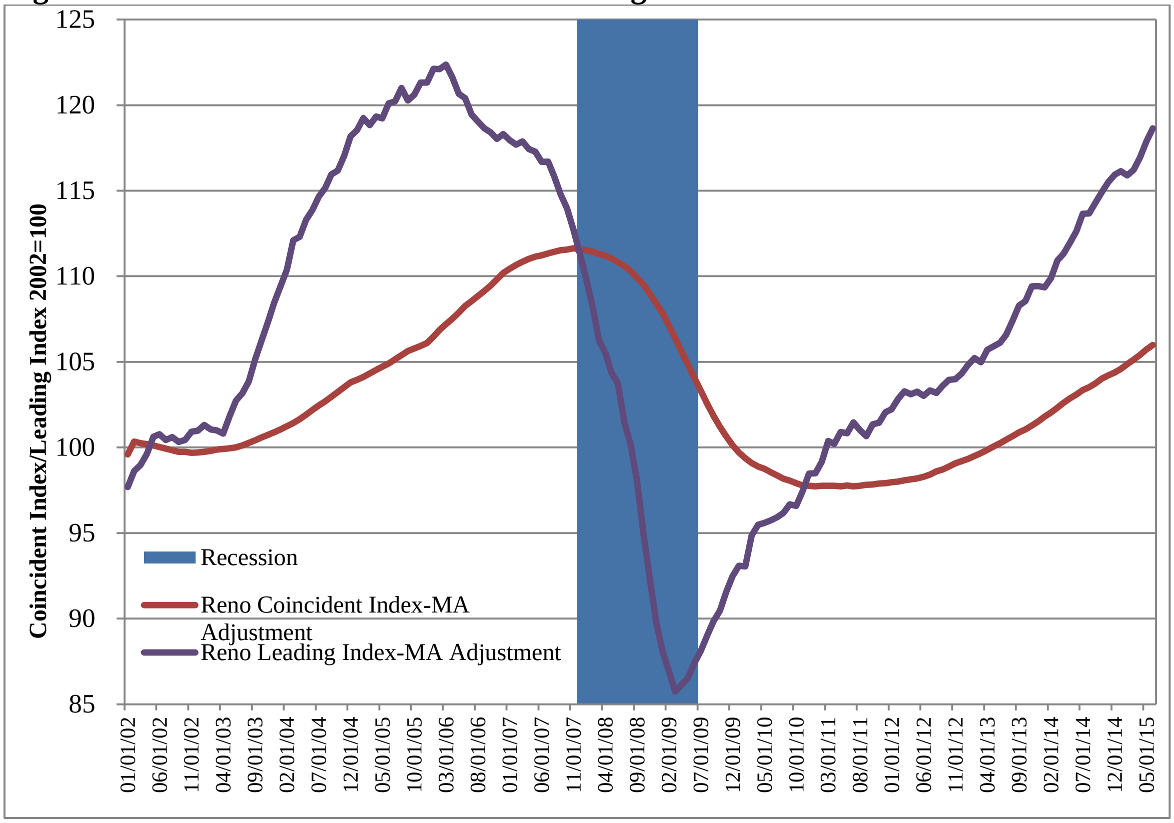


Table 9 shows the summary of index indicators for the leading index created using time-restricted data, along with the resulting weights. The table shows the weights are slightly different than those in Table 8, but no noticeably so.

Table 9. Reno MSA Leading Index Indicators and Weights-Restricted Data

Indicator	**Weight**
Ave Initial Claims for Unemployment	0.0086451
US Leading Index	0.9431929
Median Sales Price	0.0001629
Gaming Revenue	0.0000007
Single Family Homes Sold	0.0478140
Taxable Sales	0.0000002
Gasoline Sales (gallons)	0.0000126
Residential Permits Valuation	0.0000005
Airport Passengers	0.0001596
Airport Cargo (pounds)	0.0000116
Total	**1.0000000**

As the leading index using time-restricted data does not yield a better result, the index resulting from the use of full data should be used.

4.2.2 Las Vegas Index (Regression) Methodology

In creating the Las Vegas leading index, Kennelly (2012) found that The Conference Board methodology resulted in a leading index that corresponded well to the coincident index, but was poor at predicting changes in the index. In order to create a better leading index, Kennelly used a regression technique which further tested his leading indicators and created indicator weights using coefficients resulting from the regression model. Kennelly did this for all available data (starting in 1982) and by using only the data since December 2001, the ending of the second to last recession. The reason for this was that the methodology relied less on historical economic conditions, which may have changed since the last recession, but still captured an entire economic cycle from trough to peak to trough.

The Reno MSA leading index does follow economic turning points represented by the coincident index and provide a sufficient lead of predicting these turning points. However, the magnitude of change in the leading index compared to the coincident index is of some concern, indicating volatility in the leading index. The alternative methodology provided by the Kennelly paper is tested for the Reno MSA leading index to determine whether this methodology is superior to the composite Conference Board index for the Reno MSA.

The methodology used by Kennelly utilized indicators which were selected using traditional methods (qualitative and Granger causality), further narrowing these indicators down using a "hollowed out" regression model, and estimating indicator weights using results from the final model.

The "hollowed out" model, as presented by Kennelly is a version of the Granger causality test which includes only the lags believed to be relevant to the leading index. While the Granger causality includes various lags (up to 12 lags), Kennelly focuses only on lags between 4 and 6 months to result in an index which leads the coincident index by 4 to 6 months, which, as discussed above, is the ideal lead time.

To do so, Kennelly proposes the following model:

$$Coin_t = c + \sum_{i=n}^{m} a_i \, Coin_{t-i} + \sum_{j=1}^{r} \sum_{i=n}^{m} b_{j,i} \, x_{j,t-i} + \varepsilon_t \qquad (8)$$

where

$Coin_t$ is the coincident index for month t,
X is a vector of all the significant economic indicators in Table 7
C a constant, *j* is the indicator, *i* is the month, n = 4 and m = 6

The first step in using this methodology is to convert each relevant variable into an index with 1995=100. The variables are then included into the above regression model using Stata software. It should be noted that this paper estimated the leading index following the exact methodology of the Las Vegas leading index and also a similar methodology, while excluding lagged coincident variables from formula (2.8) above. As shown in Appendix F, the leading index resulting from using the above formula, excluding lagged coincident variables has a better relationship to the coincident index, than the exact Las Vegas methodology. As a result, the following formula is used to estimate the leading index, as discussed in this paper:

$$Coin_t = c + \sum_{j=1}^{r} \sum_{i=n}^{m} b_{j,i} \, x_{j,t-i} + \varepsilon_t \qquad (9)$$

where

X is a vector of all the significant economic indicators in Table 7
C a constant, *j* is the indicator, *i* is the month, n = 4 and m = 6

An F-test in Stata was used to test each of the three versions of each leading variable, the 4th, 5th, and 6th lag of the variable. Appendix E shows the resulting coefficients on each variable, as well as the results of the F-test for each set of lagged variables. The F-test for each of the three lagged variables tests their joint significance to the coincident variable. Table E-1 summarizes the results for this step.

The table shows that the US leading index, single family home price, California index, and residential permit valuation variables are not significantly joined using the F-test. As a result, these variables are excluded and the above regression model is estimated again, without these variables.

Table E-2 shows the results of the second iteration of the regression model and the results of the new F-tests. The model shows that variables for unemployment, gaming, single family homes sold, stock price, taxable sales, interest rates, gasoline sales, money supply, airport passengers, and airport cargo all result in significant F-test at the 95 percent significance level results and should be used in the leading index.

Data for each variable is already provided in index form and must be combined monthly into a single index amount. This is done by creating weights for each of the final variables using the below formula:

$$Weight_j = \sum_{i=n}^{m} |b_{ij}| \,/\, \sum_{j=1}^{r} \sum_{i=n}^{m} |b_{ij}| \qquad (10)$$

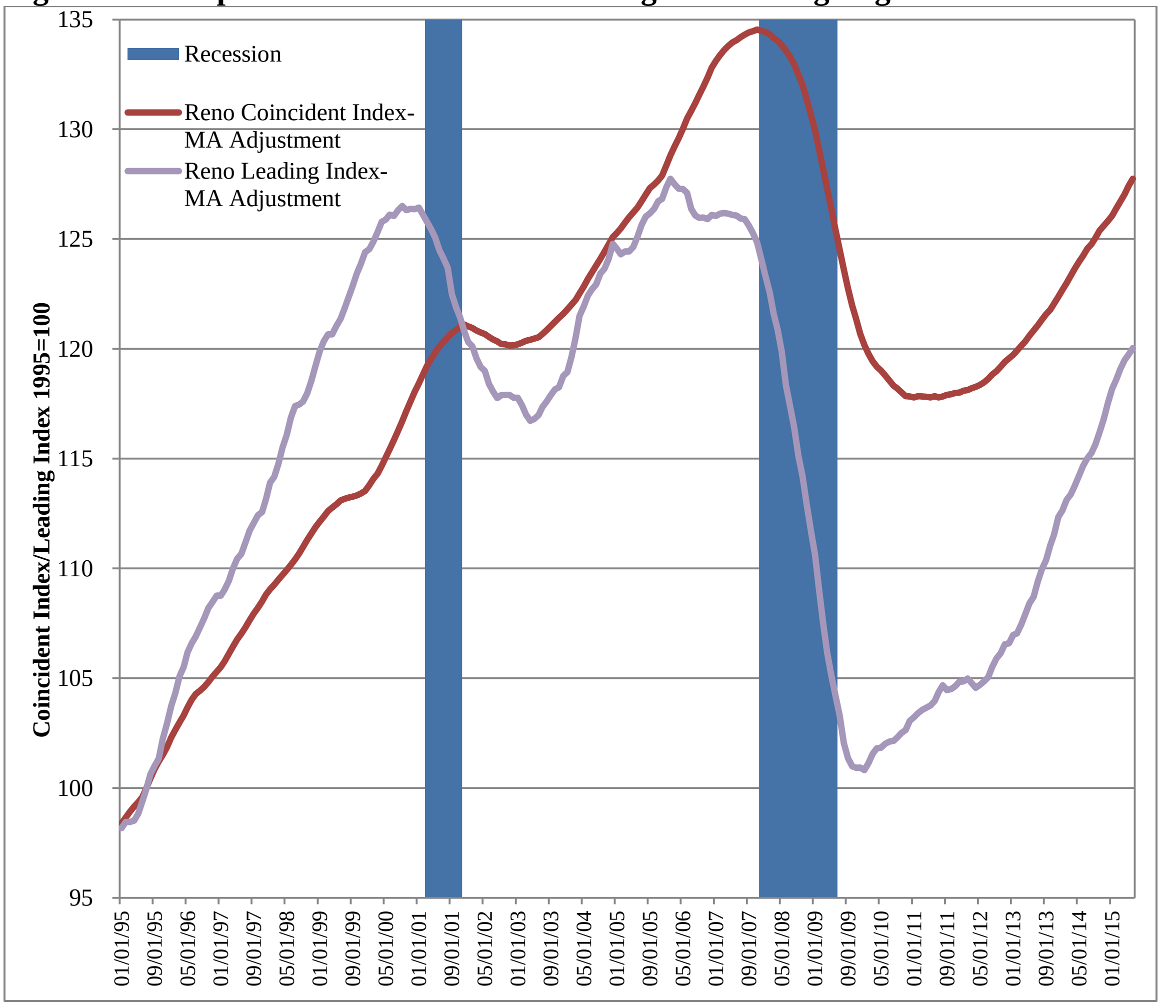
The formula sums the absolute value of estimated coefficients for lagged variable set and divides it by the absolute value for all coefficients resulting from the model in Table E-2.

Indexed variable results are multiplied by the resulting weight in each month and summarized into a total monthly index amount:

$$LEI_t = \sum_{j=1}^{r} (weight_j * X_{jt}) \qquad (11)$$

The resulting leading index is shown in Figure 12 below compared to the national recession periods and the coincident index developed using the composite methodology.

Figure 12. Comparison Coincident and Leading Index Using Regression Method



The figure shows the leading index does predict turn points of the coincident index ahead of the changes in the coincident index with no major false turning points. The index is also relatively smooth, with a small number of fluctuations.

The Kennelly Las Vegas index was first created using all data available and then adjusted to include only data since 2002 to see if a better leading index can be developed. He believed a better fit may be achieved by using limited data due to changes in the economy resulting from the most recent recessions. According to him, reliance on historical data may not represent future economic conditions. As discussed in section 4.2.1, data since January 2002 is used to capture the latest economic conditions and also to ensure a full business cycle is included.

Under the same assumption, a model was developed using Equation 9 for all relevant variables from Table 5 using variables indexed to January 2002=100 and data from January 2002 on. Table E-3 in Appendix E shows the relevant coefficients and F-test results for all lagged sets of variables. The table shows that US leading index, CA index, gaming, interest rate and gasoline sales variables are not significantly joined at 95 percent confidence level and should be excluded. Table E-4 shows the results of the regression and F-tests excluding these variables. The table shows that single family median sales price and residential permit valuation variables should also be excluded. Table E-5 shows the final results of the model created using Equation 9 excluding the above variables. The table shows that the remaining variable lag sets are significant at all levels. Using Equations 10 and 11, weights are estimated for all final variables and applied to all available data (1995-2015).

Figure 13 below compares the resulting leading index using data restricted to 2002 and on (restricted data), the leading index using all data, and the composite coincident index. The figure shows the leading index using restricted data does not provide a better lead time for changes in the coincident index than the leading index created using all data.

The leading index created using restricted data has even more pronounced fluctuations than the index using all data. As a result, the index using all data is preferable.

Figure 13. Comparison of Coincident and Leading Indices Using All and Restricted Data

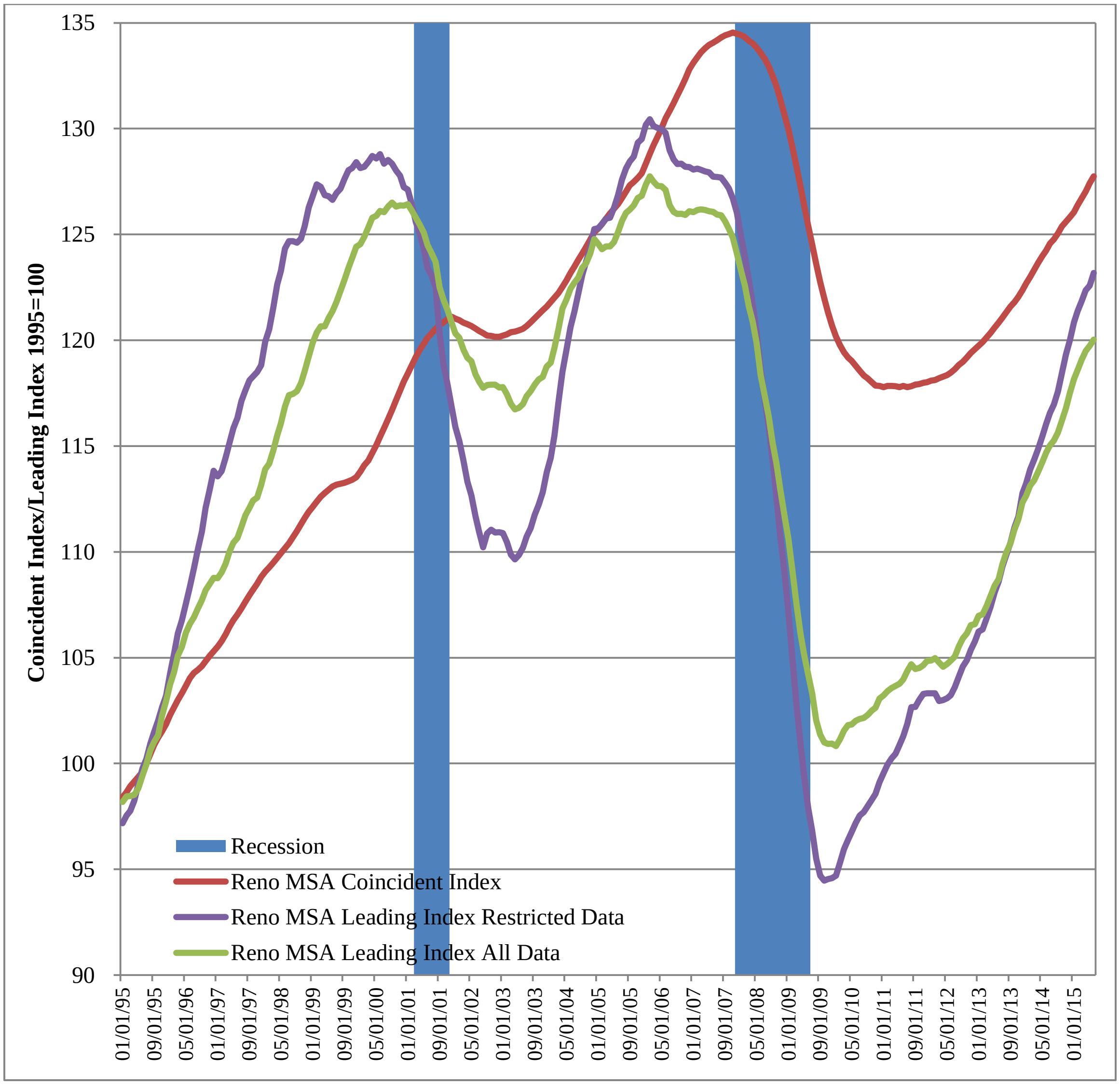


Table 10 below shows the variables used in the final non-restricted (all data) leading index and the resulting weights:

Table 10. Reno MSA Leading Index Indicators and Weights-All Data

Indicator	**Weight**
Unemployment	0.042403
Gaming Revenue	0.247663
Single Family Homes Sold	0.036611
Stock Price	0.074199
Taxable Sales	0.191052
Interest Rate	0.159589
Gasoline Sales	0.033766
Money Supply	0.082932
Airport Passengers	0.073796
Airport Cargo	0.057989
Total	**1.000000**

The table shows that instead of a high reliance on a national factor (US Leading index) of the Reno MSA leading index using the composite methodology, the new index uses a number of local factors like unemployment, taxable sales, gasoline sales, gaming revenue, single family home sold and airport traffic data. There are also a number of national factors, such as stock price, interest rate, and money supply.

5. Conclusion

The following are the conclusions of this paper as they relate to the research questions posed at the beginning of the study. Because no single variable exists to represent the Reno MSA economy, a coincident index was created. Various coincident variables were compared and two employment series were combined using the composite methodology used by The Conference Board to form the coincident index for Reno MSA.

Series for the leading index were determined by compiling a list of variables used in similar indices, adding local variables corresponding to economic theory, and visually inspecting resulting series for their leading qualities. Leading series were combined into an index using composite and econometric approaches. The leading index resulting from the composite methodology relied heavily on national variables and included a number of unexplained fluctuations. The econometric leading index provided both a more balanced weight of local and national variables and smoother index curve. As a result, the leading index using the econometric model is recommended for future use.

The effectiveness of the resulting leading index for the Reno MSA can be measured using the criteria discussed for the Las Vegas leading economic index and echoed in other similar papers. The following are the criteria and the Reno MSA results for each:

1) Data Availability and Lags – Economic indicators used to create the index were selected based on this requirement, as a result, all components of the index are available on a timely basis, are updated using a consistent methodology, and show a lagging relationship with the coincident index.
2) Substitutability – This criteria measures whether local data can be substituted for national data or proxy data used for unavailable variables. The index does not have any unavailable variables and is a combination of national and local variables.
3) Missed Turning Points – The graph of the final index shown in Figure 12 shows data between 1995 and partial year 2015. The figure also shows two major troughs and two peaks. Figure 12 shows the leading index does not miss any turning points of the coincident index with appropriate leads for the majority of the peak and troughs. Of a concern is a lagging trough in the coincident index in November 2002, which the leading index shows as occurring in February 2003. This may again be related to an issue with the coincident index and casino employment, which did not stabilize until 2003.

4) False Turning Points – The index does not show any false turning points. The figure does show a few bumps in the index, but as the definition of a turning point is three to four consecutive months of increase or decline in the index, these bumps cannot be classified as false turning points.

5) Volatility – The graph of the index shows a number of small bumps or fluctuations in the index. However, none of these fluctuations are jagged or can be confused with a false turning point. As a result, though not perfectly smooth, the index is also not considered volatile. What is of concern, is the difference in the magnitude of the two indices. For example, the peak in the leading index in 1999-2000 is higher than the peak in the coincident index that followed. The leading index peak in 2006 is lower than the subsequent coincident peak.

6) Length of the Lead – As discussed above, a 4 to 6 month lead time is ideal for a leading index. The index only predicts four major turning points, one of which the leading index shows after it has occurred. Of the other three turning points, there is a peak in 2001, another peak in in 2007, and a trough in 2011. The leading index shows a peak in January 2001 with the coincident index peaking 11 months later in December 2001. The leading index peaks in February 2006 and a smaller peak in March 2007, with the coincident index peaking in November 2007, eight months after the smaller peak. The trough in January 2010 in the leading index was followed by a trough in the coincident index approximately a year later in January 2011.

7) Consistency of the Lead – The length of the lead fluctuates from eight to twelve months. Though longer than the preferred lead time of 4 to 6 months, the index is relatively consistent in its lead time. (Kennelly 2012).

Overall, the Reno MSA leading index (RMLI) created using a regression methodology as proposed by the Las Vegas leading index shows a better fit to the coincident index than the index created using the regression methodology using data since 2002 and that created using the composite methodology.

The composite leading economic index methodology has been popular for many decades. However, this methodology resulted in an economic index that accurately forecast changes in the coincident index, but these changes were too volatile to be useful. While popular in the past, the index assigns weights to variables based on their average standard deviation. In this, the methodology rewards lack of fluctuation, assigning higher weights to less volatile data. However, the methodology does not take into account the relationship between each variable and the coincident index.

The regression methodology used in this paper does consider the relationship between leading and coincident variables and focuses on a specific lead period. Fluctuations in the variables are also considered in their overall fit with the coincident variables through the F-tests. As a result, this methodology helps not only select appropriate variables for the index using a more robust selection technique than the Granger causality, but also assign weights based on the variable's relationship to the coincident index, rather than solely on the variable's comparable historical volatility.

As a result, the regression methodology may be the better methodology to use in indices that contain volatile, but relevant data. The methodology helps pinpoint the relationship between the lag of each leading variable and coincident index and assigns weights based on this relationship, rather than variable volatility as with the composite index.

Additionally, a discussion of the coincident index should be included in this conclusion. The composite index was used to create the coincident index for the Reno MSA. While the above discussion showed that the regression analysis may be more accurate in determining relevant variables for the leading index and assigning weights to these variables, the composite methodology is appropriate in this case due to the simplicity of the index. The composite index provides a blending of two sources of employment, one collected at the household level and one at the business level. The two variables measure the same occurrence and each has its strengths and weaknesses as discussed in the above paper. Blending of the two variables allows the index to create a more complete picture of the employment changes in the region than any single variable.

The paper does show that neither of the individual employment variables, nor the combination of the two variables provide a perfect match to the area GDP, which is considered to be the proxy for the regional economy. However, none of the other variables reviewed for the paper showed a better coincidence relationship to GDP. As a result, while not ideal, the employment variables may be the best available timely monthly variables available to represent the region. One of the reasons for the periodical mismatch between coincident and leading indices is due to the lack of additional data that can be used to create a better coincident index. The ideal coincident index would use GDP data which is available for a longer historical period and quarterly at the state level, but not at the local level, an issue often faced with forecast modeling at a small area level.

Also of interest is the difference between relevant variables for the Reno MSA and the Las Vegas leading indices as summarized in Table 11 below. Though using similar methodologies and located in the same state, the two locations have very different variables used to predict future economic fluctuations in each area. The Las Vegas index relies heavily on regional factors, the Arizona and California leading indices. The S&P 500 variable represents a national variable and the airport passengers variable is the only local variable. The index also considered hotel/motel occupancy rates, visitor volume, and taxable sales data but found them not strongly relevant to the index.

Table 11. Comparison of Reno MSA and Las Vegas Leading Index Variables

Indicators	**Reno MSA LI Weights**	**Las Vegas LI Weights**
Unemployment	0.0424	-
Gaming Revenue	0.2477	-
Single Family Homes Sold	0.0366	-
Stock Price	0.0742	0.0100
Taxable Sales	0.1911	-
Interest Rate	0.1596	-
Gasoline Sales	0.0338	-
Money Supply	0.0829	-
Airport Passengers	0.0738	0.0200
Airport Cargo	0.0580	-
Arizona Leading Index	-	0.6600
California Leading Index	-	0.3100
Total	**1.0000**	**1.0000**

The use of Arizona and California series makes sense in that Las Vegas relies heavily on tourist dollars for its economy, with many tourists from the Arizona and California areas and from across the nation. Other components of the local economy seem less important to the overall economic performance, according to the index results. The Reno economy is more diversified, with a growing transportation sector. This is consistent with the index having three transportation-related variables (gasoline sales, airport passengers, and airport cargo). The accommodation sector, while declining, is also an important part of the Reno economy, which is shown by the use of gaming revenue and taxable sales in the index. Regional factors are not as important in Reno as in Las Vegas, but economic national factors are, represented by the S&P 500, money supply, and interest rate variables.

Future work on this index should include an annual re-measurement of the relationships between the leading and coincident variables and a re-calculation of the leading and coincident index weights. Additionally, similar indices for the entire Northern Nevada area, whether defined as the Reno CSA (Combined Statistical Area) which includes Washoe, Storey, Carson City, Douglas, and Lyon Counties or another combination of counties, should be considered. These counties have close economic and demographic ties and should be considered as a single unit. Another index can be created for the Elko area, which has a different economic structure than the remainder of Northern Nevada due to its focus on the mining industry. With an existing economic index for Southern Nevada, these three indices would cover the majority of the State. The main issue with creating such indices, however, would be lack of data available for some of the more rural and/or smaller counties, as was seen with the number of data sources unavailable for Storey County.

CHAPTER 3:
FISCAL IMPACT MODEL FOR WASHOE COUNTY

1. Introduction

As the national economy improves post-recession, many small communities across the US will face new growth as the real estate market and employment recover. This is true for the Reno-Sparks region, which is projected to experience a high level of growth in the near future. With the news of the selection of Northern Nevada as the site for the Tesla gigafactory, the announcement of the Switch development, and other efforts by economic development agencies such as EDAWN (Economic Development Authority of Western Nevada), employment and resulting population growth is expected to be considerable.

The Northern Nevada Regional Growth Study 2015-2019 created by the Economic Planning Indicator Committee (EPIC) projects employment to increase by 47,400 to 56,600 employees in the five-county region over the next five years (2015-2019) (EPIC 2015). The five-county region includes Douglas, Lyon, Storey, Washoe, and Carson City counties. Of these, Washoe County is expected to absorb approximately 34,700 new jobs. These estimates are summarized in Table 1 below:

Table 1. Summary of EPIC Projected Jobs, by County

Employment	Start of Period	End of Period	Total Growth	% Change	Avg. Growth
Douglas	29,741	32,322	**2,581**	8.7%	1.7%
Lyon	17,230	18,802	**1,572**	9.1%	1.8%
Storey	4,813	15,315	**10,502**	218.2%	43.6%
Washoe	258,158	292,899	**34,741**	13.5%	2.7%
Carson	38,557	41,531	**2,974**	7.7%	1.5%
Total	**348,499**	**400,869**	**52,370**	15.0%	3.0%

Source: "The Northern Nevada Regional Growth Study 2015-2019." Economic Planning Indicator Committee.

Table 2 shows the projected jobs by sub-geographic zones defined by the EPIC Committee.

Table 2. Summary of EPIC Projected Jobs, by EPIC Zone

Zone #	Epic Zone	Start of Period	End of Period	Emp. Growth	Emp. % Growth
1	Sparks	12,806	14,167	1,361	10.6%
2	Sparks Industrial	33,046	37,474	4,428	13.4%
3	Sparks Suburban	6,039	6,849	810	13.4%
4	Downtown Reno	51,008	56,322	5,313	10.4%
5	North Reno	25,982	30,914	4,932	19.0%
6	West Reno	8,010	9,190	1,180	14.7%
7	Southwest Reno	25,076	27,949	2,873	11.5%
8	Southeast Reno	68,514	78,831	10,318	15.1%
9	North Washoe	7,357	8,440	1,083	14.7%
10	South Washoe	20,320	22,763	2,444	12.0%
11	Storey	4,813	15,315	10,502	218.2%
12	Carson City	35,185	37,907	2,723	7.7%
13	Carson City - Rural	3,372	3,623	251	7.4%
14	Douglas	12,013	12,542	529	4.4%
15	Douglas - Rural	17,728	19,780	2,052	11.6%
16	Fernley Area	6,262	7,066	803	12.8%
17	Central Lyon	6,378	6,856	477	7.5%
18	South Lyon	4,589	4,880	291	6.3%
Total	Study Area	348,499	400,869	52,370	15.0%

*Source: EPIC Committee. *The Study Period covers 2015, 2016, 2017, 2018 & 2019.*

Source: "The Northern Nevada Regional Growth Study 2015-2019." Economic Planning Indicator Committee.

As with all projections, it is unknown whether these jobs will come to fruition or where they will be located when or if they do occur. Further unknown is the actual impact of these jobs on the region in terms of new residents to the area, place of residence for the new population, and the demand new employment or residents will place on local governments in Washoe County. What is clear from these projections is that Washoe

County and the entire region are poised for growth, which will likely bring with it demand for housing and commercial space and resulting public services demands.

As development in the county occurs, it is important to balance this growth with the county's ability to provide services to the businesses and residents created by this growth. For example, it is commonly believed that residential development, especially lower priced residential development does not generate sufficient revenues for local governments to cover the costs for the local government to provide services to the residents of the development. Corresponding commercial growth is believed to be necessary to help balance the county's budget. It is important for the county to understand the type and magnitude of future growth to help plan for the growth through changes in service levels, capital projects, and infrastructure development.

Finally, Nevada's unique property tax system depends heavily of property and sales tax revenue for local funding, and its property tax assessment system limits growth of existing property assessments, placing higher emphasis on new construction. These issues must also be considered by the fiscal impact model.

1.1 Problem Statement

As with the regional economic index and the revenue forecasting model, models are needed for businesses and local governments across the US to plan future operations. As with other models, no countywide fiscal impact model is available for Washoe County. Such model will allow the county to estimate the impact of population and/or labor market changes on the county.

1.2 Methodology Overview

The fiscal impact model described in this Chapter is designed to estimate Washoe County revenues and costs associated with changes in population and/or the labor force from a single development or those occurring across the county. The model will estimate impacts of labor force or population growth (if unrelated to labor force, such as growth in retirees) on total population growth in the Washoe County area. Based on these projections, revenues and expenditures for the Washoe County General Fund was estimated. The analysis focuses on the General Fund as the majority of the county's expenditures, including law enforcement, judicial, and administrative functions are funded through this source. Additionally, the majority of growth-related revenues such as property tax, sales tax, gaming license, room tax, and other revenues are collected for this fund.

1.3 Research Questions

There are a number of research questions on which this paper is based. These include:

- What type of methodologies are available to estimate fiscal impacts of growth?
- What methodology can be used to estimate the impact on Washoe County revenues and expenditures of growth within the county limits given data available for the county?
- Does the Nevada tax structure make any of the methodologies more or less accurate for the fiscal impact model, or more or less difficult to use?
- What type of information is necessary to conduct a fiscal impact analysis for the county? Are these data readily available?

- What revenue and expenditure components should be included in the model?
- What is the causal relationship between population and employment, does one cause the other or both?

1.4 Significance

As discussed above, a fiscal impact model is important as a planning tool for local governments, who depend on revenues to fund operations and often lack information regarding the impact of growth on their budget. This tool will allow local staff and elected officials to ensure that any proposed developments or regional growth will have a positive impact on the local government's budget or that the government is provided advanced notice of potential negative impacts of these changes.

The labor market module discussed in this paper is based on cross-sectional information for multiple counties within six west coast states including Nevada, California, Idaho, Utah, Arizona, and Colorado. As a result, findings of the labor market analysis can be applied to all counties within these states. While the fiscal impact module is based on Washoe County financial data, it can also be useful as a model of the interaction between population, employment, and government revenues and expenditures for all local governments across the US. Washoe County is used as a case study for this paper as the author has access to County budget data for this County.

As the national and local economy continues to improve, development of residential and commercial projects in Washoe County, which all but stopped during the recession, is expected to increase. Prior to the recession, demand for housing and supporting commercial projects created a large number of developments seeking approval from local governments. Larger projects were required to submit fiscal impact analyses, but the majority were approved based on traffic and other non-economic studies, with little understanding of the impact the project would create on the County's ability to fund services to existing and new residents. This fiscal impact model would help County staff determine the impact of the proposed project on its budget and help plan the County's response in terms of spending and staffing.

2. Literature Review

A fiscal impact model is a tool that estimates public costs and revenues that result from demographic and economic changes in the region. The model estimates the public entity's revenues, such a property tax, sales tax, impact fees, etc. and compares them to estimated police, fire, roads and other costs. A fiscal impact is said to be positive when revenues exceed costs and negative when costs exceed revenues.

Fiscal impact analyses have been conducted for a long time. One of the first comprehensive studies on fiscal impact models was the paper by Burchell and Listokin in 1978. The paper introduced six methods for estimating project costs, with the same revenue-estimating methodology for all six cost methods. Cost estimates were made using the following methodologies:

1. **Per Capita Multiplier Method** - This method uses average per capita revenues and costs and applies them to the estimated population of the development. This method is most appropriate for medium sized communities of 10,000 to 50,000 residents with moderate expected growth.
2. **Case Study Method** - This method is appropriate for very large or small jurisdictions where levels of service are found to be substandard or excessive, or are expected to

change with the project. The method projects future costs based on specific future service levels provided by interviewing public representatives, typically department heads.

3. **Service Standard Method** - Similar to the Per Capita Multiplier Method, this method is appropriate to estimate impacts on moderately sized and moderately growing communities. Unlike the Per Capita method, this method uses national or local service standards to estimate public manpower requirements for the project.
4. **Comparable City Method -** This method is best for long-term impact projections or estimating impacts of large-scale developments, both resulting in a large increase in population. This method involves estimating the future size of the city/county/etc. and comparing costs from similarly-sized jurisdictions on the assumption that similarly sized jurisdictions have similar expenditure patterns.
5. **Proportional Valuation Method** - This method is a quick and simple way to estimate impacts of non-residential projects that have employment levels close to the average for a similar use type. The method then assigns a portion of total jurisdiction's costs based on the ratio of the project's valuation of total jurisdiction's real estate valuation.
6. **Employment Anticipation Method** - This method is also used to estimate the impact of new non-residential facilities, but is more appropriate for projects with more or fewer employees per square foot than the average for that use type. The method estimates the increase in public service costs associated with each new employee and applies this amount to the estimated number of new employees of the project (Burchell 1978).

Following on work of Burchell and Listokin, Kotval and Mullin (2006) created a table summarizing when each methodology is appropriate to use.

Technique	Residential Development	Nonresidential Development	Steady or Moderate Growth	Substantial Increase/ Decrease in Growth	New Development	Redevelopment or Infill	Development Consistent with Existing Character	Development Catalyst for Change
Average Costing								
1. Per Capita	X		X		X		X	
2. Service Standard	X		X		X		X	
3. Proportional Valuation		X	X		X		X	
Marginal Costing								
1. Case Study	X	X		X	X	X	X	X
2. Comparable Cities	X	X		X	X	X		X
3. Employee Anticipation		X		X	X	X	X	

Source: Kotval and Mullin (2006)

They also discuss a number of shortcomings of traditional fiscal impact models, including the fact that these models fail to address the spatial dimensions of development alternatives, and, particularly, the costs of housing density. Since fiscal impact analyses are typically conducted on case-by-case basis, there is a tendency to lose the "big picture" spatially. Failing to consider density implies that the fiscal impact of density is not presented on a continuum basis, which affects the accuracy of the estimated deviation from the current budget balance (Kotval 2006).

According to a paper by Leistritz estimating a fiscal impact analysis only for a jurisdiction in which the project will be located is not always recommended as population and service impacts may occur in a neighboring jurisdiction. For example, a commercial project may be constructed in City A, however, the majority of employees of the project may live in City B. The project will generate property tax revenue for City A, while City B will experience an increase in demand for services from the project's employees. Another important factor to consider in the fiscal impact analysis is the idea of "front end financing" which considers the timing of revenues and costs as they impact each jurisdiction (Leistritz 1994).

In addition to a fiscal impact analysis, some studies include an economic impact component. An economic impact analysis estimates changes in employment, income, and levels of business activity with and without the project. The difference between the two scenarios is considered the economic impact of the project. The economic impact analysis is based on the export base theory, including the following two concepts. First, an economy can be divided into two units, basic and non-basic. The basic sector is defined as those firms that sell goods and services to markets outside the area. The non-basic sector includes firms that supply goods and services to customers within the area. Second, a change in the basic sector, such as a new business in the sector, causes changes in the non-basic sector, also known as a multiplier.

There are multiple input-output (I-O) models available to conduct an economic impact analysis; two of the most popular include REMI and IMPLAN. In addition to an I-O model, the analysis will need the following project-related information: 1) workforce requirements-including permanent and temporary jobs, 2) capital investment amounts, 3) local input purchase patters, 4) output, and 5) resource requirements (Leistritz 1994).

A comparison of three most common economic impact models: the capacity utilization model (CUM), Regional Economic Models, Inc. (REMI) and the impact analysis for planning (IMPLAN), were examined by Bonn et al (2008) to provide insights into their applicability for hospitality and tourism educators and researchers. The paper found numerous differences in model methodologies, but did not provide recommendations regarding which models should be utilized. The did conclude that the REMI model is a more complex of the three models, accounting for economic labor force population (migration, births, deaths), fiscal impacts, market dynamics, and relative regional competitiveness across time. The IMPLAN model is simpler, accounting for economic variables only (production, spending, and employment) (Bonn 2008).

Halstead (1991) suggested that a fiscal impact model must focus on the following six key dimensions:

1. **Temporal Dimension** - this component includes the length of the projection and simulation period, the model must be able to distinguish between the short- and long-term impact of the project.
2. **Spatial Dimension** - this component includes a consideration of the local of the project and the jurisdiction for which the impact is estimated.
3. **Public Service Dimension** - this component considers the list of public services which are included in the analysis. This includes police, fire, road maintenance, etc. The need to the model to include as many services as possible to aid with the planning process must be balanced here with the cost and time of model creation.
4. **Sectoral Dimension** - this dimension may not be included in the model, however, if included, this component identifies differential impacts on various economic sectors, typically through the multiplier effect.
5. **Demographic Dimension** - this component includes the number and characteristics of people moving in and out of the jurisdiction as a result of the project.
6. **Modeling Dimension** - this component includes considerations of software, sources of data, costs, time, and output associated with the model (Halstead 1991).

Researchers at the Wichita State University (WSU) put many of these components together in their CEDBR (Center for Economic Development and Business Research) Fiscal Benefit-Cost Model for Local Governments. In addition to estimating the fiscal impact of a project, the model is designed to provide local officials and economic development professionals an ability to assess the costs and benefits of economic development incentives. The model includes impacts for cities, counties, school districts and the state.

According to the WSU paper, the following information is needed as an input into the model to estimate the fiscal impact of the project with the extra step of providing developer incentives:

1. **Firm Data** - this is project-specific data and includes project location and selection of impact industries, NAICS codes, capital investment information, new jobs and average wages, sales and purchases, and visitors.
2. **Incentives Data** - this includes types of incentives, if any, offered by each impacted jurisdiction to the project, including tax abatement, forgivable loan, training dollars, and infrastructure improvements.
3. **Background Data** - these data are included in the model and differ for each impacted industry, including tax rates, budget information, number of residents, number of employees, average market value of new residential property, average wages for jobs, number of students, General Fund Budget information.
4. **RIMS II Multipliers** - these multipliers estimate the direct, indirect, and induced increases in economic activity associated with the project. Direct multipliers are those job and output effects created by direct spending by the project's construction and operation. Indirect effects are the result of increased demand for goods and services as intermediate inputs to the new industry. Induced effects arise from the relationship between wages and employee demands on supporting industries. The total increase in economic activity results in greater economic activity than that directly attributable to the project. Therefore, the total amount of economic activity is the combination of the direct, indirect, and induced effects.
5. **Substitution** - this is a standardized parameter of substitution of new goods and services created by the project for existing goods and services. If the project's commercial component does not bring unique products or services to the area, some of its sales will come at the expense of existing economic activity, which needs to be considered.

Given the above inputs, the WSU model provides the following result printouts:

1. **Project Summary** – this output component describes the combined obligation over the ten-year project horizon for number of full-time equivalent employees on payroll, total ten-year change in payroll expenditures, and total ten-year capital investment expenditures in land, buildings, and machinery & equipment.
2. **Incentive Summary** – the output component provides the total cash amount of the incentive package offering as well as types of abatements and incentives.
3. **Construction Impacts** - Construction impacts are not considered in the unofficial assessment and have no influence on the overall impact.
4. **Substitution and Firm Multipliers** – this output component shows the substitution and multiplier parameters for the project based on the NAICS code selected for the project.
5. **Economic Impact** – this output component shows the ten-year economic impact of project operations on local employment and wages.
6. **Fiscal Impact –** this output component shows net contributions to the jurisdiction discounted over time (WSU 2013).

Closer to home, Harris et al (1996) created a fiscal impact model for Douglas County. In reviewing past fiscal impact models, the team decided their model had to include the following attributes:

1. The ability to be reduced to a worksheet format;
2. A structure that lends itself to characterizing the geographical area of interest;
3. Modest and obtainable data requirements with a minimum amount of user estimated inputs;
4. A conceptually simple to understand structure; and
5. The ability to be validated for accuracy and subsequent fine-tuning.

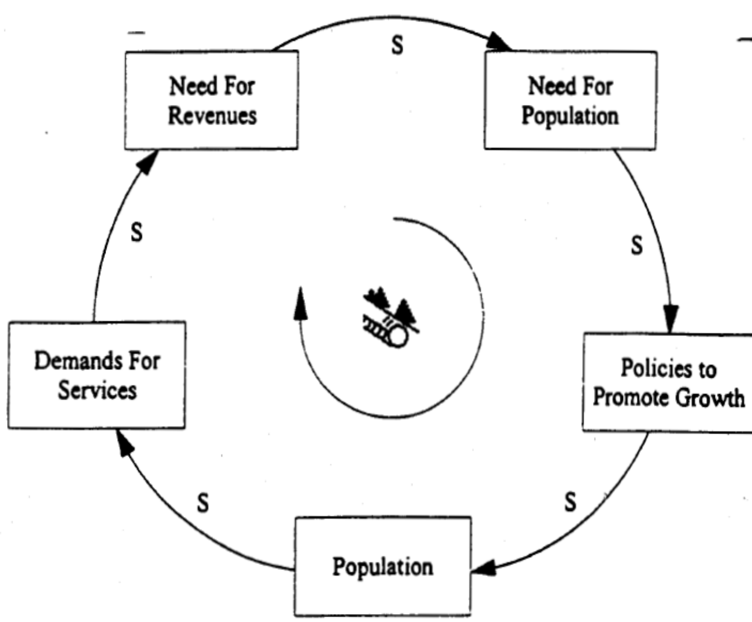
The resulting Douglas County Industrial Fiscal Impact Model is an input-output based worksheet with continuous steps for estimating the impact of a commercial or residential project on employment, income, and tax revenues in the state, county, municipality, special district and school district. The model utilized the IMPLAN database to arrive at income and employment multipliers for all sectors except agricultural, mining and gaming sectors, IMPLAN data for which was augmented with actual data.

The model discusses five areas of consideration when estimating the fiscal impact of growth created by a project. First, the model must ask “what type of growth is occurring”? Projects that result in employment or residential population growth have different impacts on host jurisdictions. Second, “what type of employment will the project generate”? Employment in different industries results in different wages, different revenue sources, and different expenditures. Third, “what type of residential population will the project generate”? This includes considerations of population demographics, including age and income as each results in different spending and service requirement levels. Also, what is the value of housing and the housing’s location from existing services. Fourth, “how much of the impact will remain in jurisdiction”? This component considers whether employees will live in the jurisdiction and where the jurisdictions' residents work, that is the commuting patterns of the jurisdiction. It also considers purchase patterns of residents and businesses. Finally, “where will growth occur”? This portion considers the impact on the host jurisdiction and surrounding areas, as well as distribution of revenues and expenditures association with the project regionally.

The model estimates revenues and expenditures for all jurisdictions based on various methodologies. Methodologies for revenue estimation depend on the type of revenue assessment, sales tax revenue, for example is estimated by applying the sales tax rate to estimated taxable sales, while charges for services revenue is estimated using a per capita methodology. Expenditures, including operating and capital costs are estimated using the per capita methodology (Harris 1996).

Another local paper by Ted Oleson, Glen Atkinson, Steven Lewis, and Tom Harris in Douglas County discussed the fact that regional growth does not necessarily result in growth in public revenues. Similar to previous studies, it discusses the fact that growth in one area may negatively impact nearby areas, relative growth may be more important than absolute growth, type of growth matters more than amount of growth, and the fact that Nevada's tax system favors increases in property and sales over population and employment. These are important issues to consider in creating a fiscal impact model for any Nevada region.

Additionally, the paper provided a graphic on the impact of growth on the community and the public sector as shown below (Oleson et al1996).



A paper by Bilanin et al (2007) provides a model for conducting a fiscal impact analysis for the City of Aberdeen, Maryland and other municipalities. The paper discussed two types of impacts. Capital impacts occur when existing facilities are at or will reach capacity as a result of the project and additional infrastructure is needed to provide services to the project. This includes new roads, new or expanded police stations, expanded administrative buildings, vehicles, equipment and more. The challenge of capital impacts is the funding of these expenditures as they typically occur towards the beginning of the project and may not have sufficient revenue to cover them. On the revenue side, capital impacts typically include impact fees, which are one-time fees collected from project developers and used for restricted projects, such as road or park construction.

The second type of fiscal impact is operating impact. As opposed to capital impacts, operating impacts typically occur annually for the life of the project. These impacts include police, fire, road maintenance and other expenditures and revenues associated with property, sales, and other taxes and fees. For a fiscal impact to be found to be positive, operating revenues must exceed operating expenditures (Bilanin 2007).

Some models provide even greater detail of impacts, such as the model by Shields et al (1999) which examined the economic and fiscal impacts of elderly households moving to the area based on household income scenarios. The analysis uses a conjoined input-output and economic model for Wisconsin counties. The paper found that high-income elderly households will increase local expenditures by a higher amount the similar low-income households. However, the revenue generated by higher-income households results in a much higher net fiscal impact on local governments than those of lower-income (Shields 1999).

In the early 1990s fiscal impact models evolved from stand-alone project models to Community Policy Analysis Systems (COMPAS). Though still based on practices discussed above, these models go further than a simple fiscal impact. Designed to cover the entire regional economy, these models are made up of multiple modules, including economic (employment, unemployment, per capital income, retail sales), demographic (population, labor force participation, age), fiscal (expenditures, revenues, cash flows), social (poverty rate, social capital, health status), and even environmental (water quality, air quality, land use) factors.

COMPAS models are part of the regional econometric models (REM) framework, one of three approaches for comprehensive modeling of local economies. The other two approaches are input-out (I-O) and computable general equilibrium (CGE). The strength of the REM approach is they are more flexible that input-output models by introducing exogenous variables into the model structure. These models can capture direct effects of policy changes rather than estimating these impacts by fixed proportions or other methods. I-O models are static models which show a snapshot of the local economy, while REM models are dynamic taking into account the timing of the impacts, its magnitude and the changes in the relationships of various modules as the economy adjusts to a new equilibrium.

Finally, I-O and CGE models ignore distances such as transportation and opportunity cost of travel, REM models can include these in its modules. The main weakness of REM models is their complexity and need for large amounts of data. Data is required to population and estimate each of the multiple modules and is often unavailable at the local level. Industry-specific data such as wages, employment, output, prices, and capital stock are often unavailable at the regional level, along with other sources of data. One of the solutions is to integrate I-O and REM models to compensation for some of the data needs of the REM model through an I-O framework (Johnson 2006).

The typical labor module of the COMPAS model includes three equations which then tie into the population equation. Each dependent variable is a function of various other, often shared endogenous and exogenous variables:

Labor Force = f(employment, housing conditions, cost of living, public services, taxes, industry mix, area)

Out-Commuting = f(employment, external employment, external labor force, housing conditions, cost of living, public services, taxes, industry mix, area, distance to jobs)

In-Commuting = f(employment, external employment, external labor force, housing conditions, cost of living, public services, taxes, industry mix, area, distance to residence)

Population = f(labor force, dependency rate),

where dependency rate = nonworking (youth, retirees, students, etc.) residents/ working residents

For the fiscal impact module, revenues and spending are estimated using similar variables for each component:

Spending/Revenues = f(quality, quantity, input considerations, demand considerations) (Johnson 2006)

Multiple COMPAS models have been created for various jurisdictions. The Show Me model for counties within the State of Missouri focused on the above labor market equations, adding another structural equation for second jobs and an identity equation for unemployment. The model includes place of work data, rather than place of residence data, as modeling the number of jobs in the paper region is the key to the model. The model uses the 3-stage least squares (3SLS) methodology because of the existence of correlation between the individual equation's error terms. The 3SLS model is more appropriate in this case as it incorporates cross-equation correlation into the parameter estimates.

The model was then further expanded to add spatial considerations to the model. The existing model did not consider size differences between the 114 counties in Missouri. The expanded model captured structural changes caused by the different sizes of counties, as measured by the county's area. A linear expansion terms are AREA and AREA*employment-related variable (employment by workplace, contiguous employment by workplace, and contiguous labor force).

Similar to the original COMPAS model, the Show Me model estimated expenditures as a function of quality, quantity, input conditions, and demand conditions.

Expenditures = f(quality, quantity, input conditions, demand conditions)

Expenditures are broken into public works, police protection, administration, parks and recreation, welfare, education, fire protection, etc. with independent variables defined differently for each cost source. Revenues are estimated as follows:

Nonlocal aid = f(expenditures, income, personal property, real property)

Sales tax revenues = f(income, employment, in-commuters)

Other tax revenues = f(sales tax revenues, income)

Real property tax revenues = f(income, employment, out-commuters)

Personal property = f(income, out-commuters)

The Show Me model is a spread-sheet model based in Microsoft Excel, which allows for model adjustments, customization, and running of scenarios (Johnson 2006).

Similarly, an Iowa fiscal and economic impact model developed by Swenson and Otto (1998) identified city and county income, employment, population, school enrollment, and fiscal impact responses to a proposed project. The model assumed that employment levels locally and in nearby localities determine population level, with population being a function of labor force, and employee participation and non-participation rates. The model included two components, those related to the labor market and the fiscal impact. The model later added school enrollment and housing market modules including models for enrollment, housing supply, occupied housing, housing costs and new housing.

On the revenue side, the model included property tax, other tax, intergovernmental assistance from Federal, state, and local sources, charges and fees and other miscellaneous revenue. As is common with many of these models, it did not include revenue and cost estimates for enterprise funds such as water, gas, electric, and transit. On the expenditure side, administrative, public safety, fire protection, health and welfare, highway, community development, and parks and recreation costs were included. The model also utilized 3-stage least squares (3SLS) model for its fiscal component estimation. The process of model creation was as follows:

- Determine in and out commuters and place of work
- Determine external labor force, employment, and distance values for the area

- Compile relevant social statistics to include in model
- Perform a whole system estimation of fiscal variables using a 3-stage least squares methodology (Swenson 1998).

Adhikari and Fannin (2011) also used the COMPAS methodology which included statistically estimated relationships to forecast changes in demographic, economic, and fiscal conditions under exogenous changes in economic activity. For these models exogenous changes were results of changes in employment demand within the economy. The paper focused primarily on the creation of the labor force model, on which subsequent market and fiscal impact calculations were based.

The labor force module estimated the intersect of labor force demand and labor force supply or XD = XS, where XD is labor force demand and XS is labor force supply. The demand curve for the labor force is a function of the wage rate, or XD = f(w); where w is the wage rate. Labor supply is a function of XLF (total labor force), XU (total unemployment), XO (total number of out-commuters), and XI (total number of in-commuters).

The empirical specifications for the three basic labor force equations were expressed as:

$$LABFOR = \beta 10+\beta 11EMP+ \beta 12UNEMP+ \beta 11OUTCOMM \quad (1)$$

$$INCOMM= \beta 20+\beta 21EMP+ \beta 22CONEMP+ \beta 23CONLABFOR+ \beta 24UNEMP \quad (2)$$

$$OUTCOMM= \beta 30+\beta 31EMP+ \beta 32CONEMP+ \beta 33CONLABFOR+ \beta 34UNEMP \quad (3)$$

Where, LABFOR (labor force), EMP (place of work employment), UNEMP (unemployment), OUTCOMM (out-commuters), INCOMM (in-commuters), CONEMP (contiguous employment) and CONLABFOR (contiguous labor force) are endogenous variables.

The authors compared the results of ordinary least squares (OLS), panel regression, and three stage least squares (3sls) models using BEA data for areas within the state of Louisiana. Three stage least square regressions were found to have an advantage over the panel model and OLS regression in improving model performances and were suggested by the authors as another COMPAS estimator alternative since they could be used in order to correct for the correlation, if any, present between the individual equation's error terms (Adhikari 2011).

The COMPAS model in Washington (Yeo 2003) also simulated the impact of an exogenous local employment shock on the local labor force, population, commuting patterns, and the local government revenues and expenditures. According to the authors, additional demand for labor attracts new participants in the potential employment pool who consist of formerly unemployed residents, new in-commuters, former out-commuters and new in-migrants. As a result, the greater the proportion of new residents, the greater the increase of population and total personal income. The econometric model was first created using theoretically important variables according to economic theory and other publications. However, some explanatory variables were highly correlated and were dropped and replaced with more meaningful variables.

Authors also tested various model specifications, linear and non-linear in variables and parameters. It was found that the model fitted by log-transformed variables yielded the best results in terms of lowest variances and significant variable coefficients. Cross sectional data for all 39 Washington counties was used based on data from the 1990 US Census. The summary of variables, sources, and transformations are shown below as these variables and sources will be useful for the Nevada COMPAS model. The final l model consists of 7 equations, 7 endogenous variables, and 7 exogenous variables to represent the interrelationships among the variables. The model is also estimated using the 3 Stage Least Squares (3SLS) method as it estimates all the equations jointly (Yeo 2003).

Table 1. Descriptions and Sources of the Variables

VARIABLE	SCALE	DESCRIPTION	SOURCE
POP	Number of persons	Population, 1990	U.S. Census of Population and Housing, 1990
LF	Number of persons	Total county labor force, 1990	Derived from BEA Journey to Work data and U.S. 1990 Census data
POWEMP	Number of persons	Place of Work Employment, 1990	BEA REIS CD-ROM 1969-1994: Journey to Work database
UNEMP	Number of persons	Number of unemployed persons, 1990	U.S. Census of Population and Housing, 1990
INCOMM	Number of persons	Number of incommuters, 1990	BEA REIS CD-ROM 1969-1994: Journey to Work database
OUTCOM	Number of persons	Number of outcommuters, 1990	BEA REIS CD-ROM 1969-1994: Journey to Work database
XLF	Σ_i [Contiguous labor force / $Distance^2_i$]	External labor force	Derived from the formula, Σ_i [Contiguous labor force / $Distance^2_i$]
XEMP	Σ_i [Contiguous labor force / $Distance^2_i$]	External employment	Derived from the formula, Σ_i [Contiguous employment / $Distance^2_i$]
CONLF	Number of persons	Contiguous labor force	Derived from Compiling contiguous labor force counts
CONEMP	Number of persons	Contiguous employment	Derived from Compiling contiguous employment counts
DISTANCE	Miles	Distance between counties	Derived from the U.S. Gazetteer Data Set
PAR	Percentage	Total Participation Rate, 1990	U.S. Census of Population and Housing, 1990
TPI	Thousands of dollars	Total Personal Income, 1990	BEA REIS database 1969-1996
WAGE	Dollars	Wage & Salary earnings per job, 1990	BEA REIS database 1969-1996
AREAPC	Square Miles / Population	Per capita County area in Square Miles	Derived from ESRI ArcView USA Counties coverage and U.S. Census of Population and Housing, 1990
POPDEN	Number of persons	Number of persons per square miles, 1990	ESRI ArcView USA Counties coverage
TRPC	Dollars	Per capita total county government general revenues	U.S. Census of Governments, 1992
TEPC	Dollars	Per capita total county government general expenditures	U.S. Census of Governments, 1992

Source: Yeo (2003).

A similar multi-equation system was used by Harris et al (2000) to create a fiscal impact model for the State of Nevada. State of Nevada only has 17 counties, so using cross-section data for the counties would yield an insufficient sample size. As a result, the authors used five BEA economic areas, which spanned counties in Nevada, California, Idaho, and Utah. This region was named Great Basin area. Unlike other models with a detailed labor/population module, this model estimated population impacts using place of work employment data only. Fixed effects were used to define differential institutional constraints for each state regarding revenues and expenditures and to account for factors not represented by socio-economic variables, as well as differentiate between rural and urban areas.

County level revenue and expenditure data from the Census of Government was used, including non-federal government revenues, intergovernmental revenues, non-local state government revenues, intergovernmental revenues, local government general fund tax revenues, and local government general fund non-tax revenues. Labor force, unemployment, population, county acreage, and public lands data were derived from "USA Counties 1996" from the U.S. Department of Commerce. A Box-Cox estimator was used and the variables were transformed to a logarithmic function form to reduce heteroskedasticity in error variance (Harris 2000).

The resulting model needs to be accurate, timely, and understandable in order to have value to decision makers. To measure the accuracy and dependability of the model at the model building level, R^2 and F- and t-statistics can be used to determine the goodness of fit of the model. Once the model is completed, model forecasts can be evaluated using qualitative and quantitative methods. Quantitative methods include mean simulation error (ME), mean percent error (MPE), means absolute error (MAE), means absolute percent error (MAPE) and more. As the last step in the overall quantitative assessment of the model's performance, the grand total simulation error (GTSE) and grand average simulation error (GASE) analyses are proposed:

$$GTSE = \sum_{i=1}^{k} \sum_{j=1}^{p} SEM_{ij} \quad (4)$$

$$GASE = \frac{GTSE}{kp} \quad (5)$$

where k is the number of counties in a sample drawn for model validation, p is the number of equations in the model, and SEM is the simulation error measure for county i and forecasted variable j (Johnson 2006).

3. Methodology

As with other forecasting tools discussed in previous chapters, two types of fiscal impact methodologies are available. One is based on econometric analysis and another on more arithmetic estimates based on interviews and historical average and marginal performance. A number of fiscal impact studies have been conducted for developers in Washoe County using the arithmetic, survey-based methodology. This methodology requires much time spent interviewing local government officials and reviewing public financial documents. As discussed in the Literature Review section of this paper, this methodology is useful for estimating impacts of unique projects or unique situations.

For example, a project located at a great distance from existing population centers may require the extension of public services to the project, resulting in higher than normal costs to provide these services to the project and potentially resulting in a negative fiscal impact. Similarly, an unusual change in the local economy, such as a shift from existing demographics to a higher percentage of retirees, may change the creation of revenues for the local government. As a result, a COMPAS model, based on existing relationships between employees and residents and public revenues and costs, may not always be applicable.

However, a COMPAS model may be an important first step in planning for growth in Washoe County. It is a model that can be used for multiple developments with minimal adjustment and is easy to use once created. Additionally, no such model exists in the region. As a result, this paper creates a COMPAS-type model for Washoe County incorporating labor market and fiscal impact modules. The Washoe County final model was created in Excel including a module showing the assumptions, calculations, and findings of each of the following model components.

The model considers the impact of a proposed project on Washoe County government only. Residents and employees of Washoe County projects will impact areas outside of the county, including the Washoe County School District, State of Nevada, and multiple special districts, which also supply services and receive revenues from these residents and employees. Modules incorporating impacts on these jurisdictions, as well as surrounding jurisdictions, such as the City of Reno, City of Sparks, and surrounding counties, will make a good addition to the model in the future.

Module 1-Development Data-the first step of the model is to collect development information on which the model is based. This Module will allow user inputs including type of development (commercial-retail, office, hotel, etc., industrial-storage, warehousing, light manufacturing, etc., and residential-single family, multi-family, etc.). Additional inputs will include construction timeline (the initial model will allow a ten-year construction timeline, and can be expanded to include more years, if necessary), number of commercial/industrial square feet planned to be built in each year of the project and/or number of residential units to be built in each year of the project. If available, total number of employees to be added by the commercial/industrial portion of the project and residential population and target household income of residents can be input by the user. If not, this information can be estimated using average data for Washoe County.

Output of Module 1 shows the number of residential units and square feet of commercial space, by component, constructed in each year of the analysis period. Using user input information, the value of land and building improvements will also be estimated. The model will not include an estimate of the value of the unimproved land on the assumption that this land was already generating some property tax revenue to the County before the development and the analysis attempts to estimate only incremental impacts of the project due to its construction. The Module also estimates the number of employees generated by the commercial component of the project, either through user-inputs or by using actual square feet per employee data for Washoe County provided by the Center for Regional Studies at the University of Nevada, Reno.

For the residential portion of the project, Module 1 estimates average per-unit household and the total impact of new households on the county. Household income data can be provided by the user based on the targeted income of new residents or using average household income based on future residents' ability to pay analysis. The ability to pay analysis estimates the price of the proposed single-family and multi-family units based on the construction information provided by the user, plus a 20 percent mark-up since land prices are not included in the provided construction information. The mark-up information is provided by the Center for Regional Studies, UNR.

Using a mortgage payment feature in Excel as summarized in Table 3, a monthly mortgage payment associated with the home price is estimated, using a 30-year note and a 4 percent annual interest rate. Property tax, utilities, and home insurance payments are also estimated using data provided by the Center for Regional Studies, UNR. This results in an average total home ownership cost for the single- and multi-family components of the development.

Table 3. Household Income Estimate Tool

	Single-Family	Multi-Family	
Home Price	$ 450,000	$ 240,000	based on project land improvement and building construction cost information provided above, plus a 20% land mark-up. Source: Center for Regional Studies, UNR.
Monthly Mortgage Payment	$ 2,148	$ 1,146	30-year note, 4% interest rate
Annual Mortgage Payment	$ 25,780	$ 13,750	Monthly payment * 12 months
Mortgage Insurance	$ 129	$ 69	Center for Regional Studies, UNR
Property Tax Cost	$ 4,500	$ 2,400	Estimated at 1% of home price, Center for Regional Studies, UNR
Utilities	$ 2,400	$ 2,400	Estimated at $200 per month, Center for Regional Studies, UNR
Home Insurance	$ 990	$ 528	Estimated at 0.22% of home price, Center for Regional Studies, UNR
Total Home-Ownership Cos	**$ 33,799**	**$ 19,146**	
Estimated HH Income	$ 102,422	$ 58,019	Assumes home costs are 30% of total household income. Source: "The HUD Home Buying Guide." US Department of Housing and Urban Development, August 2004.

Using a ratio of 30 percent of home expenses of total household income as suggested by the US Department of Housing and Urban Development, the Module estimates the household income necessary to purchase homes in the development. This amount is then multiplied by the number of new residential units in the development to estimate total household income impacts on the county from the development.

Table 3 above provides an example of the household income required to qualify for a $450,000 mortgage (assuming no down payment), which is estimated at $102,000 per year.

Module 2-IMPLAN Impacts- IMPLAN (IMpact analysis for PLANning) software was created by MIG, Inc. and is a widely accepted input-output model available at the national, state, and county level. The software was used in a number of the models discussed above. The software will estimate the number of indirect, and induced jobs associated with the direct employees generated by the project, as well as estimate direct, indirect, and induced jobs associated with residents of the project. In addition to employment, labor income and industry output information is provided for the project on the direct, indirect, and induced basis. See Appendix G for relevant definitions of the IMPLAN terms. The IMPLAN model for Washoe County was used. Latest IMPLAN model currently available is based on 2013 data.

This Module does not require any user input, all calculations in this Module are based on direct project employees estimated for the commercial component of the project and household income from the residential components, both estimated in Module 1. Using this information, along with data provided for Washoe County by the IMPLAN model, direct, indirect, and induced employees, labor income, and output created by the development are estimated.

Module 3-Labor Market Module-the impact of the employees of the commercial portion of the project and those estimated to be generated from residential expenditures, including multipliers estimated by the IMPLAN model will then be input into the labor market module to estimate the number of these employees living outside of region and other non-local residents. The result of the module is to estimate the population impact of the development of the project on Washoe County.

Similar to other COMPAS models, as insufficient uninterrupted historical employment data necessary for the labor market module is available for Washoe County, the module is based on cross-sectional data, rather than time series data. The Great Basin model developed by Harris et al (2000) used BEA economic areas spanning Nevada, California, Idaho, and Utah. Two other contiguous states to Nevada, Arizona and Oregon, were not included as these states only had 1 or 2 counties within the BEA areas. This paper includes data for all counties within the four states used by Harris et al (Nevada, California, Idaho, and Utah), plus all counties within Arizona and Colorado to obtain data for all states surrounding Nevada. The six included states are made up of 199 counties. Data for each of the counties was collected and used in the module as described below (Harris 2000).

The methodology set in the Show Me COMPAS model developed for Missouri communities was used. This methodology is similar to those used in other COMPAS models with the addition of the expansion method. The expansion method used in this model includes the addition of an intercept and slope dummy variable for each county's geographic size (area). This was done as most COMPAS labor force modules assume counties close to average size, which is appropriate for most mid-west areas, but less appropriate in the west portion of the US, where counties differ considerably by size and density. As a result, the expansion method, using this spatial econometric technique, captures structural changes cause by different sizes of counties as represented by the area of the county (in square miles) (Johnson 2006). It should be noted that the Show Me model also included an equation for estimating second jobs. As second jobs data was unavailable and this equation has not been used in similar COMPAS models, this component is not included in this paper. The expanded labor force module is represented by the following equations:

$$LF = \beta 10a + \beta 10bAREA + \beta 11aEMP + \beta 11bEMP \times AREA + \beta 12UNEMP + \beta 13OUT \quad (6)$$

$$IN = \beta 20a + \beta 20bAREA + \beta 21aEMP + \beta 21bEMP \times AREA + \beta 22aCEMP + \beta 22bCEMP \times AREA + \beta 23aCLF + \beta 23bCLF \times AREA + \beta 24UNEMP \quad (7)$$

$$OUT = \beta 30a + \beta 30bAREA + \beta 31aEMP + \beta 31bEMP \times AREA + \beta 32aCEMP + \beta 32bCEMP \times AREA + \beta 33aCLF + \beta 33bCLF \times AREA + \beta 34UNEMP \quad (8)$$

$$UNEMP = LF + IN - EMP - OUT \quad (9)$$

Where LF (labor force), EMP (employment by place of work), UNEMP (unemployment), IN (in-commuters), OUT (out-commuters), CEMP (contiguous employment by place of work), and CLF (contiguous labor force) are endogenous variables. AREA is the land area of each county in square miles. In addition to county land area, data also exists for population density in each county, which is the population per square mile of land area. This data may represent the difference not only in the size of each county, but more importantly, the concentration of population in the county, which may be important in some rural counties, especially in Nevada, where counties with large land areas have comparatively low population. As a result, in addition to the equations using AREA as the dummy variable, the paper also examines a module with DENSE slope and intercept dummy variables.

$$LF = \beta10a + \beta10bDENSE + \beta11aEMP + \beta11bEMP \times DENSE + \beta12UNEMP + \beta13OUT \quad (10)$$

$$IN = \beta20a + \beta20bDENSE + \beta21aEMP + \beta21bEMP \times DENSE + \beta22aCEMP + \beta22bCEMP \times DENSE + \beta23aCLF + \beta23bCLF \times DENSE + \beta24UNEMP \quad (11)$$

$$OUT = \beta30a + \beta30bDENSE + \beta31aEMP + \beta31bEMP \times DENSE + \beta32aCEMP + \beta32bCEMP \times DENSE + \beta33aCLF + \beta33bCLF \times DENSE + \beta34UNEMP \quad (12)$$

$$UNEMP = LF + IN - EMP - OUT \quad (13)$$

The results of the two versions of the module are compared to determine the model that yields more significant results in the dummy and structure variables. As with other COMPAS models, the Three Stage Least Squares (3SLS) methodology was used, as this has proven to be the best methodology for this type of analysis.

With the exception of the AREA and DENSE data, which was collected from the 2010 Census Summary File 1 from the US Census Bureau, all other data were collected from the 2010-2014 American Community Survey 5 Year Estimates from the US Census Bureau.

CEMP and CLF data were estimated based on these data using GIS services provided by the Center for Regional Studies at the University of Nevada, Reno. Unlike the methodology for the Show Me paper, which was based on data from counties sharing a physical border with the subject county, this paper identified contiguous counties as those located within a 60-mile radius of the center of population of the subject county. The 60-

mile radius is used as this is the approximate radius of the Reno-Sparks MSA, which captures the majority of employment commuting in the Washoe County area. This is a more accurate methodology in the western portion of the US than the mid-west, as this area includes multiple irregularly shaped counties. As a result, some counties considered contiguous in this analysis, may not share physical borders with surrounding counties but have population centers within the 60-mile study radius.

For example, Washoe County and Douglas County do not share a border, but are located only 40 miles from each other. According to the OnTheMap software provided by the US Census Bureau, approximately 1.9 percent of Washoe County employees lived in Douglas County in 2013, and, more importantly, 9.9 percent of Douglas County's employees lived in Washoe County. Using the traditional contiguous county methodology would not capture this interaction.

Additionally, instead of using a geographic point to measure the 60-mile radius, the paper uses a center of population point provided by the US Census Bureau for all US counties based on 2010 data. The US Census Bureau defines center of population as "the point at which an imaginary, weightless, rigid, and flat (no elevation effects) surface representation of the 50 states (or 48 conterminous states for calculations made prior to 1960) and the District of Columbia would balance if weights of identical size were placed on it so that each weight represented the location of one person."

Additionally, a population impact was estimated using the following model, as advocated by Johnson et al (2006) for both methodology types:

$$POP = \beta40a + \beta40bAREA + \beta41aDEP + \beta41bDEP \times AREA + \beta42LF \quad (14)$$

$$POP = \beta40a + \beta40bDENSE + \beta41aDEP + \beta41bDEP \times DENSE + \beta42LF \quad (15)$$

Where POP is subject county population and DEP is dependency rate for the subject county, estimated as the ratio of non-working population to working population.

Module 4-Fiscal Impact Module-the impact of the new population in the county on County General Fund revenues and expenditures was estimated in this module. The General Fund is included as this is the County's major fund, receiving the majority of County revenue and funding the majority of its services. The Truckee Meadows Fire Protection District Fund should also be included in this model as this fund is used to support fire protection operations for the County, an important service provided by the County to its employees and residents. This can be included in later versions of the model due to multiple fire protection districts within the County, each with its own property tax rates, other revenue sources and operations. This would add an extra layer of complexity to this first version of the model.

In following the COMPAS methodology, this paper attempted to create an econometric model for each revenue and expenditure source using various variables including population, per capita income, employment, and other data as available. Two types of methodologies are available for such a model. First, as done by Harris et al (2000) and other COMPAS models, is a cross-sectional methodology, using data for a given year for multiple locations. For example, Harris et al used Census of Governments data from 1992 for counties within the Great Basin region. The problem with this methodology is that latest detailed individual county revenue and expenditure data from the Census of Governments is available from 2002. Given the recession and changes in government operations that followed, using 2002 data may not result in accurate results. Additionally, data is available for large counties only, leading to potential selection bias. Subsequent 2007 and 2012 reports provide aggregate data for all counties or cities within the state, but not for individual counties. This not only limits the number of data points available for analysis, but also does not allow for individual fixed effects of counties within a state.

The second methodology is to use time series data for Washoe County. Historical data for the County's revenues and expenditures was available between 1995 and 2015 resulting in twenty years-worth of data and twenty data points. This is insufficient to provide a robust time series analysis for the county. Additionally, as mentioned above, government operations changed considerably since the recession, which makes historical data less useful to predict future operations. A dummy variable may be used for data following the recession, but this may add confusion and inefficiency to the model. An example of the changes in operations resulting from the recession is the "Fire Divorce" in which fire services previously provided by the joint Reno/Washoe County agency are now provided by each jurisdiction separately according to the incidents' location.

As neither of the above methodologies is appropriate in this case, the fiscal impact module is constructed using non-econometric approaches discussed in the Literature Review portion of this paper. Mainly, the per capita, case study, and the service standard methods, discussed by Kotval and other authors, are incorporated, using the latest County tax rate, expenditure, and other information. Appendices 5-7 show detailed calculations for property tax, sales tax, and police expenditures using the service standard and case study methods. Other expenditures and revenues summarized in Module 4 are estimated using the per capita method or the indirect cost method. The indirect cost method is used to estimate costs associated with support services such as administrative services for the Sheriff's office or General Government services for the entire County. This method divides total costs for indirect services by costs for direct services, this ratio is then applied to the new direct service costs estimated to be created by the project.

The per capita and service standard methods are appropriate in this case as they are designed to capture steady or moderate growth, new development, and development consisting with existing character (Kotval 2006). This is the goal of the model, to capture impacts of new developments as they occur in the county.

To simplify the model, no inflation factors are considered. Construction costs are expected to increase during the 10-year analysis period due to changes in labor costs and costs of construction materials. Taxable sales and resulting sales tax revenues, household income, salaries and wages, and other component levels are expected to change over time. Inflation impacts on each of the components will differ by the source of the component and will take a separate level of research and analysis to determine. As a result, no inflation impacts are considered, though they are planned to be added to the model at a future date.

Module 5-Property Tax Revenue-Property tax revenue for the project was estimated using the case study method. Module 1 of the model estimates replacement value of all new buildings and land improvements for the proposed project. A current tax rate is applied and distributed to various General Fund and non-General Fund sources receiving property tax revenue.

As discussed in Chapter 1 of this dissertation, Nevada's property tax is uniquely assessed using a replacement cost approach, with depreciation, and an abatement adjustment. The model created for Washoe County assessed values in Chapter 1 could be used, but the model estimates an overall level of assessed values in the county, not changes only due to a certain project type or new construction. Additionally, a new model cannot be created because no property tax revenue generated by new construction only data is available, changes in property tax revenue from year to year may be due to a combination of growth in the values of existing properties and new construction. As a result, such a model may be difficult to create and this paper uses the arithmetic methodology to estimate this revenue.

Module 6-Sales Tax Revenue-Sales tax revenue generated by the project is estimated in this Module using the case study method. Module 3 estimated new wages to be paid to employees of the development as well as those supported by project's residents. Data from the Consumer Expenditure Survey by the Bureau of Labor Statistics is used to determine the portion of these wages to be spent on taxable items, such as apparel, food away from home, and furniture purchases. Various Washoe County tax rates are applied to estimated taxable expenditures made by project employees, along with various fees and distribution percentages currently in effect for Washoe County.

Module 7-Sheriff Operations Expenditures-These expenditures are estimated using a combination of case study and service standard method. Using population estimates from

Module 3 and a service standard of 1.7 officers per 1,000 population, the number of new police officers necessary for the project is estimated. Current salary, benefits, services/supplies, and vehicle purchase costs reported by the Sheriff's Department are applied to estimate the total capital expenditure and operating costs associated with the project for this Department.

4. Findings

As discussed above, a fiscal impact model was created by Washoe County utilizing the COMPAS methodology discussed by Johnson (2006) and used, with small adjustments, by multiple economists as a template for fiscal impact models across the United States. Appendix H shows the results of the estimates for hand- and IMPLAN-calculated modules, including project employment, property tax, and project-related information. Results of the analyses for the labor force and fiscal impact modules are summarized in this section and summarized as Modules 3 and 4 in Appendix H for a sample residential and commercial project located in the unincorporated portion of Washoe County.

4.1 Labor Force Module

Using the labor force module equations described in the Methodology section of this paper and the 3SLS option in Stata, a number of model specifications were compared. An unrestricted model was first created using the AREA and DENSE dummy variables and all data in its natural form. The resulting models, shown in Table 4 below, had a number of variables not significant even at the 10 percent level. The table shows the model using the AREA variables had more significant variables, but still a large number of insignificant ones.

Both types of models had relatively low R-squared results (especially in the IN and OUT models), high standards errors (not shown in Table 4), and a number of terms not shown to be significant. Many of the non-significant terms were the dummy variables.

Table 4. Comparison of Models Using AREA and DENSE Variables

	Unrestricted Model-AREA	Unrestricted Model-DENSE	Unrestricted Log Log Model-AREA	Unrestricted Log Log Model-DENSE	Restricted Log Log Model
Labor Force (LF)					
Area (or Density)	-0.002458200	-0.314921900	-0.000000266	0.000000348	
Employment	1.009138***	1.009071***	0.900570***	0.899836***	0.901497***
Emp*Area (or Density)	-0.000001***	0.000000454	0.000000000	0.000000000	
Unemployment	1.138650***	1.101185***	0.102512***	0.102041***	0.102030***
Out-Commuters	0.024126***	0.043527***	-0.003466000	-0.002453400	-0.004180500
Constant	-63.24755000	-124.74420000	0.3582452***	0.361656***	0.357229***
R-Squared	1.0000	1.0000	0.9999	0.9999	0.9999
In-Commuters (IN)					
Area (or Density)	-0.438315900	-10.574530000	-0.000058***	0.000159600	
Employment	0.0647448**	-0.027796000	0.555471***	0.598966***	0.059105***
Emp*Area (or Density)	-0.000010***	-0.000003080	0.000000000	0.000000000	
Contig. Employment	0.112886***	0.1842614**	10.16894***	10.81826***	10.80193***
Contig Emp*Area (Density)	0.000031100	0.000295600	0.000000000	-0.000000002	
Contig. Labor Force	-0.086341500	-0.1456828**	-9.91666***	-10.48463***	-10.47436***
Contig. LF*Area (Density)	-0.000026300	-0.000252900	0.000000000	0.000000002	
Unemployment	0.354471000	0.802264***	0.3247503**	0.229515400	0.24043602*
Out-Commuters					
Constant	-3,025.682000	-4,844.968**	-1.650268**	-2.516477***	-2.437887***
R-Squared	0.8266	0.8142	0.9039	0.8954	0.8940
Out-Commuters (OUT)					
Area (or Density)	-0.463087400	-11.29477000	-0.000070***	0.000156100	
Employment	0.05580460*	-0.040306500	0.722577***	0.754718***	0.740062***
Emp*Area (or Density)	-0.000011***	-0.000000530	-0.0000000**	0.000000000	
Contig. Employment	0.096729200	0.1914078**	7.536894***	10.96738***	11.131310***
Contig Emp*Area (Density)	0.00003780*	0.000286600	0.00000000*	-0.000000001	
Contig. Labor Force	0.072428400	-0.1515281**	-7.301726***	-10.63082***	-10.804790***
Contig. LF*Area (Density)	-0.00003200*	-0.002452000	-0.00000000*	0.000000001	
Unemployment	0.41197050*	0.821232***	0.219574300	0.121422400	0.1429333000
In-Commuters					
Constant	-3,547.328000	-5,433.53***	-2.88713***	-3.568621***	-3.426981***
R-Squared	0.8193	0.8019	0.8378	0.8204	0.8187
Population (POP)					
Area (or Density)	8.184695***	13.20554000	-0.000001180	-0.000003580	
Dependency Rate	40,649.34***	23,231.9***	0.484512***	0.491724***	0.4874183***
Dep. Rate* Area (or Density)	-3.5875510**	-34.96765000	0.000000708	0.000008960	
Labor Force	1.959797***	1.978428***	0.996258***	0.995480***	0.9962505***
Constant	-57,425.65***	-21,818.10**	0.689429***	0.693462***	0.6881445***
R-Squared	0.9988	0.9988	0.9999	0.9999	0.9999

(1) Unrestricted model includes all slope and intercept dummy variables.
(2) Restricted Model omits all slope and intercept dummy variables.

A number of labor force models reviewed for this paper used the log-log form, transforming all continuous variables in the equations into their natural log form. This was done in this case. The unrestricted log-log model had slightly better results than the unrestricted original model, with slightly higher R-squared results. However, the model still had high standard errors for its estimates and a number of non-significant terms. The log-log structure did seem to yield more accurate models, but additional adjustment was needed.

F-tests conducted for the dummy variables indicated little relationship between these and proposed models. Additionally, a correlation matrix also indicated little relationship to the endogenous variables in the log-log models. This resulted in the exclusion of all dummy variables from the labor impact models. The final form of the restricted unadjusted labor impact module is summarized below and also shown in Table 3 above to provide a comparison with the results of the unrestricted models.

$$\ln LF = \underset{(0.1178)^{***}}{0.3572288} + \underset{(0.0042)^{***}}{0.9014972} \ln EMP + \underset{(0.0032)^{***}}{0.1020297} \ln UNEMP - \underset{(0.0027)}{0.0041805} \ln OUT \quad (16)$$[19]

$$r^2 = 0.9999$$

$$\ln IN = \underset{(0.6572)^{***}}{-2.437887} + \underset{(0.1438)^{***}}{0.5910528} \ln EMP + \underset{(0.1422)^{*}}{0.2404362} \ln UNEMP + \underset{(1.8746)^{***}}{10.80193} \ln CEMP$$
$$\underset{(1.8729)^{***}}{-10.47436} \ln CLF \quad (17)$$

$$r^2 = 0.8940$$

$$\%\Delta OUT = \underset{(0.9186)^{***}}{-3.426981} + \underset{(0.2025)^{***}}{0.7400615} \ln EMP + \underset{(0.1997)}{0.1429333} \ln UNEMP + \underset{(2.6077)^{***}}{11.13131} \ln CEMP$$
$$\underset{(2.6045)^{***}}{-10.80479} \ln CEMP \quad (18)$$

[19] Values in parenthesis are standard errors associated with above coefficients. Asterisks following each standard deviation number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.

$$r^2 = 0.8187$$

$$\%\Delta POP = \underset{(0.0079)^{***}}{0.6881445} + \underset{(0.0062)^{***}}{0.4874183}\ln DEP + \underset{(0.0007)^{***}}{0.9962505}\ln LF \quad (19)$$

$$r^2 = 0.9999$$

This information is incorporated into Module 3 of the Excel spreadsheet model to estimate labor force and population impacts generated by a proposed development for Washoe County.

4.2 Fiscal Impact Module

Using a combination of non-econometric methodologies, including per capita, service standard, case study, and indirect cost, the fiscal impact module estimates all Washoe County General Fund revenues and expenditures associated with a proposed project. As discussed above, Module 1 collects project information, including number of units and square feet constructed by use type, construction costs, employees, project location and more. Module 2 incorporates IMPLAN information for each use type to determine direct, indirect, and induced employment, labor income, and output associated with the project. Module 3 is the labor income module estimating Washoe County population associated with the proposed project.

Using information in these Appendices, the fiscal impact module then estimates General Fund revenues and costs associated with the project. Project construction costs outlined in Module 1 are used in Module 5 to estimate property tax revenue associated with the project. Module 6 estimates sales tax revenue generated by the project's employees for Washoe County using new wage information estimated in Module 3. Module 4 uses population estimates from Module 3 to estimate various revenues and costs associated with the project and Module 7 uses this information to estimate project-associated police costs.

All General Fund revenues and expenditures are summarized in Module 4, with an annual comparison of total revenues, expenditures, and resulting net income or loss for Washoe County associated with the project. It should be noted that the module uses FY 2014-2015 data from the Washoe County FY 2015-2016 budget. This is because FY 2014-2015 data is based on actual results for the year, while FY 2015-2016 data is budgeted.

An important component of the project is the project's location. If located within an incorporated city, such as City of Reno or City of Sparks, the project will receive major services such as police and fire from and generate some revenues, such as building permit fees and business licenses for these cities. Washoe County will only receive certain revenues such as property tax and sales tax and provide county-level services to this project, such as assessor, detention, social services, etc.

If located within Washoe County, the project will generate all revenue for and receive all services from the County. This is an important part of the fiscal impact module and is based on the answer by the developer in Module 1 regarding the project's location. The complete fiscal impact model is shown in Appendix H for a for a sample residential and commercial project located in the unincorporated portion of Washoe County.

4.3 Model Use Example

Appendix H shows the estimated impact on Washoe County total employment, population, revenues, and expenditures from a sample residential and commercial project located in the unincorporated portion of Washoe County. The project includes 1,750 residential units and 120,000 square feet of various non-residential components (hotel, casino, commercial, office, and industrial) constructed over a 10-year period.

Using average non-residential square feet per employee data for the area, Module 1 estimates the project will add a total of 207 employees from its non-commercial component. Using the IMPLAN software, Module 2 estimates 1,501 total employees will be added in the county over the 10-year construction period. This includes direct non-residential employees, direct employees generated by expenditures by new residents, as well as indirect and induced employees.

Module 3 shows the project will result in 3,112 in new residents to the county and an increase in the labor force of 1,600 persons. The labor force estimate is higher than the employee estimate due to unemployed persons and those employed less than full-time included in the labor force amount. The Module also shows estimated in- and out-commuters for the project-related employees.

Module 4 combines information from Modules 1-3 and 5-7 to estimate the fiscal impact of the project on Washoe County. The Module shows expenditures are expected to exceed revenues for the four years of the project. This is because some revenues, such as property tax, are estimated to lag behind expenditures, with services expected to be provided to the project as soon as construction begins. Over the 10-year analysis period, Module 4 shows a General Fund surplus for the County of $557,043, a positive fiscal impact, especially given a $449,220 contingency amount added to estimated expenses, which is a common practice in local government budgeting.

The Washoe County fiscal impact model developed in this Chapter can also be used to estimate population and labor force impacts of EPIC employment projections shown in

Table 2 of this study, which shows employment estimates by zone. The table shows 3,527 jobs are estimated for the unincorporated Washoe County area (zones 9 and 10). According to the EPIC study methodology, these job estimates include direct, indirect, and induced jobs. Since no housing information is available and job estimates are provided in the direct, indirect, and induced format, there is no need to use Modules 1 and 2 of the model. Plugging 3,527 total jobs into Module 3 results in an estimated total new population for unincorporated Washoe County of 7,252 and a labor force estimate of 3,759.

The full fiscal impact of projected jobs is difficult to estimate as no construction information is available. The model shows a negative fiscal impact of EPIC job projections on Washoe County of $2.2 million. However, projected employees and resulting population will require new housing and new non-residential construction, which will generate property tax revenue for the County. Property tax revenue is an important component of the County budget, but cannot be estimated in the existing model as no building construction information is provided. A future addition to the model may include a construction demand model to estimate housing and non-residential construction demands generated by employment and/or population growth in the area.

5. Conclusion

The following are the conclusions of this paper as they relate to the research questions posed at the beginning of the study. The COMPAS model used in this analysis answers the commonly-asked question as to the causal relationship between population and employment. COMPAS models use employment to estimate population impacts, suggesting that employment drives population in a region.

The fiscal impact module of the COMPAS model for Washoe County included information for the Washoe County General Fund only. Other important funds, such as the Truckee Meadows Fire Protection District Fund should also be included and will be included in future versions of the model. However, there are multiple fire protection districts within the County, each with its own property tax rates, other revenue sources and operations, which makes modeling of TMFPD revenue difficult.

Additionally, due to lack of time series financial data for Washoe County and cross sectional data for neighboring states, the analysis used an arithmetic approach to estimating the fiscal impact of proposed changes on Washoe County. This included per capita, indirect cost, case study, and service standard methods. The arithmetic methodology also simplified the estimate of property and sales tax revenue for the model, which are difficult to estimate using econometric methodology. The resulting COMPAS model is one of the first models to utilize a combination of econometric and arithmetic methodologies for its modules.

According to Harris et al (1996), a successful fiscal impact model should correspond to the following characteristics:

- The ability to be reduced to a worksheet format;
- A structure that lends itself to characterizing the geographical area of interest;
- Modest and obtainable data requirements with a minimum amount of user estimated inputs;
- A conceptually simple to understand structure; and

- The ability to be validated for accuracy and subsequent fine-tuning (Harris 1996).

The fiscal impact model introduced in this paper has all of the above characteristics. It is an Excel based model representing Washoe County, both as a geographic area and a public jurisdiction. The model is simple to understand and requires minimal user input, with input limited to project-specific information, which can be supplemented with local industry data, if unavailable. The model's accuracy can be validated using econometric techniques in its labor impact module and by comparing model output to actual Washoe County revenues and expenditures for the fiscal impact module. Additionally, the model's lay-out in Excel allows for changes to various assumptions and to update fiscal impact module components for future years.

Future work on the model will include extending the model to include impacts on Washoe County School District, State of Nevada, various special districts, and surrounding jurisdictions. These jurisdictions will also be impacted by the proposed growth. Additionally, the use of error terms can be incorporated into the model to create an impact range, rather than a single number. These would allow planners to have more certainty regarding model predictions.

The study attempted to add a spatial econometric component to the labor impact model by adding AREA and DENSE dummy variables. These were shown to not be significant and were not included in the final model. This may be, in part, due to the large percentage of public land within some counties within the sample. Public land typically cannot be developed, or can only be developed minimally. As a result, a more accurate dummy variable for population density or land available for development within a county would exclude public land from the county's land area estimate. Future work on the model would be to revise AREA and DENSE variables to exclude public land, testing for the significance of these adjusted variables. Public land data is not readily available, but may be developed through further research.

Modules estimating housing prices impacts and school impacts of growth would also be valuable. Additionally, as the existing model does not consider impacts of inflation, adding these impacts to the model would be helpful in the future.

Another valuable adjustment to the model would be to include county and state-level incentives and tax abatements to determine the net fiscal impact to the County given the growth in use of abatements and incentives as an economic development tool. An incentive, such as a reduction in property tax assessment or waiving of certain impact or other fees, would reduce the revenue to be County generated by the project. As a result, it is important for the County to know the net fiscal impact, including the loss of revenue, due to these incentives.

Additionally, the importance of using Geographic Information Systems (GIS) to map project locations, locations of existing and proposed services, and other special characteristics cannot be underestimated. Further model development would include work with the Center for Regional Studies and their GIS expertise to include mapping capabilities to the fiscal impact model, as well as to use their layers data in the model.

APPENDICES

APPENDIX A
ASSESSED VALUE MODELS FOR CITY OF SPARKS AND WASHOE COUNTY
SINGLE EQUATION REGRESSION METHODOLOGY

Similar to the analysis conducted for the City of Reno, as described in the main body of the paper, variables for the City of Sparks and Washoe County assessed value models were collected during the literature review process and through interviews with local government representatives. All variables were reviewed for their conformance to economic theory and divided into three areas 1) variables that correspond to the health of the local economy (representing demand for new construction and local land market), 2) variables that correspond to the health of the national economy (representing construction cost changes and national drivers of land market), and 3) weighted average year built of all residential and commercial structures (representing a reduction in assessed value resulting from structure depreciation). Models using various combinations of these three types of variables were created and compared to determine the best combination of variables resulting in a model with the highest R^2, most significant variable coefficients, and lowest MAPE scores. This Appendix discusses the results of the final models for the City of Sparks and Washoe County.

City of Sparks

The structure for the model is shown below:

$$AVcap=\alpha + \beta_1 Copersinccap_{t-2} + \beta_2 USperms_{t-2} \qquad (A.1)$$

where:

AV is the annual assessed value for City of Sparks for year t. This variable is adjusted for inflation to 1Q 1990 using the Consumer Price Index (CPI). It is also a per capita variable, divided by Washoe County population.

Copersinc is the personal income for Washoe County. Data is shown in thousands of dollars. This variable is adjusted for inflation to 1Q 1990 using the Consumer Price Index (CPI). It is also a per capita variable, divided by Washoe County population. *USperms*- is the new privately owned housing units authorized by building permits in permit-issuing places for the United States. Data is shown in millions of units.

The Breusch-Godfrey test indicated that the model had no issues with serial correlation and an ordinary least squares (OLS) can be used to estimate the model. The final estimated model is as follows:[20]

$$AVcap_t = -844.628 + 133.434 Copersinccap_{t-2} + 332.900 USperms_{t-2} \qquad (A.2)$$

$$(561.668) \quad (22.780)^{***} \quad (130.400)^{**}$$

$$R^2 = 0.7765$$

This model predicts approximately 77.65 percent of the annual change in City of Sparks assessed value levels. All estimated coefficients, with the exception of the constant, are significant at the 10 percent and 5 percent levels of significance.

The results of the assessed values forecast by the model for the City of Sparks are summarized below in graph and table form, compared to actual assessed values. The econometric model has a MAPE result of 5.24% using all in-sample data and an out-of sample MAPE estimate of 5.05%.

[20] Values in parenthesis are standard errors associated with above coefficients. Asterisks following each standard deviation number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.

Figure A-1. City of Sparks Actual and Predicted Assessed Values [21]

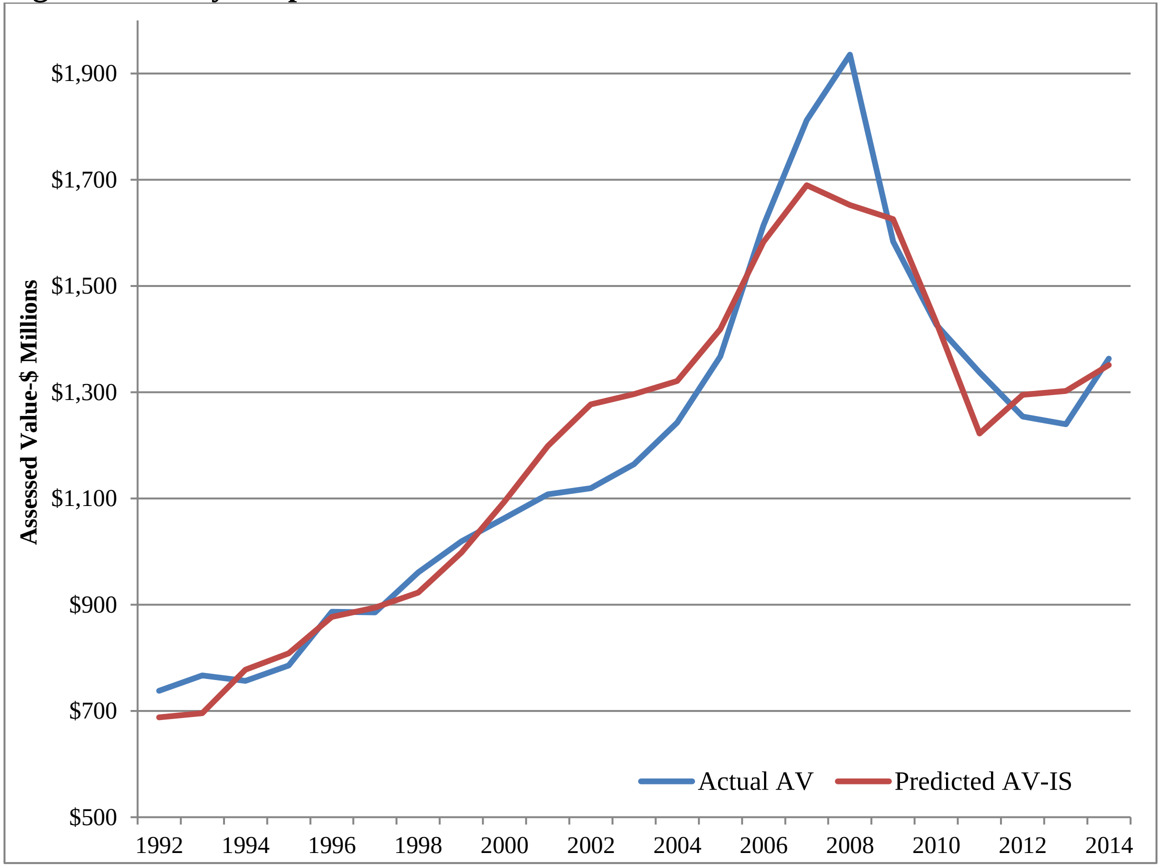


Figure A-1 above shows the comparison of actual assessed values and those predicted by the model. The model would have overestimated assessed values between 2001 and 2005 and underestimated revenues during the assessed value peak in 2008. Actual and forecast assessed values for the three-year out-of sample period, in dollar terms are shown below.

Table A-1. Comparison of Actual and Predicted Sales-City of Sparks

Forecast Period	Actual AV	Predicted AV*	Error
2012	$ 1,254,402,219	$ 1,330,653,558	6.08%
2013	1,240,115,494	1,338,078,605	7.90%
2014	1,363,654,646	1,379,461,436	1.16%
Average			**5.05%**

*using out-of sample statistics

[21] Actual and Predicted assessed values are shown in "real" terms, adjusted for inflation to 1990 levels.

Washoe County

The structure for the model is shown below:

$$AVcap = \alpha + \beta_1 Copersinccap_{t-2} + \beta_2 USperms_{t-2} \qquad (A.3)$$

where:

AV is the annual assessed value for Washoe County for year t. This variable is adjusted for inflation to 1Q 1990 using the Consumer Price Index (CPI). It is also a per capita variable, divided by Washoe County population.

Copersinc is the personal income for Washoe County. Data is shown in thousands of dollars. This variable is adjusted for inflation to 1Q 1990 using the Consumer Price Index (CPI). It is also a per capita variable, divided by Washoe County population.

USperms- is the new privately owned housing units authorized by building permits in permit-issuing places for the United States. Data is shown in millions of units.

The Breusch-Godfrey test indicated that the model had no issues with serial correlation and an ordinary least squares (OLS) can be used to estimate the model. The final estimated model is as follows:[22]

$$AVcap_t = -2258.518 + 712.780 Copersinccap_{t-2} + 1169.700 USperms_{t-2} \qquad (A.4)$$

$$(2475.184) \quad (100.387)^{***} \quad (574.600)^{***}$$

$$R^2 = 0.8408$$

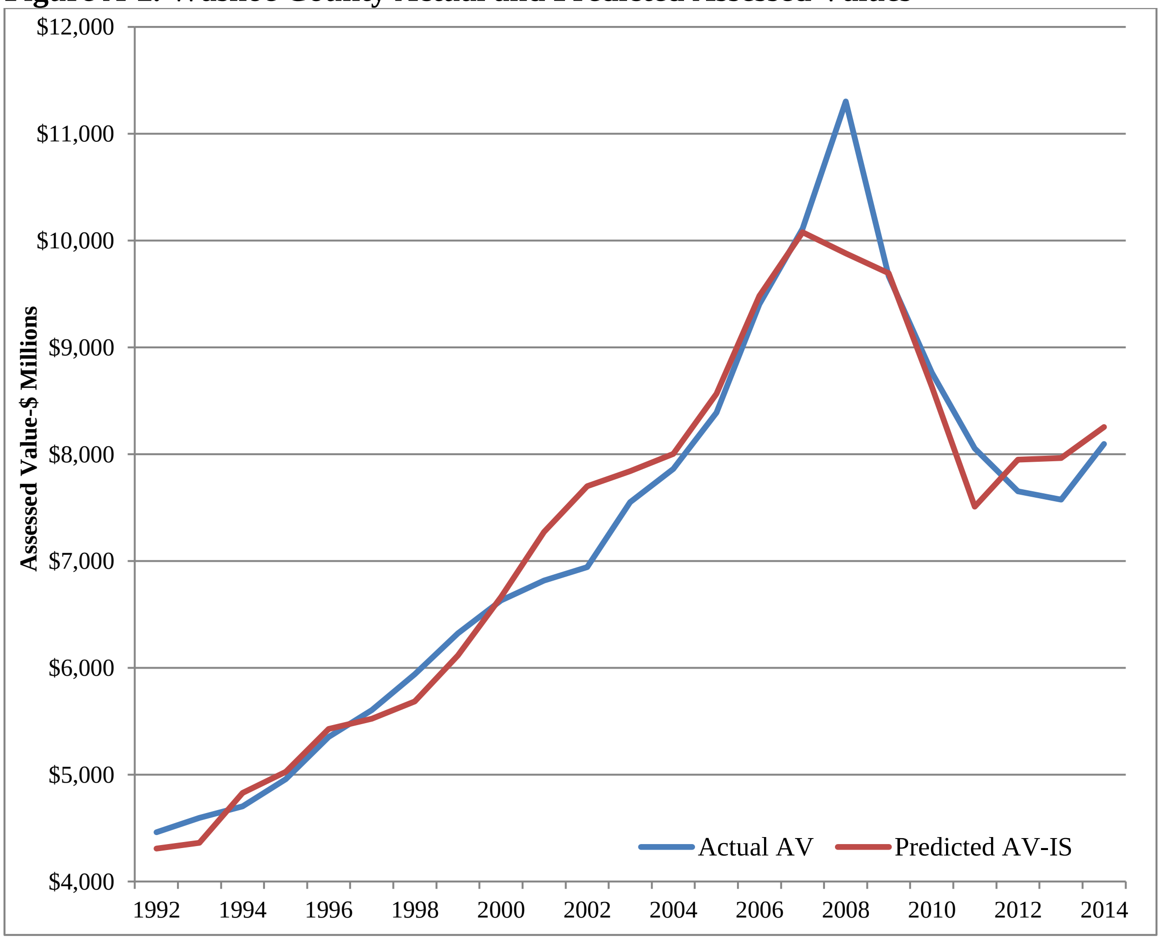
This model predicts approximately 84.08 percent of the annual change in Washoe County assessed value levels. All estimated coefficients, with the exception of the constant, are significant at the 10 percent, 5 percent, and 1 percent levels of significance.

[22] Values in parenthesis are standard errors associated with above coefficients. Asterisks following each standard deviation number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.

The results of the assessed values forecast by the model for Washoe County are summarized below in graph and table form, compared to actual assessed values. The econometric model has a MAPE result of 3.56% using all in-sample data and an out-of sample MAPE estimate of 7.36%.

Figure A-2 below shows the comparison of actual assessed values and those predicted by the model. The model would have overestimated assessed values between 2000 and 2006 and underestimated revenues during the assessed value peak in 2008.

Figure A-2. Washoe County Actual and Predicted Assessed Values[23]



[23] Actual and Predicted assessed values are shown in "real" terms, adjusted for inflation to 1990 levels.

Actual and forecast assessed values for the three-year out-of sample period, in dollar terms are shown below.

Table A-2. Comparison of Actual and Predicted Sales-Washoe County

Forecast Period	Actual AV	Predicted AV*	Error
2012	$ 7,653,020,809	$ 8,256,233,696	7.88%
2013	7,574,417,821	8,273,490,106	9.23%
2014	8,097,135,520	8,500,106,343	4.98%
Average			**7.36%**

*using out-of sample statistics

APPENDIX B
SUMMARY OF FINDINGS USING THE X-13ARIMA-SEATS SOFTWARE FOR SEASONAL ADJUSTMENT

As mentioned in the body of the paper, the X-13ARIMA-SEATS software created by the US Census Bureau was used to adjust leading indicators to eliminate seasonal differences. Indicators adjusted using the software were compared to similarly adjusted coincident indicators using the qualitative and quantitative methodologies outlined in the body of the paper.

As the qualitative methodology compared leading indicators to coincident and GDP variables on an annual level, no differences were found between the leading indicators selected using the moving average and the X-13 adjustment methodologies.

The quantitative methodology for selecting leading index variables utilized the Granger causality test after a Dickey Fuller test was performed to ensure stationarity of variables. Table B-1 below summarizes the results of the Dickey Fuller test. It shows that all coincident and leading indicators are stationary at level or first difference and can be used in the analysis.

Table B-1. Results of the Dickey Fuller Test for Stationarity-Variables Adjusted for Seasonality using the X-13 Software [24]

Variable Name	Definition	Dfuller Levels	Dfuller 1st Diff
empave	Average Employment-SA[25]	-3.083**	-
unempl	Ave Initial Claims for Unemployment-SA	-2.245	-18.950***
gaming	Taxable Gaming Revenue-SA, CPI[26]	-1.248	-26.184***
sfhomes	Single Family Homes Sold-SA	-2.856**	-
uslead	US Leading Index	-1.130	-11.299***
respermits	Residential Building Permits-SA	-6.889***	-
compermits	Commercial Building Permits-SA	-9.830***	-
taxsales	Taxable Sales-SA, CPI	-1.987	-22.884***
respermval	Residential Permits Valuation-SA, CPI	-4.618***	-
compermval	Commercial Permits Valuation-SA, CPI	-12.670***	-
gassales	Gasoline Sales-SA	-4.881***	-
passengers	Airport Passengers-SA	-1.199	-21.653***
cargo	Airport Cargo-SA	-2.498	-21.793***
sfprice	Median Sales Price-SA, CPI	-1.072	-19.331***
caind	California Index	-1.774	-13.972***
visitors	Visitors-SA	-5.265***	-
stockprice	S&P 500 Historical Prices-CPI	-1.449	-15.632***
intrate	Treasury Note/ Federal Funds Rate Spread	-1.786	-12.389***
exrate	Trade Weighted U.S. Dollar Index	-1.080	-11.223***
moneysupl	US Money Supply-CPI	3.560	-9.682***
occrate	Occupancy Rate-SA	-5.265***	-

The table below summarizes the results of using the Granger Causality test for leading indicators adjusted for seasonality using the X-13 methodology. The table indicates average initial claims for unemployment, US leading index, taxable sales, valuation of residential building permits, gasoline sales (gallons), median price of single family homes

[24] Asterisks following each test statistic number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.
[25] SA-seasonally adjusted
[26] CPI-adjusted for inflation

sold, and California leading index indicators should be selected for use in the Reno MSA leading index.

Table B-2. Summary of Granger Causality Results for Leading Indicators Adjusted for Seasonality using the X-13 Software[27]

Variable Name	1 lag		2 lags		3 lags		4 lags		5 lags		6 lags	
	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.
unempl	59.0910	0.000***	48.5860	0.000***	35.1910	0.000***	27.6050	0.000***	29.6970	0.000***	26.9620	0.000***
uslead	91.2400	0.000***	84.2280	0.000***	67.6870	0.000***	55.3880	0.000***	47.8430	0.000***	40.2970	0.000***
taxsales	24.1240	0.000***	18.6800	0.000***	14.2010	0.003***	12.3590	0.015**	14.5070	0.013**	14.4500	0.025**
respermval	26.4790	0.000***	18.8200	0.000***	13.7510	0.003***	18.4820	0.001***	16.4240	0.006***	14.9920	0.020**
gassales	0.3633	0.5470	0.5901	0.7440	2.6480	0.4490	12.2120	0.016**	15.9750	0.007***	16.8260	0.010***
sfprice	13.8970	0.000***	9.9066	0.007***	20.6900	0.000***	24.1610	0.000***	26.2840	0.000***	28.3600	0.000***
caind	81.1440	0.000***	68.1380	0.000***	52.3350	0.000***	40.8070	0.000***	33.7320	0.000***	28.0210	0.000***
intrate	10.1830	0.001***	11.9780	0.003***	10.4970	0.015**	16.0820	0.003***	15.7420	0.008***	13.6890	0.033**
sfhomes	24.8210	0.000***	17.7300	0.000***	18.1430	0.000***	14.7680	0.005***	12.4990	0.029**	29.4270	0.000***
stockprice	25.3300	0.000***	20.0280	0.000***	17.2580	0.0010	14.5050	0.006***	12.8260	0.025**	13.9290	0.0300**
compermits	8.4500	0.004***	7.4199	0.024**	7.5003	0.058*	6.0109	0.1980	9.1738	0.1020	9.3601	0.1540
gaming	3.5375	0.060*	2.0384	0.3610	2.7905	0.4250	6.2031	0.1840	5.7054	0.3360	5.1145	0.5290
respermits	16.4050	0.000***	11.5520	0.003***	8.6925	0.034**	7.6032	0.1070	6.9418	0.2250	5.8441	0.4410
compermval	0.0602	0.8060	2.8396	0.2420	2.1637	0.5390	2.5402	0.6370	3.0745	0.6880	4.0472	0.6700
passengers	2.6033	0.1070	1.4671	0.4800	1.7152	0.6340	1.6046	0.8080	8.1583	0.1480	10.0200	0.1240
cargo	3.9057	0.048**	3.5585	0.1690	2.7362	0.4340	3.3970	0.4940	3.1847	0.6720	7.8519	0.2490
visitors	16.6960	0.000***	11.2560	0.004***	7.1659	0.067*	5.0506	0.2820	3.9118	0.5620	4.5089	0.6080
exrate	2.0516	0.1520	1.5762	0.4550	4.6743	0.1970	5.2275	0.2650	6.9275	0.2260	9.4532	0.1500
moneysupl	0.0073	0.9320	0.3105	0.8560	0.1983	0.9780	0.4914	0.9740	3.3892	0.6400	4.6869	0.5850
occrate	20.1460	0.000***	14.9540	0.001***	11.9650	0.008***	9.0815	0.059*	7.4259	0.1910	9.0556	0.1700

Variable Name	7 lags		8 lags		9 lags		10 lags		11 lags		12 lags	
	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.
unempl	23.8140	0.001***	32.9570	0.000***	32.7890	0.000***	34.9830	0.000***	37.2390	0.000***	44.0360	0.000***
uslead	38.6330	0.000***	39.4750	0.000***	41.6100	0.000***	41.8880	0.000***	43.3050	0.000***	44.5950	0.000***
taxsales	13.2930	0.065*	14.8960	0.061*	15.7420	0.072*	18.3550	0.049**	22.0300	0.024**	25.2620	0.014**
respermval	15.2000	0.034**	16.0010	0.042**	16.0400	0.066*	16.6650	0.082*	15.7550	0.1500	15.5690	0.2120
gassales	13.0480	0.071*	13.0570	0.1100	14.8480	0.095*	19.3440	0.036**	19.8630	0.047**	19.4390	0.078*
sfprice	29.5300	0.000***	30.0530	0.000***	30.9220	-	30.1670	0.001***	33.7090	0.000***	34.9700	0.000***
caind	24.8640	0.001***	28.9680	0.000***	32.7640	0.000***	34.1340	0.000***	38.7050	0.000***	39.5830	0.000***
intrate	13.4970	0.061*	15.9140	0.044**	15.7980	0.071*	19.1840	0.038**	25.0490	0.009***	26.0860	0.01***
sfhomes	29.3270	0.000***	32.7970	0.000***	38.0130	0.000***	37.8860	0.000***	36.5420	0.000***	37.2480	0.000***
stockprice	12.9200	0.074*	12.7990	0.1190	12.5840	0.1820	14.8660	0.1370	18.5940	0.069*	19.3040	0.081*
compermits	6.1308	0.5250	10.7520	0.2160	19.4680	0.021**	16.9190	0.076*	17.4520	0.095*	17.1090	0.1460
gaming	9.7895	0.2010	10.3080	0.2440	12.8860	0.1680	16.1160	0.096*	16.8380	0.1130	17.6810	0.1260
respermits	6.2668	0.5090	7.4750	0.4860	8.2017	0.5140	8.3748	0.5920	8.2652	0.6890	8.8984	0.7120
compermval	9.5432	0.2160	9.6064	0.2940	12.3180	0.1960	12.5870	0.2480	14.5630	0.2030	14.5610	0.2660
passengers	9.6080	0.2120	9.4654	0.3050	9.3709	0.4040	12.0190	0.2840	12.9500	0.2970	15.7220	0.2040
cargo	7.1989	0.4080	8.1515	0.4190	8.1764	0.5160	8.7468	0.5560	9.3177	0.5930	9.5146	0.6580
visitors	3.4022	0.8450	7.5692	0.4770	7.6935	0.5650	8.8561	0.5460	14.5360	0.2050	19.2600	0.082*
exrate	8.8654	0.2620	9.7515	0.2830	10.2870	0.3280	10.9390	0.3620	11.2540	0.4220	12.8720	0.3780
moneysupl	7.1968	0.4090	11.0920	0.1970	10.7800	0.2910	13.2530	0.2100	15.9760	0.1420	17.6760	0.1260
occrate	7.9701	0.3350	17.3310	0.027**	16.7920	0.052*	17.6030	0.062*	23.3640	0.016**	33.3020	0.001***

[27] Asterisks following each probability number represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.

The table shows that all variables highlighted in green Granger-cause average employment at 5 percent and 10 percent confidence levels. Of these, average initial claims for unemployment (unempl), US leading index (uslead), and taxable sales (taxsales), are the series chosen using the prior qualitative methodology. Instead of residential building permits (respermits), residential building permit valuation (respermval) series is shown to have a better leading relationship to average employment; as a result, this series was used instead of the building permit series.

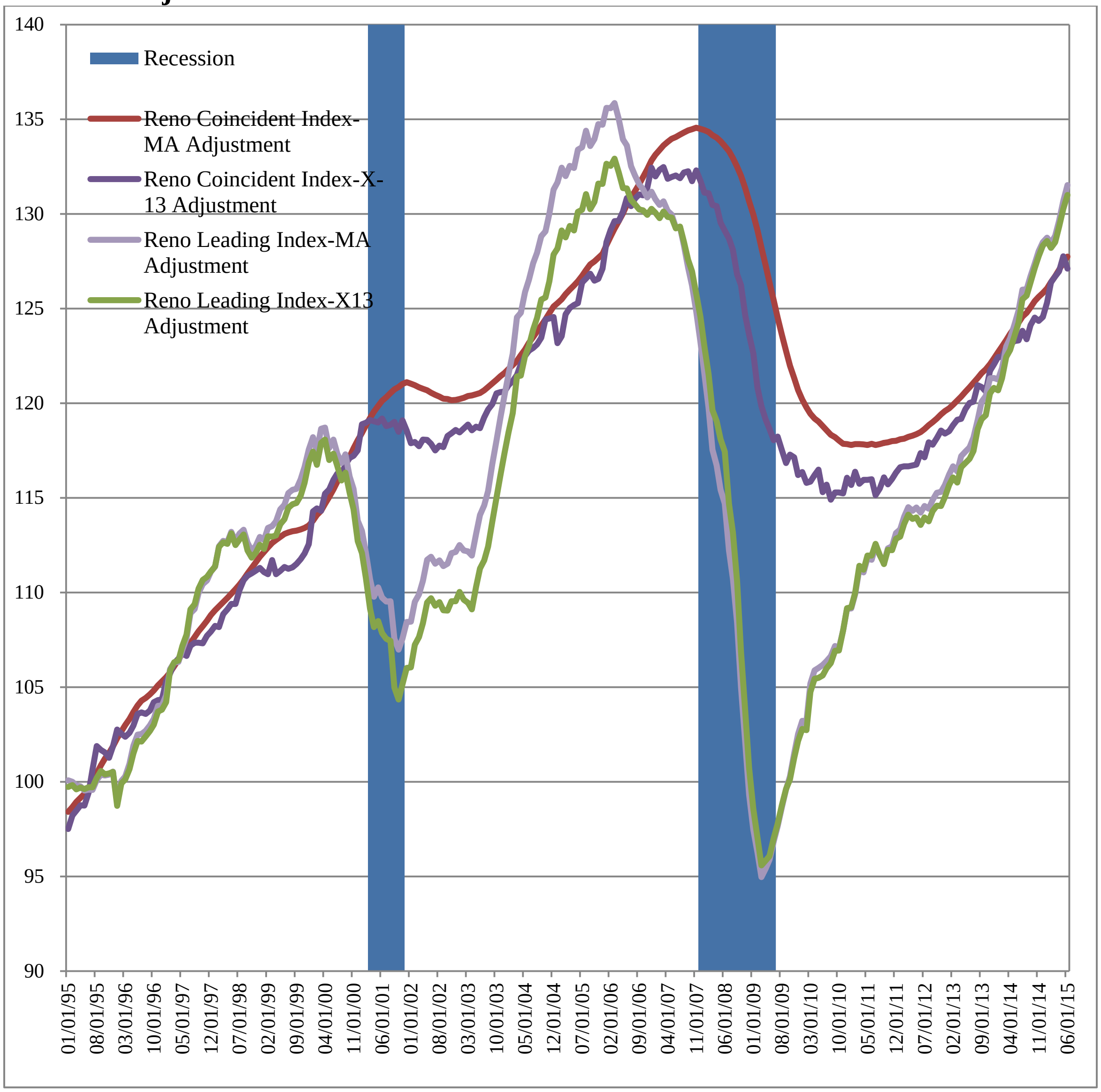
While both single family homes sold (sfhomes) and median home sales price (sfprice) series show both a good qualitative and Granger relationship to average employment, both represent the same indicator and to simplify the index, only one series was used. The median homes sales price series showed a higher level of confidence in the Granger test than single family homes series using the 4-6 lags. As a result, this series can be used.

The qualitative analysis showed that airports pounds of shipped cargo series could be used in the leading index. The Granger test showed little relationship between the series and average employment. As a result, this series will not be used. However, three series excluded during the qualitative process were found to be related to average employment. These include gas sales (gassales), California leading index (caind), interest rate spread (intrate), and S&P 500 price (stockprice). Both the gas sales and California leading index series were found to be related to average employment during the qualitative selection process, but too volatile in the case of the California index and unclear in the case of gas sales. Given their Granger causality results, both series were included in the leading index for the Reno MSA.

The two other series, interest rate spread and S&P stock prices, were shows to be related to average employment during the qualitative and Granger causality tests. However, these series, along with other national series, including national average weekly initial claims for unemployment insurance, national average weekly hours in manufacturing, national consumer confidence index, and leading credit index, are included in the US leading index created by The Conference Board, which is one of the series to be used for the US leading index. As a result, despite their relationship, to simplify the resulting index, interest rate spread and stock prices series were excluded from the Reno MSA index as they are already included in the US leading index. Remaining series shown in Table B-2 were found to be unrelated to average employment during the qualitative and quantitative testing processes.

The figure below shows a comparison of the resulting Reno MSA coincident and leading indices created using indicators adjusted for seasonality using the moving average (MA) and X-13 methodologies. The figure shows that while the leading indices resulting from the different methodologies are very similar, with some differences where the X-13 leading index is lower than the MA index. However, the coincident index created using the MA methodology is higher and smoother than the X-13 coincident index. The smoothness of this index is another reason why the moving average methodology is preferred in this paper.

Figure B-1. Comparison of Leading and Coincident Indices using MA and X-13 Seasonal Adjustments



APPENDIX C
SUMMARY OF QUALITATIVE SELECTION ANALYSIS OF LEADING INDICATORS

Below is a comparison of various leading indicators for the Reno MSA economic index. For each proposed indicator, the analysis considers the economic importance of the economic theory behind the indicator, data adequacy, data timing, cyclical variations and data smoothness. Indicators are compared to Reno MSA GDP and average employment (coincident variable) levels on an annual basis to assess their cyclical variations and timing. The results of the analysis are summarized below.

Average Weekly Hours in Manufacturing

As discussed above, manufacturing is not a sizeable industry in Washoe County in terms of employment. However, with the plans for a Tesla gigafactory and the focus of economic development agencies on attracting manufacturing companies to the area, this industry is likely to grow and become a more important part of the region's economy.

Data for average weekly hours in manufacturing series is not available for either the Reno MSA or Washoe and Storey counties. Statewide data for the average weekly hours in manufacturing is available from the Nevada Department of Employment, Training, and Rehabilitation starting in 2014 and for average weekly hours in goods producing industries from the Bureau of Labor Statistics starting in 2007. This is insufficiently long-term data to use this indicator in the index.

Average Weekly Initial Claims for Unemployment Insurance

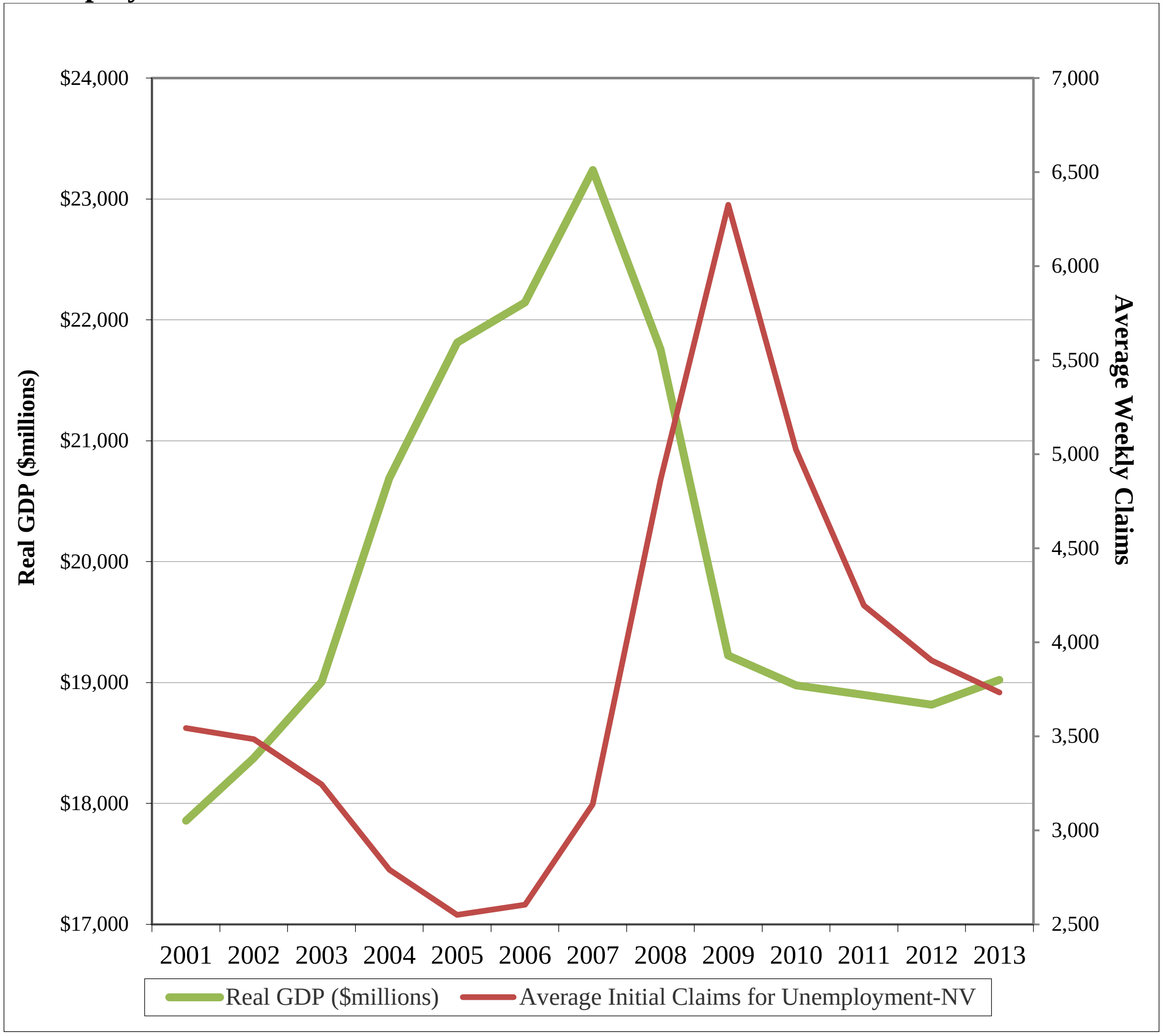
The theoretical basis for using this series is that new unemployed persons file for unemployment insurance due to their loss of employment. This not only indicates a decline in the economic activity which required the layoffs in the first place, but unemployed persons reduce spending in the economy and do not create production through their employment, resulting in a decline in the economy's output.

Average weekly initial claims for unemployment insurance data is published by the US Department of Labor, a reliable source of labor data in the United States. This series is available on a statewide basis only, with data available from 1990 to the week of August 1, 2015. As a result, this series is reliable, available over a long-term period, and is the most up-to-date series of all other series reviewed.

Figure C-1 below compares Reno MSA GDP to Nevada average initial claims for unemployment insurance data. Reno MSA GDP, available annually between 2001 and 2013 is used to represent changes in the regional economy. Comparison to the GDP data determines both the series' timing and its cyclical variations.

The Figure shows an inverse relationship between initial claims for unemployment and GDP. This is because growth in unemployment indicates a decline in economic growth. The Figure also shows a leading relationship exists between initial claims for unemployment in the State and Reno MSA GDP. Average initial claims for unemployment reached its lowest level in 2005, two years before GDP peaked in 2007. Initial claims peaked in 2009, a year before GDP reached its lowest level. As a result of this relationship, average initial claims for unemployment insurance indicators can be used in the leading index.

Figure C-1. Comparison of Gross Product and Average Initial Claims for Unemployment Insurance Series



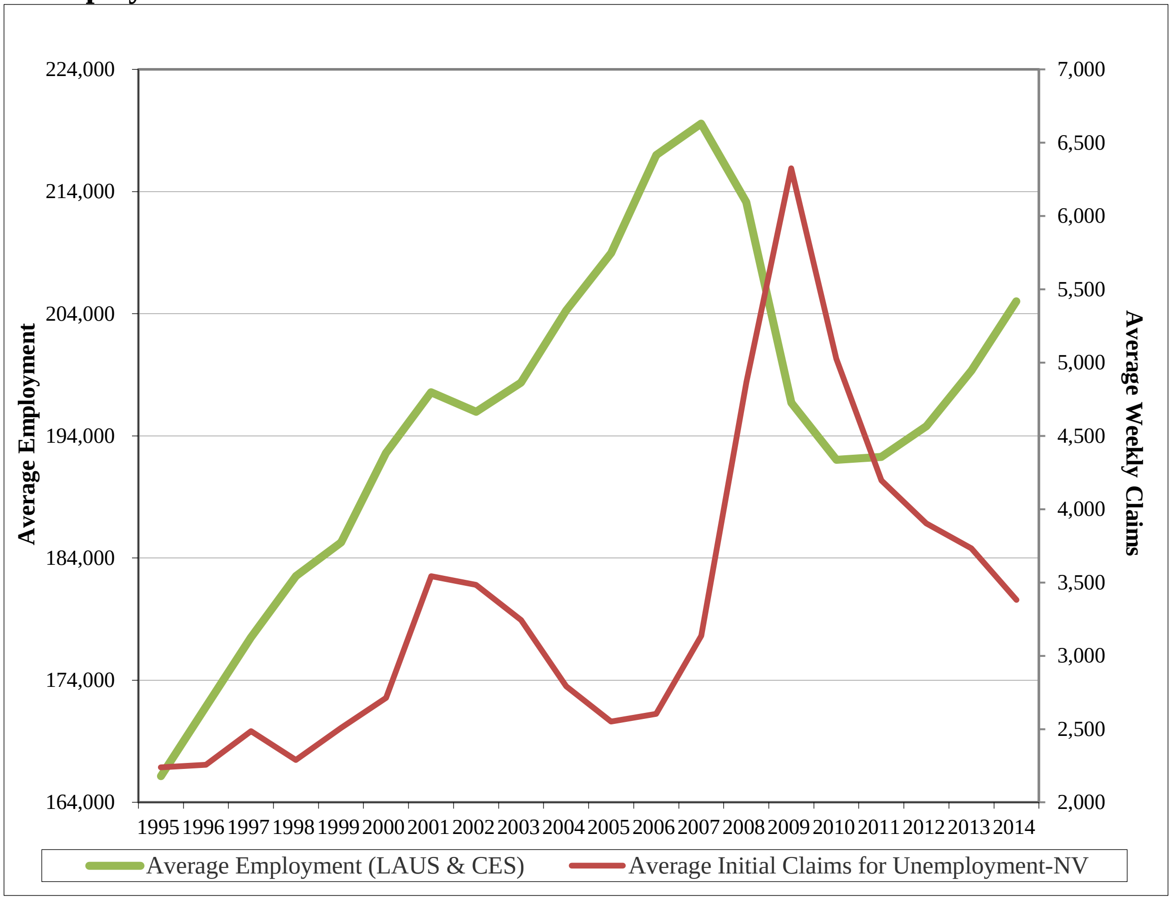
Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Nevada statewide average initial claims for unemployment insurance from "Unemployment Insurance Weekly Claims Data," US Department of Labor. Data is available weekly, 1990-August 1, 2015.

To further show the cyclical relationship between weekly claims for unemployment insurance and the economy, the series is compared to average employment in the area (average of the LAUS and CES series), as employment was shown to be have a close coincident relationship with GDP and is available over a longer historical period. Figure

C-2 shows a comparison between Nevada average initial claims for unemployment and Reno MSA employment between 1994 and 2014.

Figure C-2. Comparison of Average Employment and Average Initial Claims for Unemployment Insurance Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Nevada statewide average initial claims for unemployment insurance from "Unemployment Insurance Weekly Claims Data," US Department of Labor. Data is available weekly, 1990-August 1, 2015.

This figure also shows an inverse leading relationship between average initial claims for unemployment insurance and area employment. The relationship is leading, with increases in initial claims preceding decreases in employment and vice versa.

Finally, above graphs show that the claims for unemployment insurance series is relatively smooth, with no erratic changes, other than those corresponding to changes in the economy. As a result, this indicator can be used in the leading index for the Reno MSA.

US Index of Leading Indicators

The US leading index used by the majority of the sampled local indices is The Conference Board Leading Economic Index (LEI). The index is a leading index for the United States. The use of this index for the Reno MSA leading index makes economic sense as the Reno MSA economy is impacted, in part, by the national economy, and the LEI provides a composite look at the changes in the national economy.

The LEI is created by The Conference Board, based on the methodology pioneered by the National Bureau of Economic Research. The index is cited in numerous academic works and is used as a primary index for forecasting national economic change. The index is published monthly and is based on reliable and trusted national data. Index data is available starting 1959 and through June 2015.

Figure C-3 below compares Reno MSA GDP to the US leading indicator index represented by the LEI. The table shows a combination of a leading and coincident relationship between the two series.

Figure C-3. Comparison of Gross Product and Conference Board Leading Economic Index Series

Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. US Index of Leading Indicators from "The Conference Board Leading Economic Index," The Conference Board 2015. Data is available monthly, 1959-June 2015. Index is not seasonally adjusted as it is based on seasonally adjusted data.

Figure C-4 below compares the LEI index to regional employment, which represents the regional economy. As discussed above, employment data has a close relationship to MSA GDP and is available over a longer historical period. The Figure provides a better understanding of the relationship between LEI and employment, showing a leading relationship, with the LEI changes occurring before changes in employment. The figure also shows that the LEI series does capture cyclical fluctuations in employment. Finally, the LEI series is smooth, with no erratic fluctuations. As a result, this series can also be used in the Reno MSA leading index.

Figure C-4. Comparison of Average Employment and Conference Board Leading Economic Index Series

Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. US Index of Leading Indicators from "The Conference Board Leading Economic Index," The Conference Board 2015. Data is available monthly, 1959-June 2015. Index is not seasonally adjusted as it is based on seasonally adjusted data.

Residential Building Permits and Permit Valuation

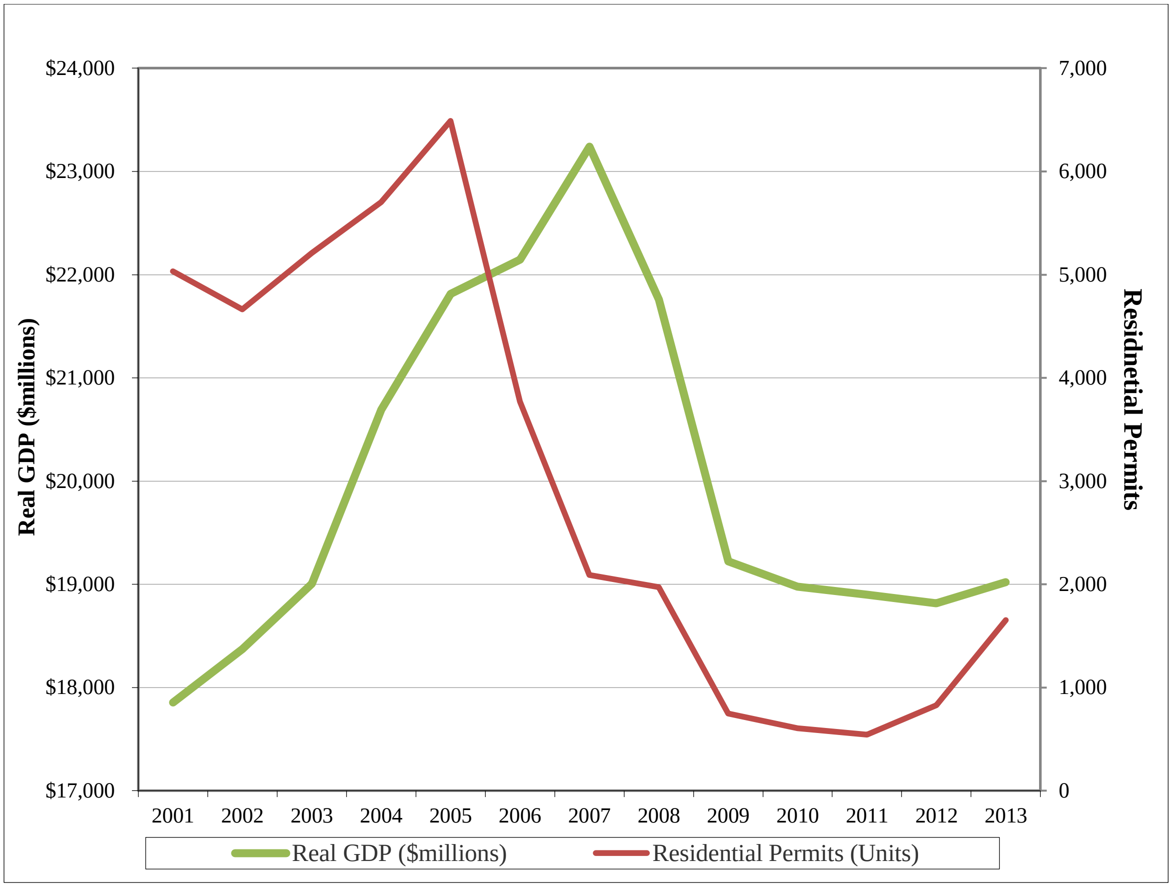
Four of the ten sampled local indices used residential building permit valuation as an indicator and three out of ten used the number of residential permits issued. This makes economic sense in that building permits are obtained prior to building residential structures. An increase in the number of building permits and the value of these permits not only helps the economy in terms of addition construction employment and spending, it indicates an improving economy with investors feeling confident to build and purchase homes.

Building permits issued and value of permits data is collected through Building departments of the City of Reno, City of Sparks, and Washoe County, the three entities operating within Washoe County. A conversation with Storey County representatives revealed that while some of the necessary building permit data is collected by the County, the County does not have the manpower to summarize these data for the index. US Census Bureau also publishes building permit data for the Reno MSA. However, these data are not available over a sufficiently long historical period. As a result, only Washoe County data can be used in the index.

Data collected from the three Washoe County entities is reliable in that it is collected by local governments. However, there are some issues with the data. The data is not always audited and is self-reported by developers during the permitting process. As the permitting process occurs prior to construction, actual building costs may differ from those reported to the public entity.

Figure C-5 below compares Reno MSA GDP to the number of residential building permits issued in Washoe County by all entities. The table shows a leading relationship between the number of issued residential building permits and area GDP.

Figure C-5. Comparison of Gross Product and Residential Building Permits Issued Series

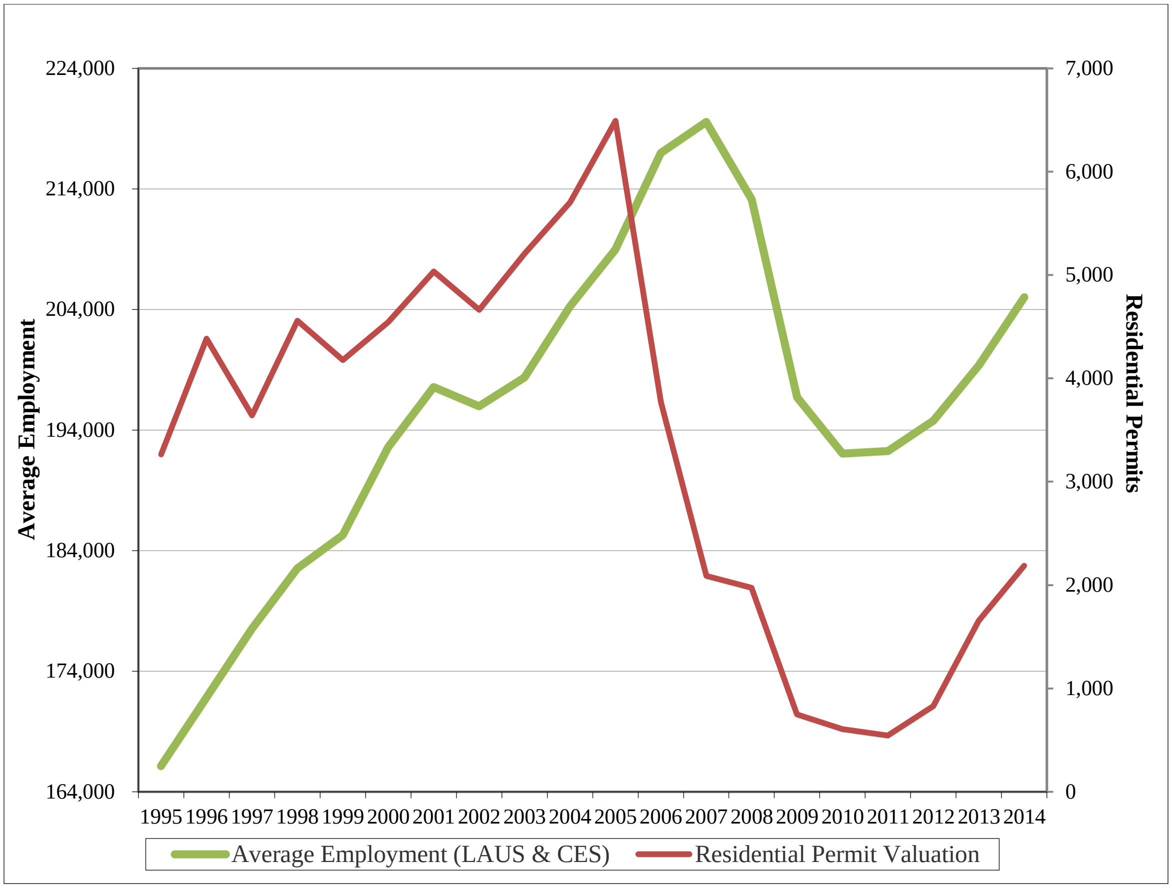


Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Residential building permit issued data includes data for multi- and single-family units from Building Permit websites for the City of Reno, City of Sparks, and Washoe County. Data available 1988 to June 2015.

Figure C-6 below compares issued residential building permits to regional employment, which represents the regional economy. The figure shows that the building permit series does capture cyclical fluctuations in employment. The building permit series has a number of fluctuations, however these occur early in the series and are not large compared to the data. As a result, this series can also be used in the Reno MSA leading index.

Figure C-6. Comparison of Average Employment and Residential Building Permits Issued Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Residential building permit issued data includes data for multi- and single-family units from Building Permit websites for the City of Reno, City of Sparks, and Washoe County. Data available 1988 to June 2015.

As discussed above, residential building permit valuation data is collected from the same sources as the building permit data and is economically relevant and adequate, though not available for a long-term historical period. Figure C-7 below compares Reno MSA GDP to the value of residential building permits issued in the Reno MSA. The Figure shows a leading relationship between the valuation of residential building permits and area GDP.

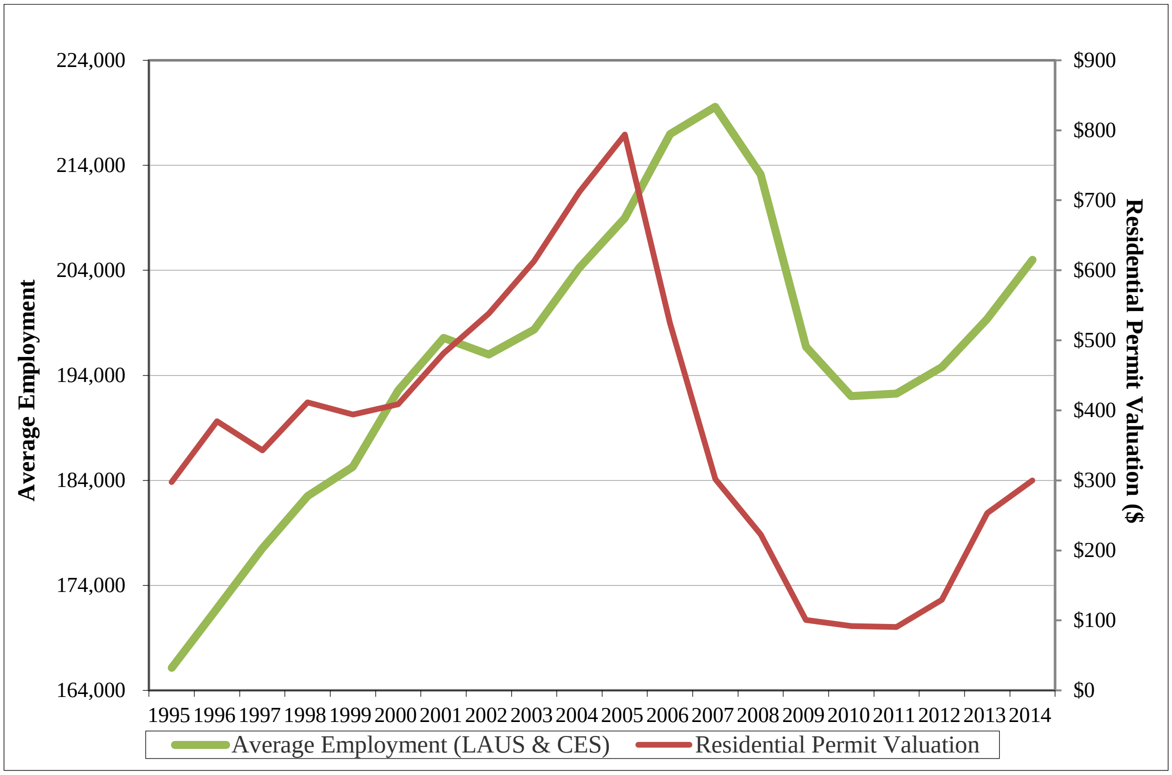
Figure C-7. Comparison of Gross Product and Residential Building Permits Valuation Series

Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Residential building permit valuation data includes data for multi- and single-family units from Building Permit websites for the City of Reno, City of Sparks, and Washoe County. Data available 1988 to June 2015. Data is inflation adjusted.

Figure C-8 below compares the value of residential building permits to regional employment, which represents the regional economy. The figure shows that the building permit series does capture cyclical fluctuations in employment. The building permit series is smooth, with no erratic fluctuations. As a result, this series can also be used in the Reno MSA leading index. However, as the building permit and permit valuation data are very similar and are related, only one of the series, number of building permits issued, was used to simplify the index. This is because the number of building permits issued data can be verified with actual physical construction, whereas value of these permits is more difficult to confirm and is based on developer estimates prior to construction.

Figure C-8. Comparison of Average Employment and Residential Building Permits Valuation Series



Source:
1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Residential building permit valuation data includes data for multi- and single-family units from Building Permit websites for the City of Reno, City of Sparks, and Washoe County. Data available 1988 to June 2015. Data is inflation adjusted.

Airport Passengers (Enplanements and Deplanements)

This series was also used in four out of ten sampled indexes. The series measures the number of passengers boarding and disembarking from airplanes in the Reno Tahoe International Airport. The airport serves both Washoe and Storey counties, as well as other counties in the area, including some areas of California, such as Truckee. This data is economically relevant as it represents the number of recreational and business visitors to the area. An increase in visitors would not only signal an improving overall economy, it will increase regional demand for goods and services, increasing output and employment in the region.

This series is collected and published by the Reno Tahoe Airport Authority based on actual data for the airport. The data is adequate, it is available monthly starting 1994 through June 2015. The methodology for data collection has not been changed and data is seldom revised.

Figure C-9. Comparison of Gross Product and Airport Passengers Series

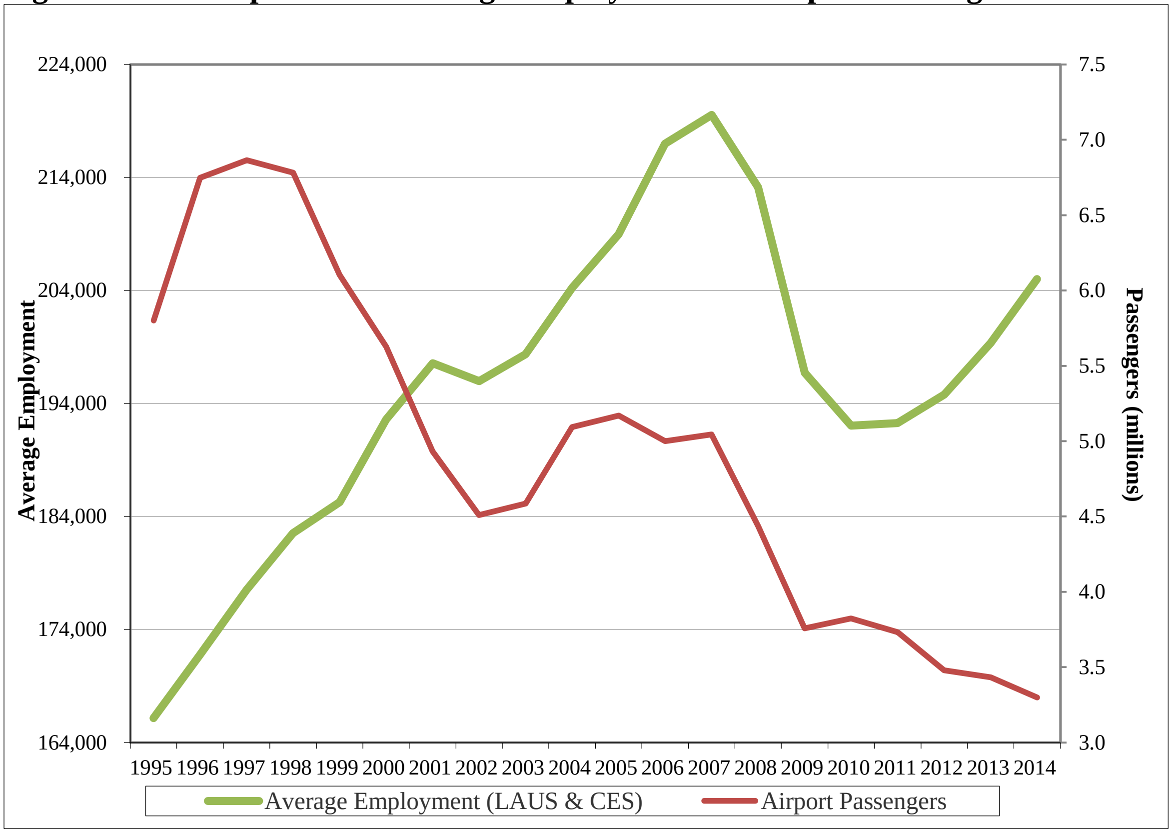
Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Reno-Tahoe International Airport passengers enplaning and deplaning from "Passenger and Cargo Statistics Report." Reno-Tahoe International Airport. Data is available monthly, 1994-June 2015.

Figure C-9 compares Reno MSA GDP to the number of passengers enplaning and deplaning from the Reno Tahoe International Airport. The Figure indicates no clear relationship exists between airport passengers and Reno GDP.

Figure C-10 compares this series to the area employment data. The table also indicates a potential leading relationship between employment and passengers in the area, though it is unclear. However, the series does not seem to provide a good match for cyclical fluctuations in the employment data and is not smooth. As a result, this series should not be used in the index.

Figure C-10. Comparison of Average Employment and Airport Passengers Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Reno-Tahoe International Airport passengers enplaning and deplaning from "Passenger and Cargo Statistics Report." Reno-Tahoe International Airport. Data is available monthly, 1994-June 2015.

In addition to passenger data, the Airport also publishes the number of pounds of cargo shipping through the Reno Tahoe International Airport. This series is also economically relevant and adequate.

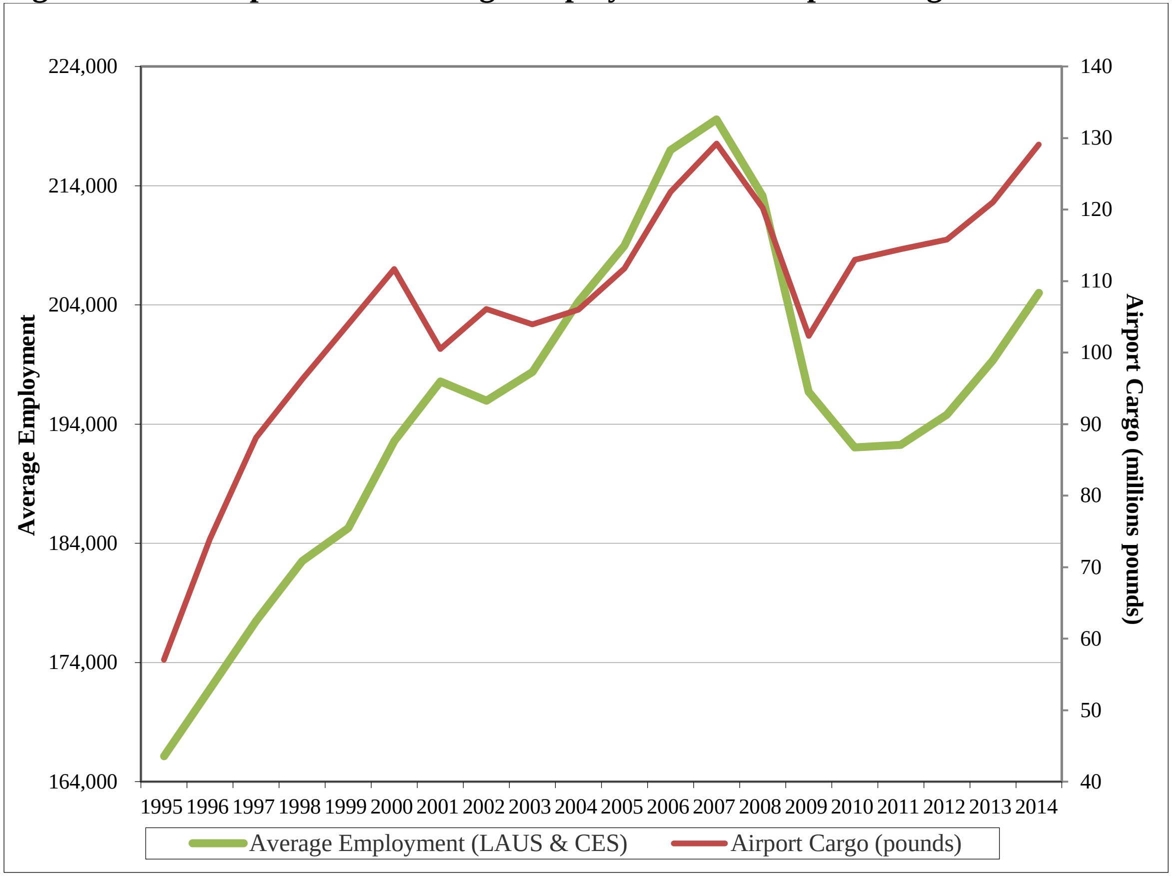
Figure C-11 shows that airplane cargo shipped series has a better relationship to GDP than passengers, though the relationship is not perfect. The relationship between cargo and GDP is a combination of leading and coincident.

Figure C-11. Comparison of Gross Product and Airport Cargo Series

Source:
1. Real metropolitan Gross Product (GDP) data for Reno MSA from “Gross Domestic Product (GDP) by Metropolitan Area,” Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Reno Tahoe International Airport cargo shipped from “Passenger and Cargo Statistics Report.” Reno-Tahoe International Airport. Data is available monthly, 1994-June 2015.

Figure C-12 compares airport cargo to area employment for a clearer picture regarding series timing and cyclical variations. The Figure also shows a combination of a leading and coincident relationship, with some unexplained fluctuations. However, the series may still be a strong indicator of employment in the area. As a result, the series can be used, after additional testing.

Figure C-12. Comparison of Average Employment and Airport Cargo Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Reno Tahoe International Airport cargo shipped from "Passenger and Cargo Statistics Report." Reno-Tahoe International Airport. Data is available monthly, 1994-June 2015.

Help-Wanted Ad Volume

This is another popular series, used in four out of the sampled ten indices. This data can be purchased by State from The Conference Board or is available by region (West, East, etc.) from the Job Openings and Labor Turnover Survey by the Bureau of Labor Statistics starting 2000. The Conference Board data is available monthly, but is only available statewide. As of June 2015, Reno MSA only had 16.1 percent of total employment and labor force in the State (DETR 2015). As a result, using statewide data for help-wanted ads may not provide an accurate representation of Reno MSA economy. Therefore, Help-wanted ad volume series is not used in the Reno MSA leading index.

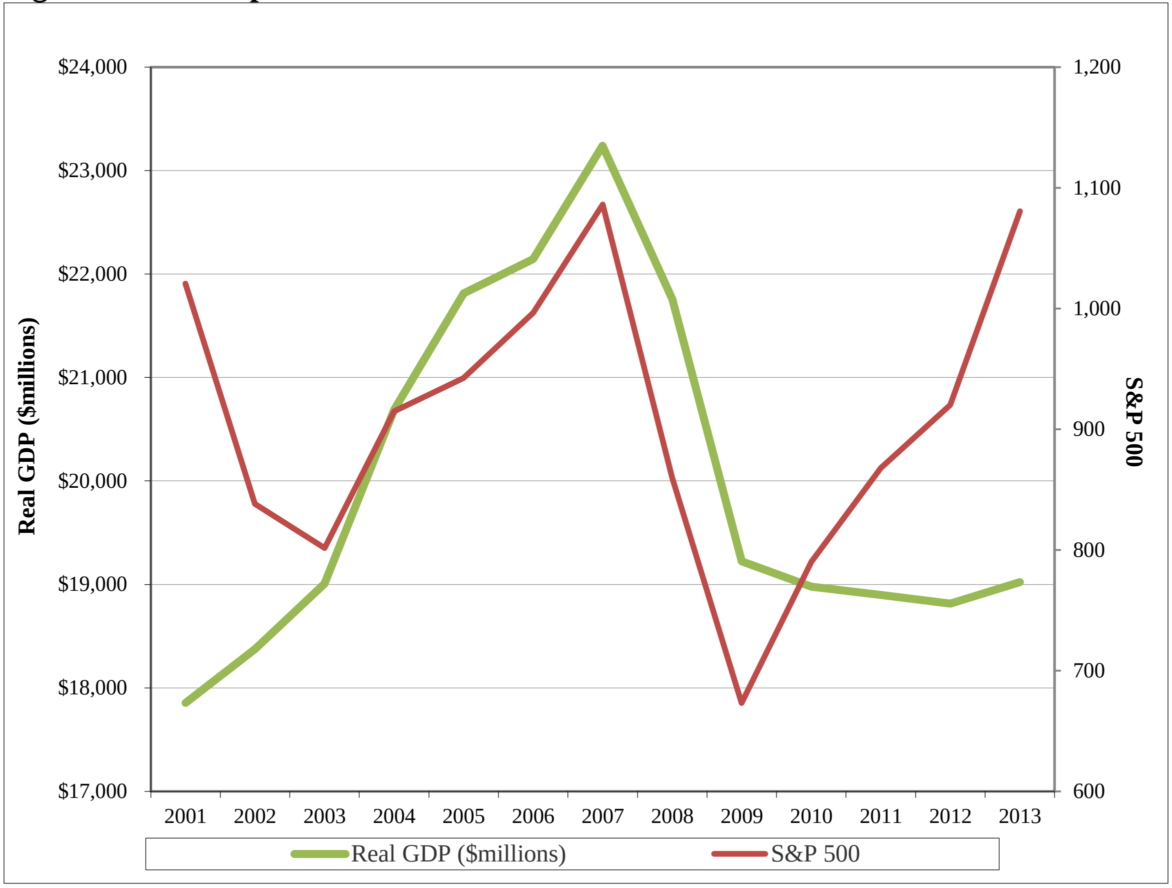
Stock Prices/S&P 500

Two out of the ten sampled indices utilized some type of a national stock price index, typically the S&P 500, to represent changes in the national economy. The index includes 500 leading companies in leading industries of the U.S. economy, which are publicly traded on either the NYSE or NASDAQ, and covers 75 percent of U.S. equities. This makes economic sense as changes in stock prices reflect consumer confidence and performance of the national economy. Local businesses and residents participate in the stock market, so this series directly impacts the local economy. Additionally, the national economy, represented by the series, also impacts the local economy.

This data is collected by the S&P Dow Jones Indices LLC and is available daily, monthly, or weekly starting 1950. Data is available through August 2015. The methodology for collecting data and estimating the index has not changed in the past and no plans for future changes are known. As a result, this series is adequate for use in the index.

Figure C-13 provides a comparison between Reno GDP and the S&P 500 index. The Figure shows both a leading and coincident relationship between the two series.

Figure C-13. Comparison of Gross Product and S&P 500 Index Series

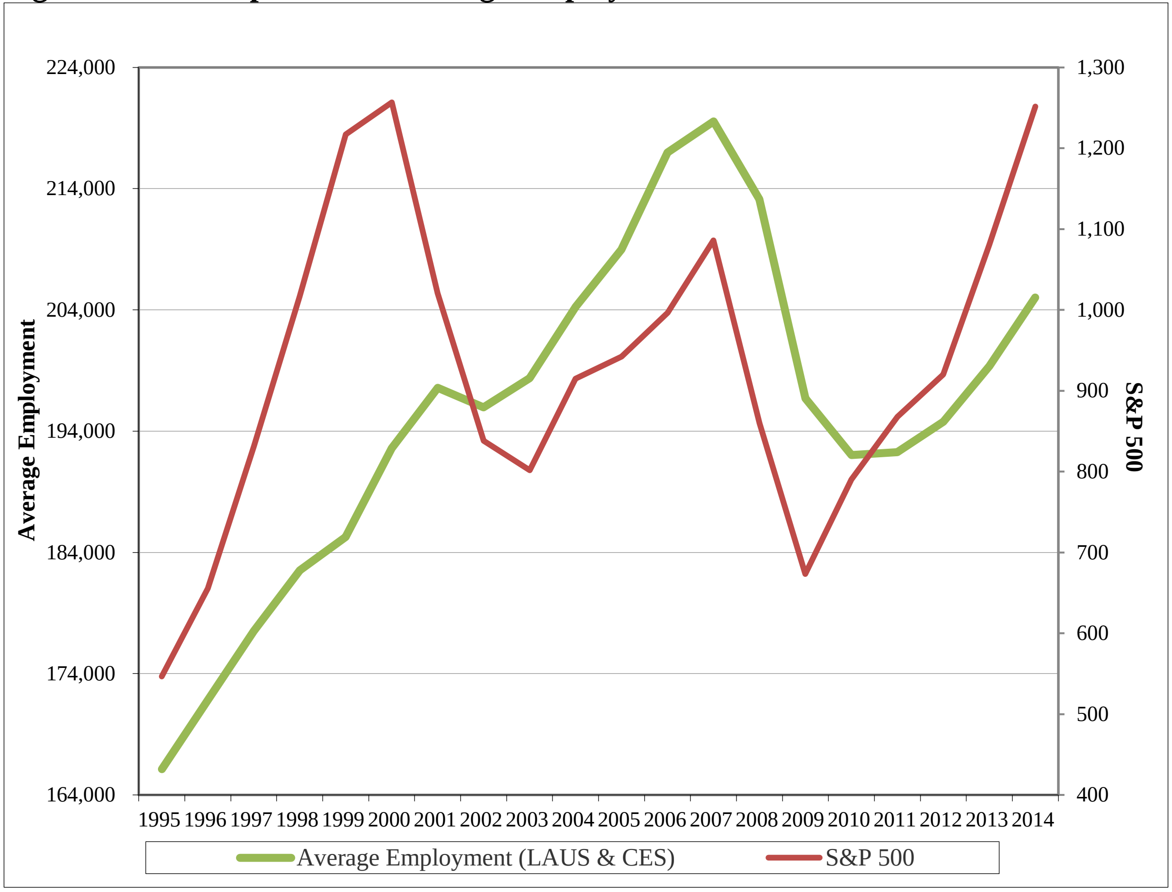


Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. National stock prices as represented by the S&P 500 index from "S&P 500 Historical Prices." Federal Reserve Bank of St. Louis. Data is available monthly, 1950-August 2015. Data is inflation adjusted.

Figure C-14 also shows the series has a mixed leading and coincident relationship to area employment. The series also follows cyclical fluctuations closely. Finally, the data does not show erratic fluctuations, it is smooth with the exception of cyclical flows. As a result, this data is acceptable to use in the index. However, the data shows some coincident relationship to both employment and GDP, rather than a leading relationship during the recession. Additionally, a national component, represented by the US leading index was used to represent changes in the national economy. Further testing is required to determine whether this series should be included.

Figure C-14. Comparison of Average Employment and S&P 500 Index Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. National stock prices as represented by the S&P 500 index from "S&P 500 Historical Prices." Federal Reserve Bank of St. Louis. Data is available monthly, 1950-August 2015. Data is inflation adjusted.

Interest Rate Spread

Interest rate spreads are used by two out of the ten sampled local indices and 5 of the 11 national/state indices. According to the World Bank "Interest rate spread is the interest rate charged by banks on loans to private sector customers minus the interest rate paid by commercial or similar banks for demand, time, or savings deposits" (TWB 2015). The exact types of spreads used differ by index. The Conference Board Leading index uses the interest rate spread for 10-year Treasury bonds less federal funds rate (The

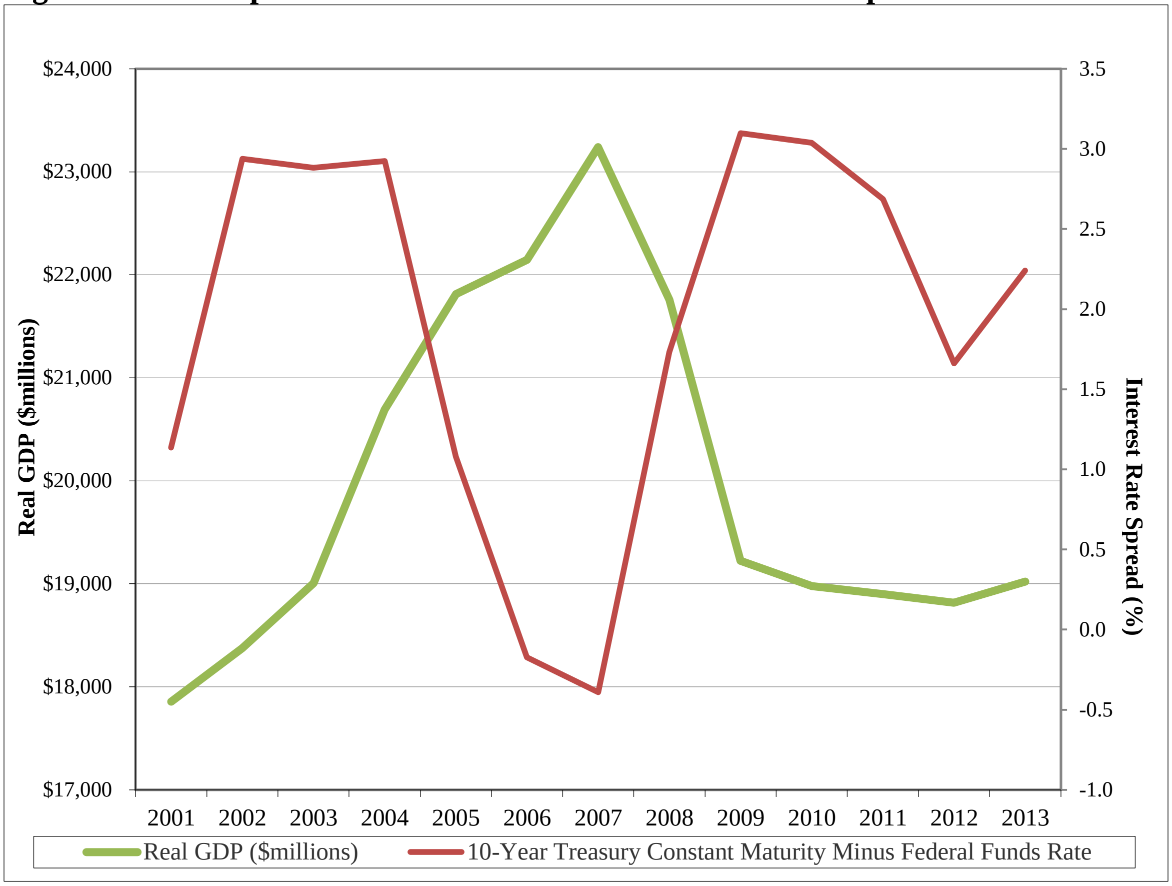
Conference Board 2015). The Federal Reserve Bank index uses the interest rate spread between the 10-year Treasury bond and the 3-month Treasury bill. The index for the Massachusetts economy uses the spread between the 10-year Treasury Bond and 90-day Treasury Bill yields (Clayton-Matthews 1999). To be consistent with The Conference Board methodology, the interest rate spread for 10-year Treasury bonds less federal funds rate is reviewed in this paper.

It is economically appropriate to assume that interest rates for borrowing and saving funds have a relationship with the national and local economies. Economic growth is expected to increase if interest rates are lower and businesses can borrow money at a lower cost. This would relate to a local economy, where rates charged for borrowing and saving at the local level are determined nationally.

The interest spread rate data is collected and published by the Economic Research division of the Federal Reserva Bank of St. Louis. Data is avilable daily starting in 1962 through August 2015. The data is reliable and the methodology is not frequently revised or update. This makes this series adequate for use in the Reno MSA leading index.

Figure C-15 provides a comparison between Reno GDP and the interest rate spread series. The Figure shows an inverse relationship between GDP and interest rate spread. This makes sense as an economy's output (GDP) is likely to increase as interest rates, which represent the cost of businesses and persons to borrow money, decrease. The type of a relationship between the two series is not perfect, but the relationship is more of a coincident, than a leading one.

Figure C-15. Comparison of Gross Product and Interest Rate Spread Series

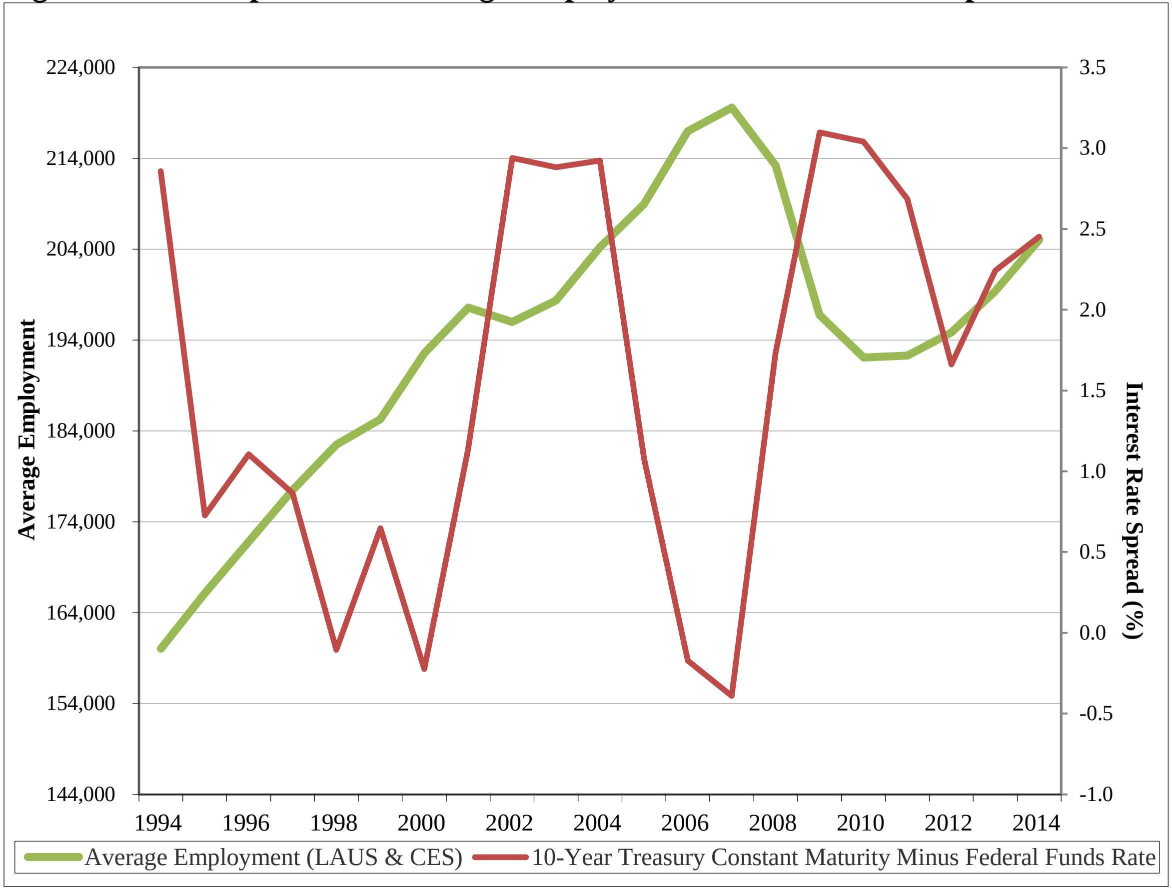


Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. National interest rate spread from "10-Year Treasury Constant Maturity Minus Federal Funds Rate." Federal Reserve Bank of St. Louis. Data is available daily, 1962-August 2015.

Figure C-16 also shows the series has a coincident relationship to area employment. The series follows cyclical fluctuations somewhat closely, with some unusual fluctuations in the later 1990s and early 2000s. This not only makes the data imperfect in terms of capturing cyclical fluctuations, it makes the series insufficiently smooth. As a result, due to the series' coincident relationship with local economic indicators and fluctuations, this series should not be used in the Reno MSA leading index. Additionally, the US leading index, created by The Conference Board, includes interest rate spread series in the index.

Figure C-16. Comparison of Average Employment and Interest Rate Spread Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. National interest rate spread from "10-Year Treasury Constant Maturity Minus Federal Funds Rate." Federal Reserve Bank of St. Louis. Data is available daily, 1962-August 2015.

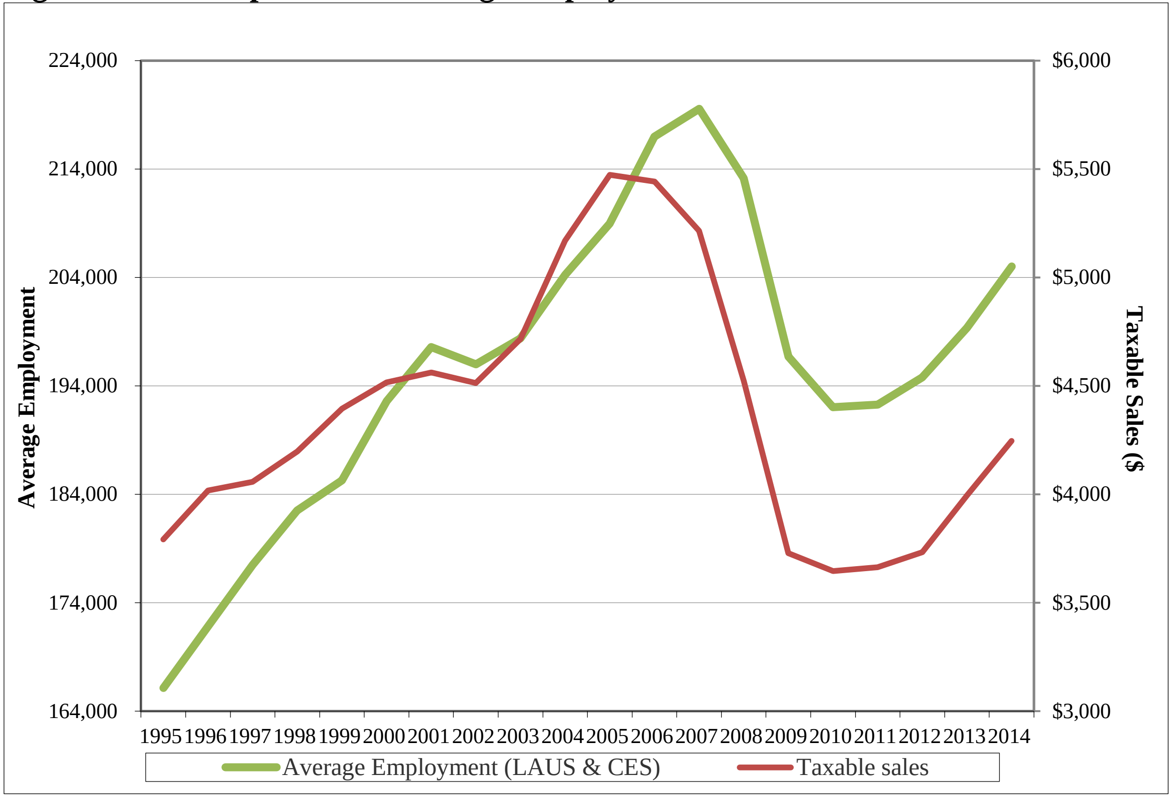
Taxable Sales

Taxable sales or retail sales data was used by two out of the ten sampled local indices. As discussed above, taxable sales were analyzed for the inclusion in the coincident index, but due to their partial leading properties and lagged release date, it was decided not to use this series as a coincident indicator. Its use as a leading indicator by a number of local indices also suggests it should be used as a leading, rather than a coincident indicator. This makes economic sense in that increases in purchases within the local economy increases demand for goods and services within the economy and results in higher output levels of GDP.

Taxable sales data are collected in the State of Nevada Department of Taxation as outlined in Nevada Revised Statutes (NRS) 372. With the exception in changes to sales tax rates, the methodology for estimating taxable sales was last changed in 1979. Taxable sales amounts are published monthly, by county in which they are collected. Data are available starting 1994 through May 2015 (June 2015 data was released by the end of August 2015). The majority of the other data reviewed in this paper are available through at least June 2015 (as of beginning of August 2015). The lag of approximately two weeks behind other series will delay the update of the index by a few weeks, but is not a substantial issue.

Figure C-17 provides a comparison between area employment and taxable sales series. The Figure shows a combination of a coincident and leading relationship between taxable sales and employment. The series captures cyclical fluctuations as shown by the employment series. The annualized data is smooth, with no erratic fluctuations. As a result, the taxable sales series can be included in the Reno MSA leading index, but should be tested for significance.

Figure C-17. Comparison of Average Employment and Taxable Sales Series



Source:

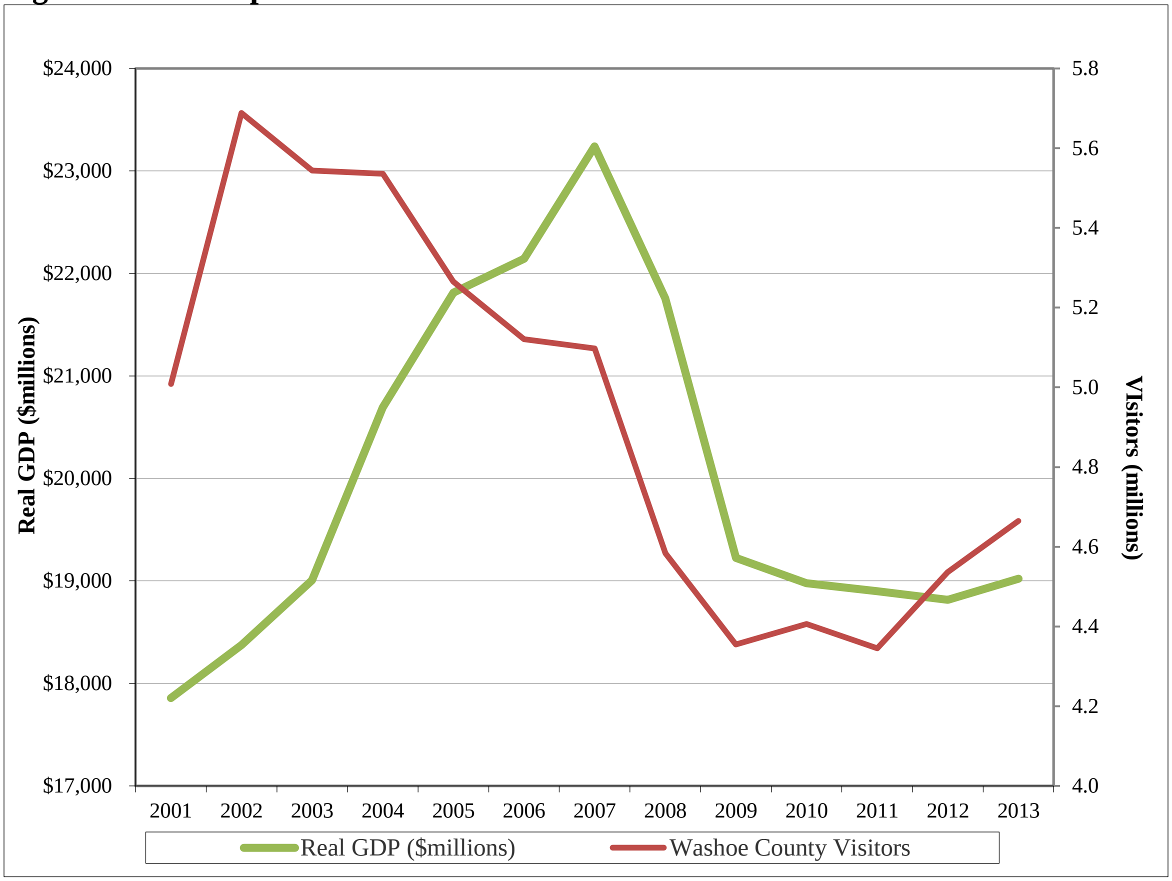
1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Washoe County taxable sales data from "Monthly Taxable Sales Statistics," State of Nevada Department of Taxation. Data is available monthly, 1994-June 2015. Data are inflation and seasonally adjusted.

Visitor Volume

Visitor volume series was used by two of the ten sampled local indices. Visitors are an important component of Reno MSA economy given Washoe County's Accommodation and Food Services industry's LQ score of 1.64. An increase in the number of visitors to the area indicates an increase in the disposable income of these visitors and an increase in economic activity in the Reno MSA resulting from visitor spending. Both cause growth in the regional economy.

Monthly visitor data is available for Washoe County only. No consistent, monthly data collection is available for Storey County. For Washoe County, these data are collected by the Reno Sparks Convention and Visitor Authority (RSCVA). While adequate and reliable, visitor data is available for the county only starting in 1997, which may be insufficiently long enough for a historical comparison.

Figure C-18. Comparison of Gross Product and Visitor Series

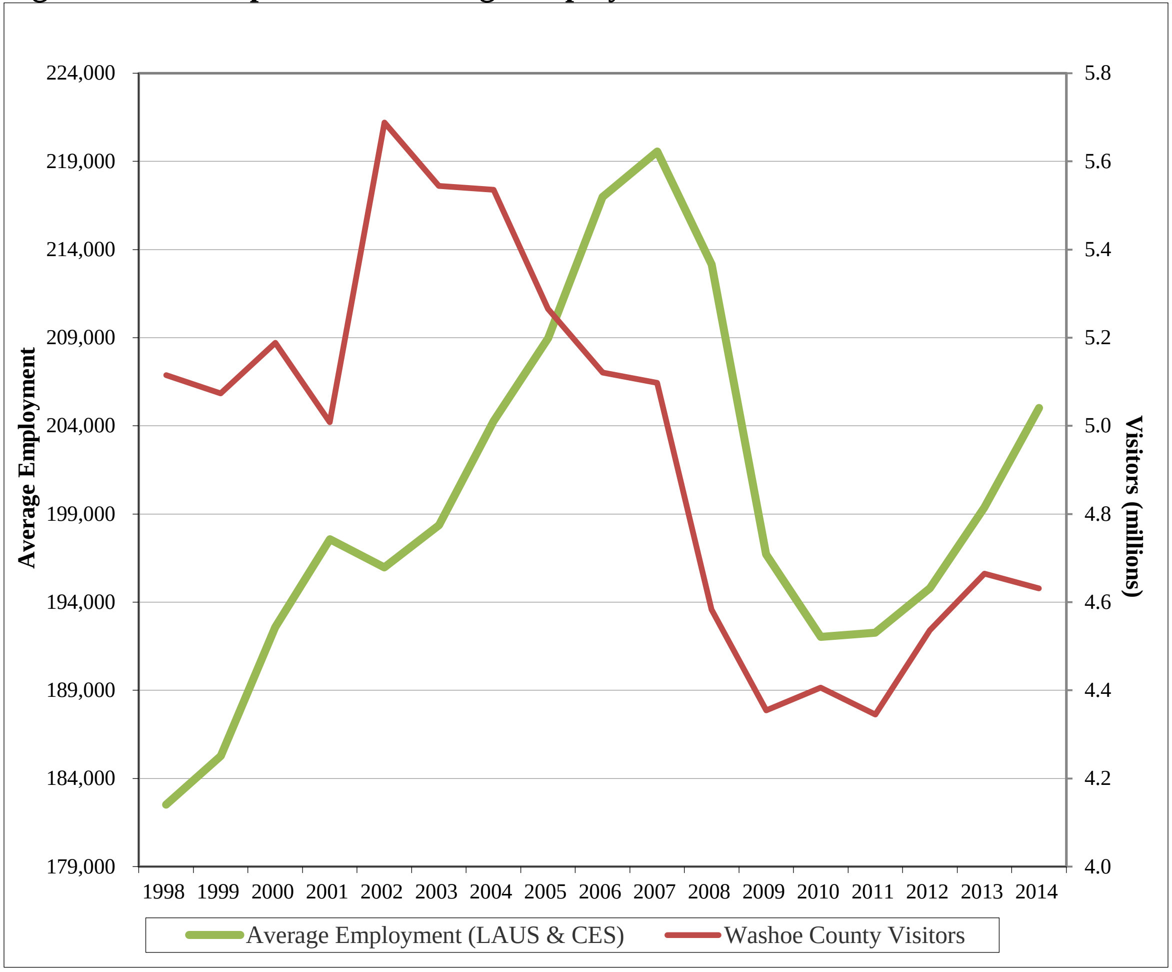


Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Washoe County visitors data from "Estimated Visitor Counts to Reno-Sparks and Washoe County Area, Calendar Year – Trend." Reno-Sparks Convention and Visitors Authority (RSCVA). Data is available monthly between October 1996 and June 2015.

Figure C-18 provides a comparison between Reno GDP and the visitor series. The Figure shows an unclear relationship between the series.

Figure C-19. Comparison of Average Employment and Visitor Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Washoe County visitors data from "Estimated Visitor Counts to Reno-Sparks and Washoe County Area, Calendar Year – Trend." Reno-Sparks Convention and Visitors Authority (RSCVA). Data is available monthly between October 1996 and June 2015.

Figure C-19 also shows the series has an unclear relationship to area employment. The series follows some cyclical fluctuations, but has a number of erratic fluctuations that do not correspond to employment data. This not only makes the data imperfect in terms of capturing cyclical fluctuations, it makes the series insufficiently smooth. As a result, due to the series' coincident relationship with local economic indicators, lack of historical data, and fluctuations, this series should not be used in the Reno MSA leading index.

Trade Weighted Nominal Exchange Rate

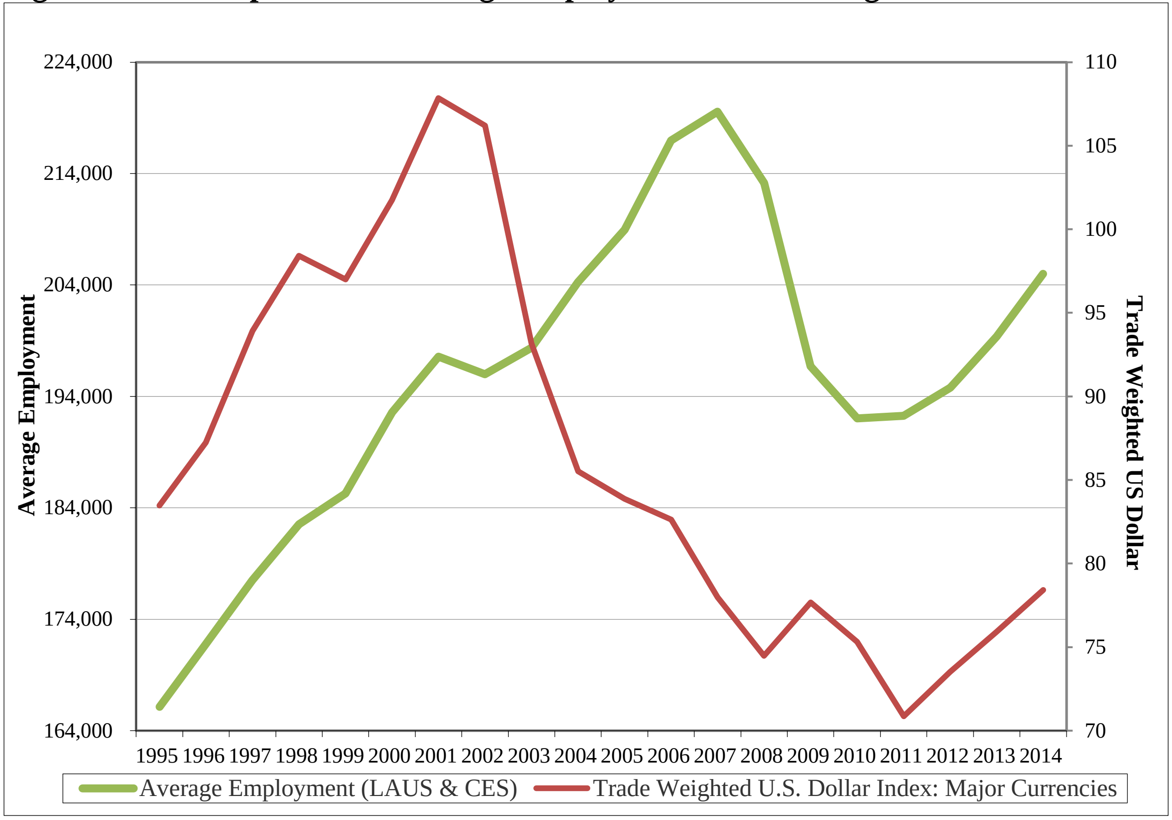
Two of the ten sampled indices used a series for trade weighted nominal exchange rate between US dollar and UK, West Germany, France, Italy, and Japan. The inclusion of this series makes sense for regions with major international exports and imports. Having a lower exchange rate than its trade partners would make US goods cheaper, increasing demand for US exports and creating more domestic production and aiding in the growth of the economy. This would apply to any region with high exports outside of the US. Trade weighted nominal exchange rate data is readily available as an index of all major currencies. It is collected and published by the Economic Research division of the Federal Reserve Bank of St. Louis. Data is available daily starting in 1973 through August 2015. The methodology for the collection of this data is not often revised and data is highly reliable. As a result, the series is adequate for the use in the leading index. Figure C-20 provides a comparison between Reno GDP and the exchange rate series. The Figure shows an inverse relationship between GDP and the exchange rate data. This makes sense as an economy's output (GDP) is likely to increase as the exchange rate falls compared to other currencies, since this increases exports and demand for national services. The series shows a mostly unclear relationship with some lagging with the drop in the series in 2008.

Figure C-20. Comparison of Gross Product and Exchange Rate Series

Source:
1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. US trade weighted nominal exchange rate series from "Trade Weighted U.S. Dollar Index: Major Currencies." Federal Reserve Bank of St. Louis. Data is available daily, 1973-August 2015.

Figure C-21 compares average employment and exchange rate series. The Figure does not show a clear relationship between the two series. Due to the inverse relationship between the series and fluctuations in the exchange rate series, it is difficult to determine whether changes in the series are leading or lagging the employment series. Also, starting 2011 the two series are showing a direct relationship, which is counterintuitive. As a result, due to the unclear relationship between the two series and erratic fluctuations, this series should not be used in the Reno MSA leading index.

Figure C-21. Comparison of Average Employment and Exchange Rate Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. US trade weighted nominal exchange rate series from "Trade Weighted U.S. Dollar Index: Major Currencies." Federal Reserve Bank of St. Louis. Data is available daily, 1973-August 2015.

Money Supply

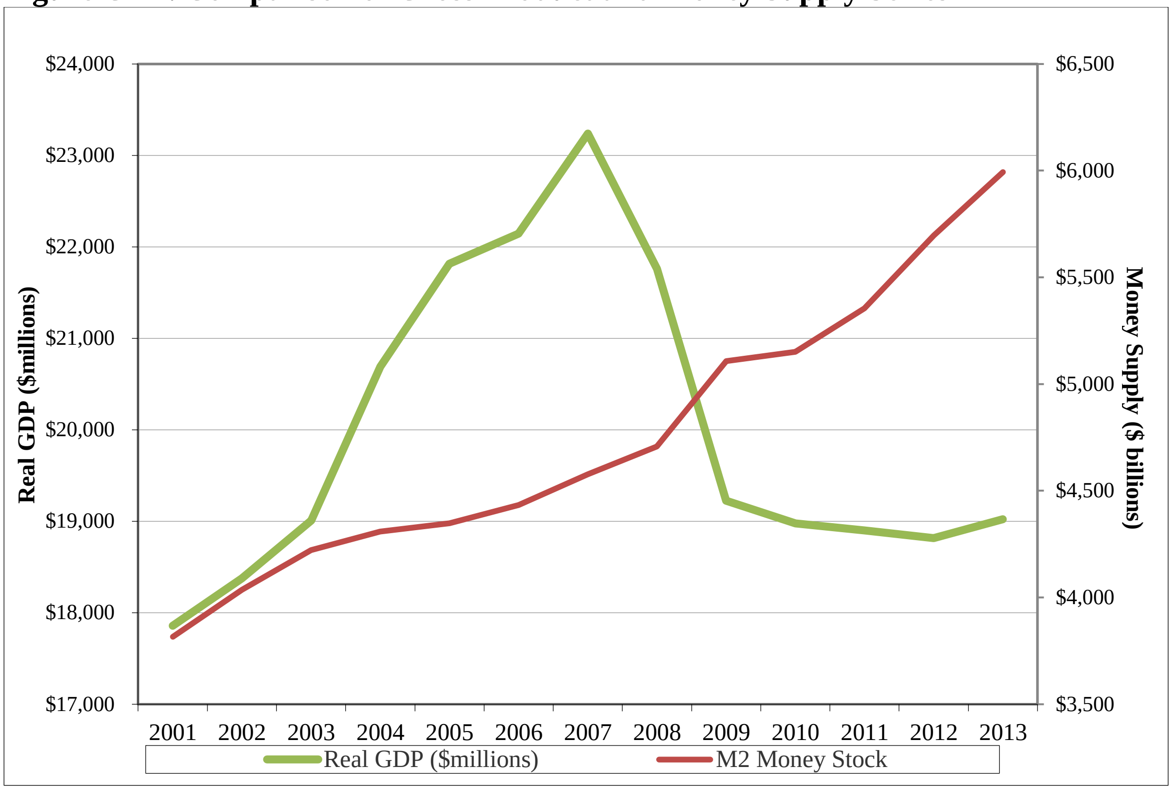
This series is also included in two of the ten sampled indices. Increases in the money supply, typically measured by M2 money stock,[28] put more money into the economy,

[28] M1 consists of (1) currency outside the U.S. Treasury, Federal Reserve Banks, and the vaults of depository institutions; (2) traveler's checks of nonbank issuers; (3) demand deposits at commercial banks (excluding those amounts held by depository institutions, the U.S. government, and foreign banks and official institutions) less cash items in the process of collection and Federal Reserve float; and (4) other checkable deposits (OCDs), consisting of negotiable order of withdrawal (NOW) and automatic transfer service (ATS) accounts at depository institutions, credit union share draft accounts, and demand deposits at thrift institutions. Seasonally adjusted M1 is constructed by summing currency, traveler's checks, demand deposits, and OCDs, each seasonally adjusted separately. M2 consists of M1 plus (1) savings deposits (including money market deposit accounts); (2) small-denomination time deposits (time deposits in amounts of less than $100,000), less individual retirement account (IRA) and Keogh balances at depository institutions; and (3) balances in retail money market mutual funds, less IRA and Keogh balances at money market mutual funds. Seasonally adjusted M2 is constructed by summing savings deposits, small-denomination time deposits,

increasing spending and investment in the economy, leading to a growth in the national and regional economies. As a result, this series is economically relevant to a regional leading index.

Money supply (M2) data is readily available and is collected and published by the Economic Research division of the Federal Reserve Bank of St. Louis. Data is available daily starting in 1980 through August 2015. The methodology for the collection of this data is not often revised and data is highly reliable. As a result, the series is adequate for the use in the leading index.

Figure C-22. Comparison of Gross Product and Money Supply Series



Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Money Supply M2 series from "M2 Money Stock." Federal Reserve Bank of St. Louis. Data is available daily, 1980-August 2015. Data is inflation adjusted.

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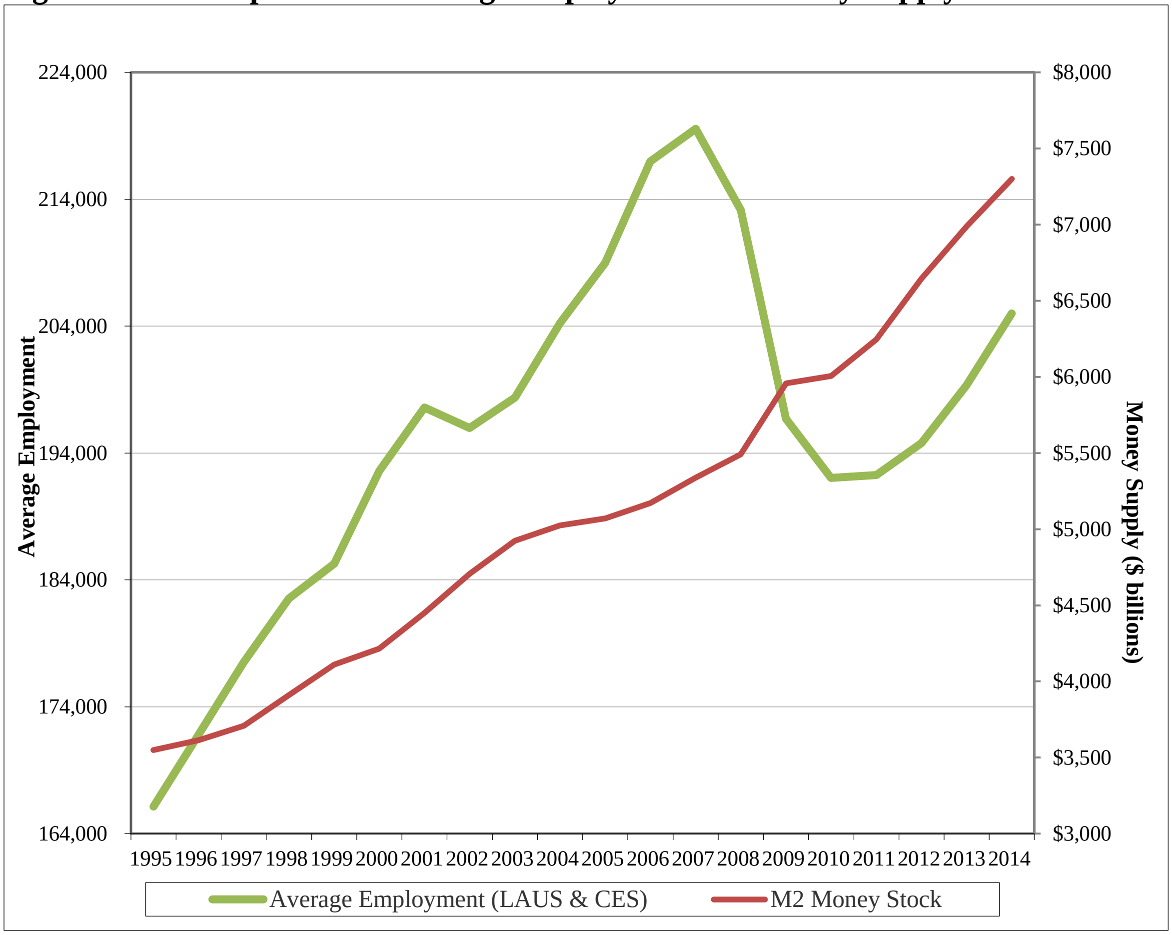
and retail money funds, each seasonally adjusted separately, and adding this result to seasonally adjusted M1. Source: "Money Stock Measures - H.6." Board of Governors of the Federal Reserve System. August 13, 2015.

Figure C-22 provides a comparison between Reno GDP and the money supply series. The Figure shows a potential lagging relationship between regional GDP and money supply, with a small peak in the money supply in 2009, but overall the series increased consistently between 2001 and 2013, with little fluctuations.

Figure C-23. Comparison of Average Employment and Money Supply Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Money Supply M2 series from "M2 Money Stock." Federal Reserve Bank of St. Louis. Data is available daily, 1980-August 2015. Data is inflation adjusted.

Figure C-23 shows the comparison between average employment and money supply. The Figure shows a small flattening in the money supply in 2009 and 2010, but the money supply series does not correspond well to cyclical fluctuations shown by the area employment series. As a result, money supply series should not be used in the Reno MSA leading index.

Total Employment

Total employment series is used in two of the ten sampled local indices. However, as discussed above, Reno MSA employment series have a strong coincident relationship with Reno MSA GDP and was used in the coincident index for the area.

In addition to the above commonly-used series, a number of series were used in the Southern Nevada and Las Vegas indices. As these indices are located in the same state as the proposed Reno MSA index, series used by these indices may be useful for the Reno MSA index. Series used by these indices, with the exception of those already discussed above, include: commercial building permits and commercial permit valuation (SNILI), sales of gasoline (SNILI), gross gaming revenue (SNILI), conventions held attendance (SNILI), Arizona and California leading indices (Las Vegas), and hotel/motel occupancy rate (Las Vegas).

Commercial Building Permits and Permit Valuation

Southern Nevada Index of Leading Indicators (SNILI) used both the number of commercial building permits issued and the value of these permits in its leading index. This makes economic sense in that building permits are obtained prior to building commercial structures. An increase in the number of building permits and the value of these permits not only helps the economy in terms of addition construction employment and spending, it indicates an improving economy with investors feeling confident to build and purchase or lease commercial space.

Building permits issued and value of permits data is collected through Building departments of the City of Reno, City of Sparks, and Washoe County, the three entities operating within Washoe County. A conversation with Storey County representatives revealed that while some of the necessary building permit data is collected by the County, the County does not have the manpower to summarize these data for the index. US Census Bureau also publishes residential building permit data for the Reno MSA; however, no commercial data is available. As a result, only Washoe County data is used in the index.

Data collected by Washoe County entities is reliable in that it is collected by local governments. However, there are some issues with the data. The data is not always audited and is self-reported by developers during the permitting process. As the permitting process occurs prior to construction, actual building costs may differ from those reported to the public entity.

Figure C-24 compares Reno MSA GDP to the number of commercial building permits issued in the Reno MSA. The table shows a leading relationship between the number of issued commercial building permits and area GDP.

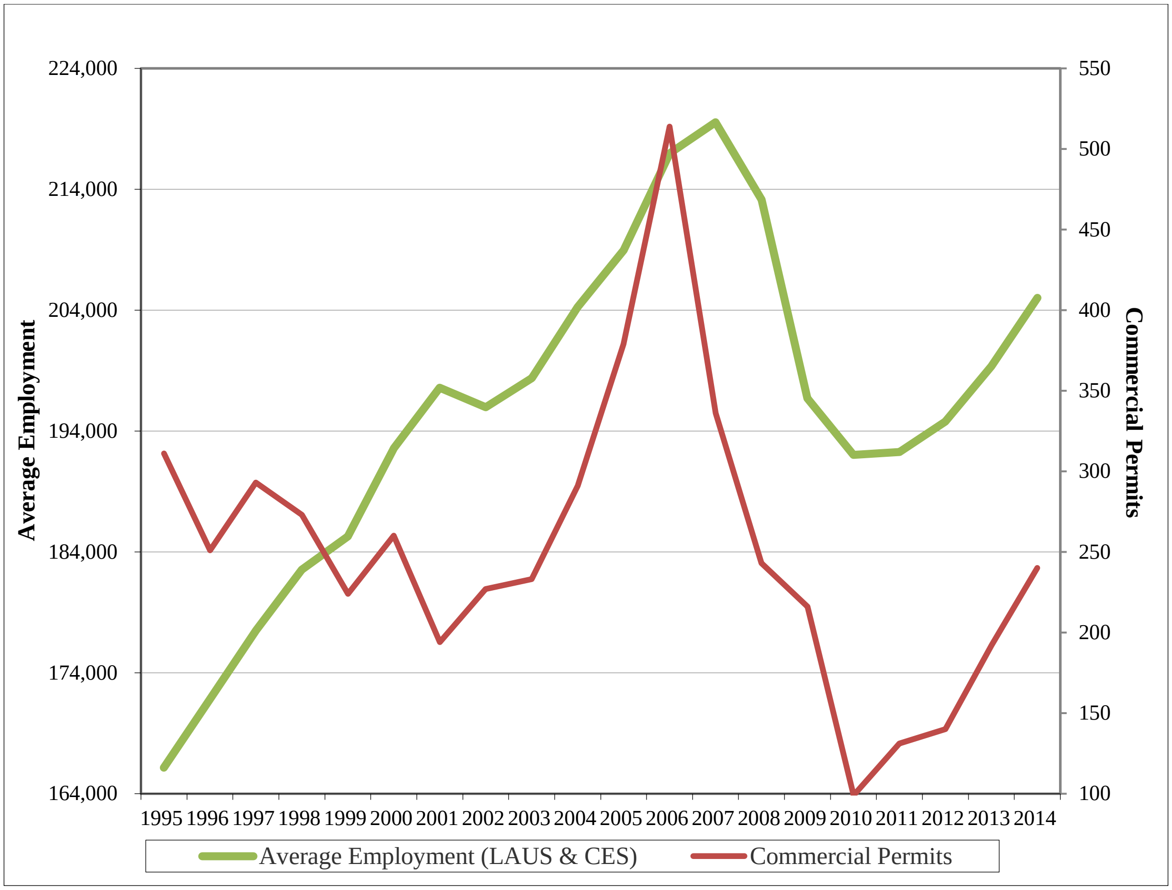
Figure C-24. Comparison of Gross Product and Commercial Building Permits Issued Series

Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Commercial building permit issued data from Building Permit websites for the City of Reno, City of Sparks, and Washoe County. Data available 1988 to June 2015.

Figure C-25 below compares issued commercial building permits to regional employment, which represents the regional economy. The figure shows that the building permit series does capture cyclical fluctuations in employment. However, the building permit series is not smooth; it includes a number of erratic fluctuations, especially prior to the recession. As a result, this series should not be used in the Reno MSA leading index.

Figure C-25. Comparison of Average Employment and Commercial Building Permits Issued Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Commercial building permit issued data from Building Permit websites for the City of Reno, City of Sparks, and Washoe County. Data available 1988 to June 2015.

As discussed above, commercial building permit valuation data is collected from the same sources as the building permit data and is economically relevant and adequate. Figure C-26 below compares Reno MSA GDP to the value of commercial building permits issued in Washoe County by the three entities. The Figure shows a somewhat leading relationship between GDP and commercial building permit valuation. However, this relationship is difficult to determine due to fluctuations in building permit valuation data.

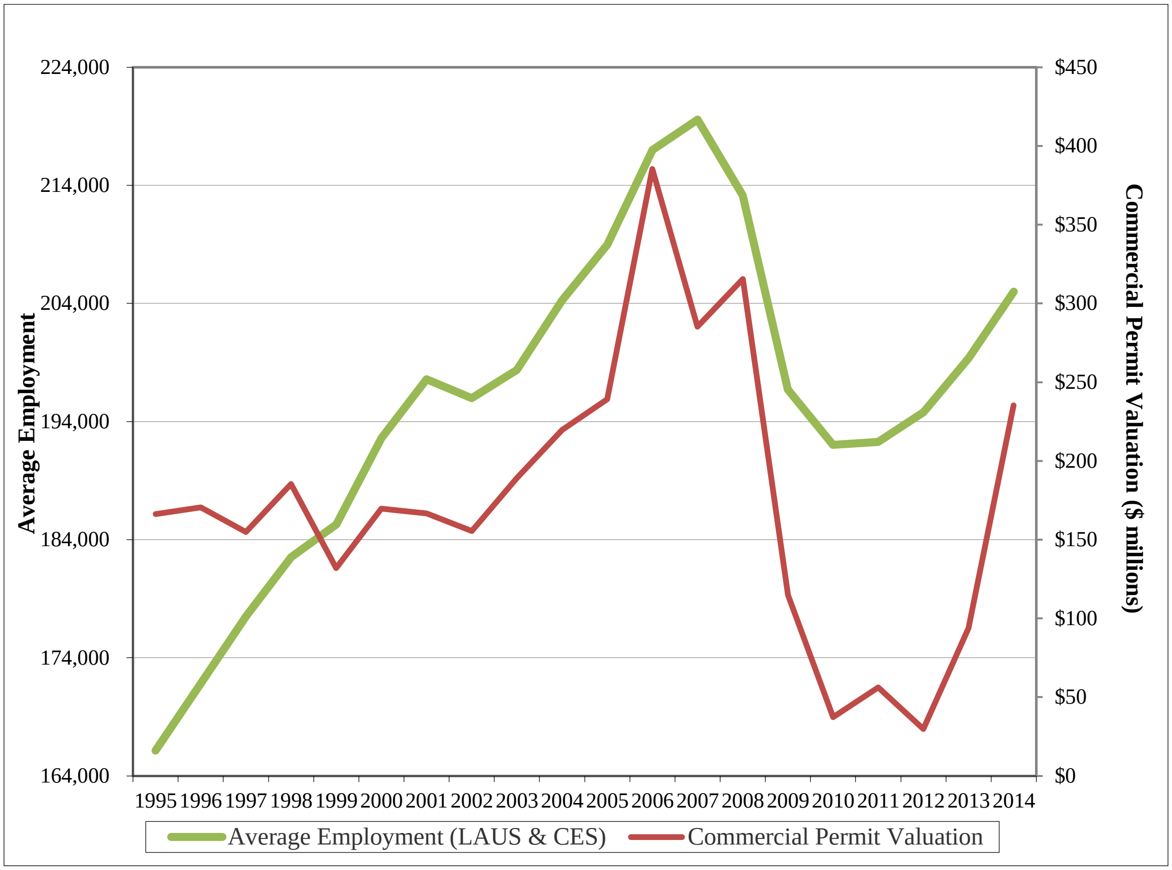
Figure C-26. Comparison of Gross Product and Commercial Building Permits Valuation Series

Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Commercial building permits valuation data from Building Permit websites for the City of Reno, City of Sparks, and Washoe County. Data available 1988 to June 2015. Data are adjusted for inflation.

Figure C-27 below compares the value of commercial building permits to regional employment, which represents the regional economy. The figure shows that the building permit series does capture cyclical fluctuations in employment. However, the building permit series is not smooth; it includes a number of erratic fluctuations. This is likely due to the fact that valuation for building permit purposes is estimated by developers prior to construction and may not reflect actual construction costs. As a result, this series should not be used in the Reno MSA leading index.

Figure C-27. Comparison of Average Employment and Commercial Building Permits Valuation Series



Source:

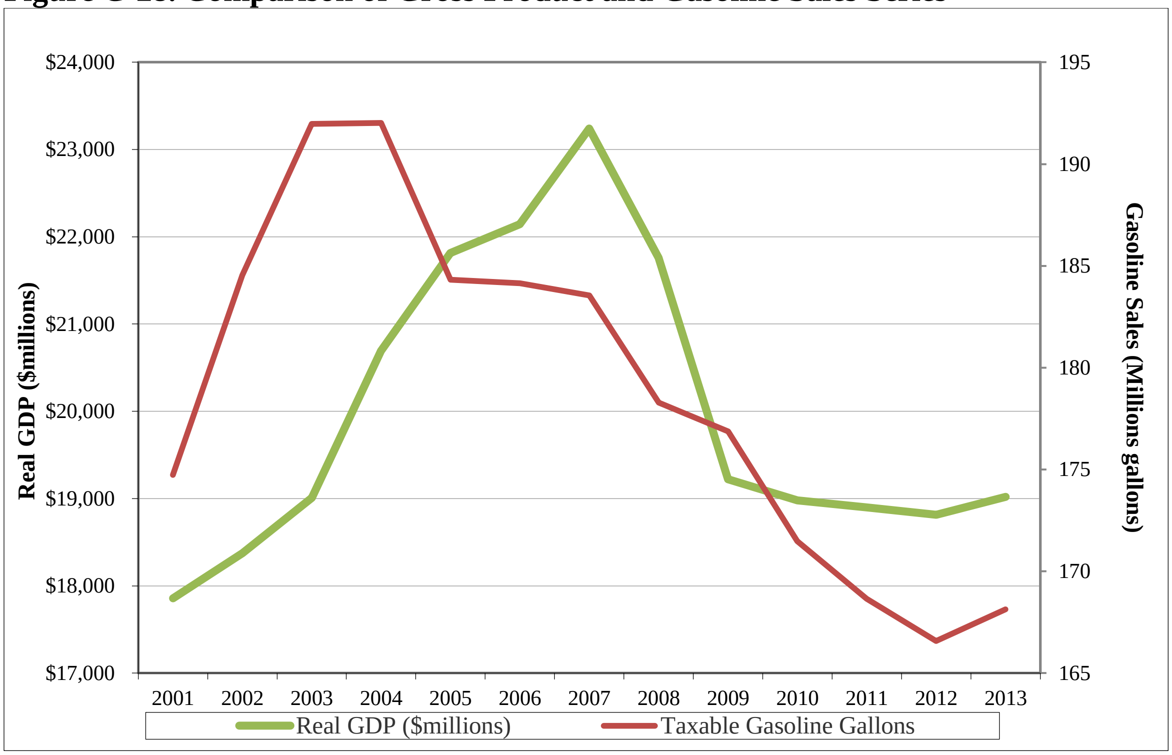
1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Commercial building permits valuation data from Building Permit websites for the City of Reno, City of Sparks, and Washoe County. Data available 1988 to June 2015. Data are adjusted for inflation.

Gasoline Sales

SNILI also includes a series for gasoline sales. This series is also economically relevant as increased residential and commercial activity, which increases driving and demand for gasoline in the region helps drive economic growth and is a good indicator or changes in the economy.

Data for gasoline sales is available by county from the Nevada Department of Motor Vehicles. Data for Washoe and Storey counties (Reno MSA) is available and was used for the gasoline sales series. Data is available monthly, starting June 1977 through June 2015. Department of Motor Vehicles collects data on the number of gasoline gallons sold in each county for taxation purposes. Looking at the number of gallons sold instead of tax revenues allows the series to exclude any fluctuations associated with tax rate changes over time. As a result, this data is reliable, consistent and adequate for the series.

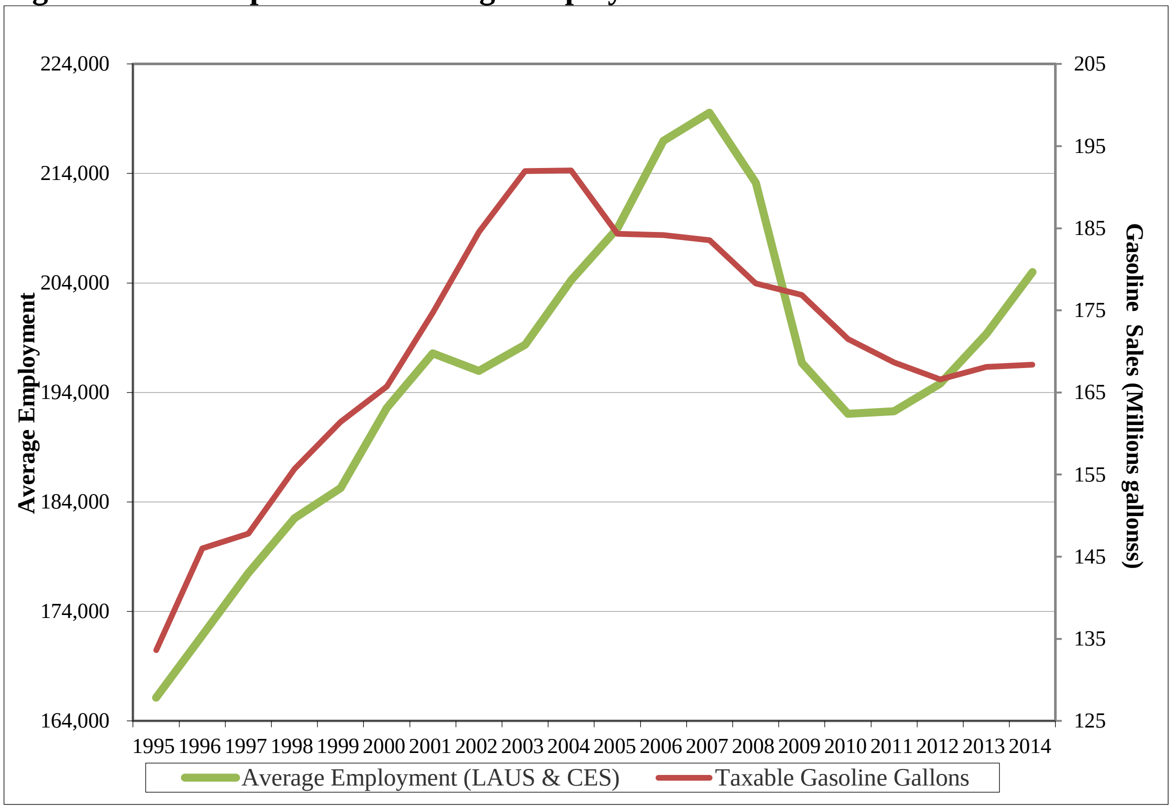
Figure C-28. Comparison of Gross Product and Gasoline Sales Series



Source:
1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Washoe and Storey County gasoline sales data from "Statistical 3A-Motor Vehicle Fuel Tax Collection and Distribution Statistical," State of Nevada Department of Motor Vehicles. Data is available monthly, 1977-June 2015.

Figure C-28 compares Reno MSA GDP and Reno MSA gasoline sales data. The Figure shows a somewhat leading relationship between the two series, however, the relationship is unclear due to the short timeframe shown.

Figure C-29. Comparison of Average Employment and Gasoline Sales Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Washoe and Storey County gasoline sales data from "Statistical 3A-Motor Vehicle Fuel Tax Collection and Distribution Statistical," State of Nevada Department of Motor Vehicles. Data is available monthly, 1977-June 2015.

Figure C-29 compares area employment to Reno MSA gasoline sales. This Figure shows a possible lagging relationship between the two series or a partial leading relationship. If lagging, this variable cannot be used in the index. Even if leading, the relationship is not strong and does not follow cyclical fluctuations in the employment series. This series is included in the SNILI, gasoline sales may be more related to the Las Vegas area economy than the Reno MSA economy. It should not be included in the Reno MSA index.

Taxable Gaming Revenue

SNILI also used gross gaming revenue series in its index. Gaming revenue is an important part of Reno MSA's economy. There is a slight difference between gross and taxable gaming revenue, with not all gaming revenue taxable in the State of Nevada. However, the two amounts are fairly similar; the use of taxable gaming revenue in this index is not expected to generate a big difference compared to gross gaming revenue. Taxable revenue is used in this index as historical data for this variable was more readily available than gross gaming revenue.

Gaming revenue is generated by both area residents and visitors. According to the location quotient analysis for Washoe County, visitor-impacted industries for the county Arts, Entertainment, and Recreation and Accommodation and Food Services have location quotients of 1.71 and 1.64 respectively. It is an important indicator of both disposable income of area residents and changes in the number of visitors to the area and their spending habits. Both are related to economic activity in the region.

Taxable gaming revenue for Washoe County is collected by the Nevada Gaming Control Board. No significant casinos exist in Storey County and the Nevada Gaming Control Board does not report any gaming revenue for the county. As a result, only Washoe County data is used. Data for Washoe County is available monthly from 1994 to June 2015. The methodology for data collection has not changed and is unlikely to change in the near future. As a result, gaming revenue data is adequate for use in this index.

Figure C-30 compares Washoe County gaming revenue to Reno MSA GDP. The relationship between the two series is difficult to determine from this Figure.

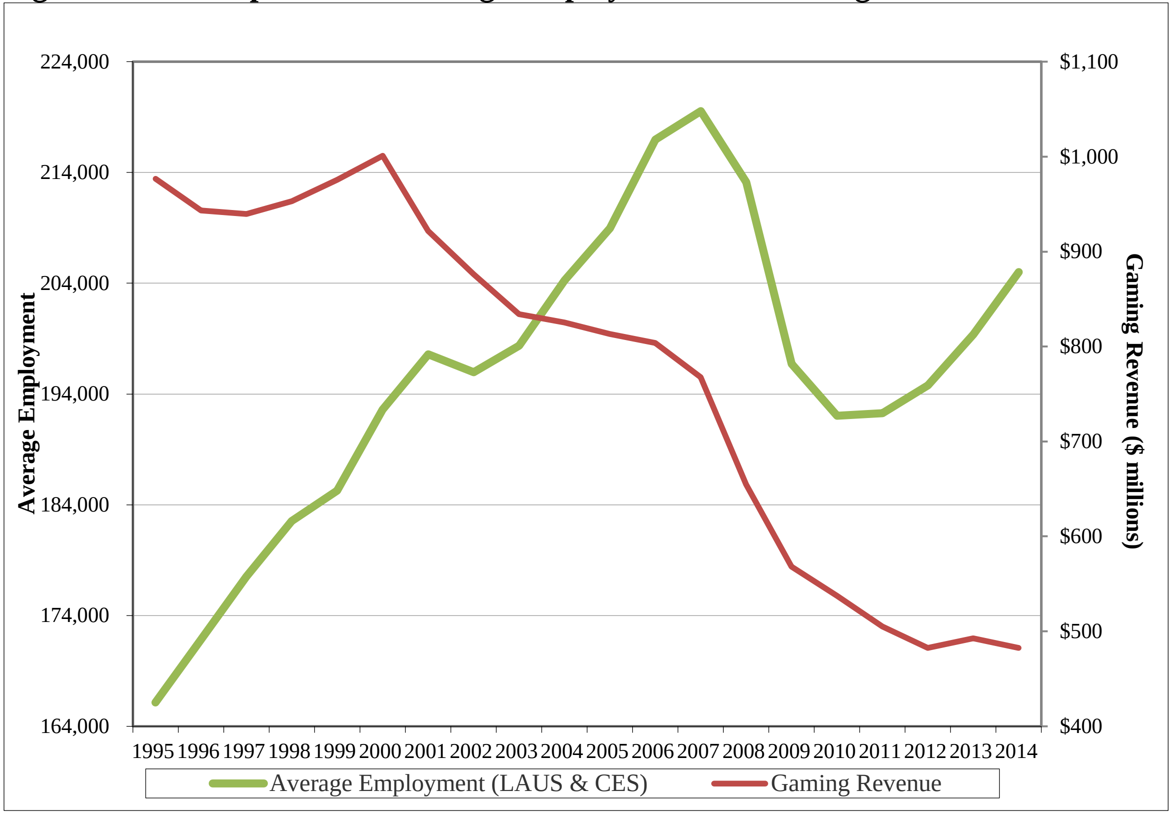
Figure C-30. Comparison of Gross Product and Gaming Revenue Series

Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Washoe County gaming revenue from "Gaming Revenue Report," Nevada Gaming Control Board. Data is available monthly, 1994-June 2015. Data is inflation adjusted.

Figure C-31 compares regional employment and gaming revenue. The Figure provides a clearer representation of a somewhat leading relationship between the two series. It should be noted that gaming revenue is impacted not only by regular economic forces, but also by increased gaming competition, especially that rising from increased number of California casinos.

Figure C-31. Comparison of Average Employment and Gaming Revenue Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Washoe County gaming revenue from "Gaming Revenue Report," Nevada Gaming Control Board. Data is available monthly, 1994-June 2015. Data is inflation adjusted.

The gaming revenue series does not clearly show cyclical fluctuations represented by employment data. Data is also mostly smooth, with only a few fluctuations. Given the outside influences on the data and its lack of a strong relationship to employment and GDP, this series may not be used in the index.

Conventions Held Attendance

This is another series used in the SNILI. Conventions held attendance is particularly important for the Las Vegas area. However, while the Reno-Sparks area also has a number of conventions, it is not at the same level as Las Vegas. Additionally, no consistent, monthly, convention attendance data is available for the Reno MSA. As a result, this series should not be used in the index.

Arizona and California Leading Indices

The Las Vegas leading index uses these series in its forecasts. Las Vegas is in close proximity to both Arizona and California and its economy is impacted by the economies of these two states. Reno MSA is located further away from Arizona, but is in close proximity to California.

Table C-1. Top 10 States of Work and States of Residence for Reno MSA Residents and Employees

	Live in Reno MSA, Work In:		**Work in Reno MSA, Live In:**	
States	**Employees**	**% of Total**	**Employees**	**% of Total**
Nevada	162,443	94.87%	169,206	95.09%
California	7,434	4.34%	7,396	4.16%
Utah	192	0.11%	172	0.10%
Oregon	150	0.09%	251	0.14%
Arizona	135	0.08%	89	0.05%
Texas	123	0.07%	109	0.06%
Idaho	100	0.06%	84	0.05%
Washington	76	0.04%	152	0.09%
Florida	58	0.03%	41	0.02%
Colorado	51	0.03%	20	0.01%
Other	456	0.27%	428	0.24%
Total	**171,218**	**100.00%**	**177,948**	**100.00%**

Source:

1. Place of work data for Reno MSA from "Work Destination Report - Where Workers are Employed Who Live in the Selection Area - by States." OntheMap, US Census Bureau. Data for 2013.
2. Place of residence data for Reno MSA from "Home Destination Report - Where Workers Live Who are Employed in the Selection Area - by States." OntheMap, US Census Bureau. Data for 2013.

Table C-1 shows employment flows from and to Reno MSA from surrounding states. The table shows top 10 states associated with Reno MSA employees and residents. The Table shows, other than Nevada, California provides the highest amount of Reno MSA workers and employs the highest number of Reno MSA residents. No other state, including Arizona, provides a comparable level of employment and residence. As a result, changes in California economy may have an impact on the Reno MSA economy. As a result, the Arizona leading index should not be used.

The California Leading index is reported by the Federal Reserve Bank of St. Louis. The methodology for the index has not recently changed and the data is available on a monthly basis starting in 1983 through June 2015. This data is adequate for use in the leading index.

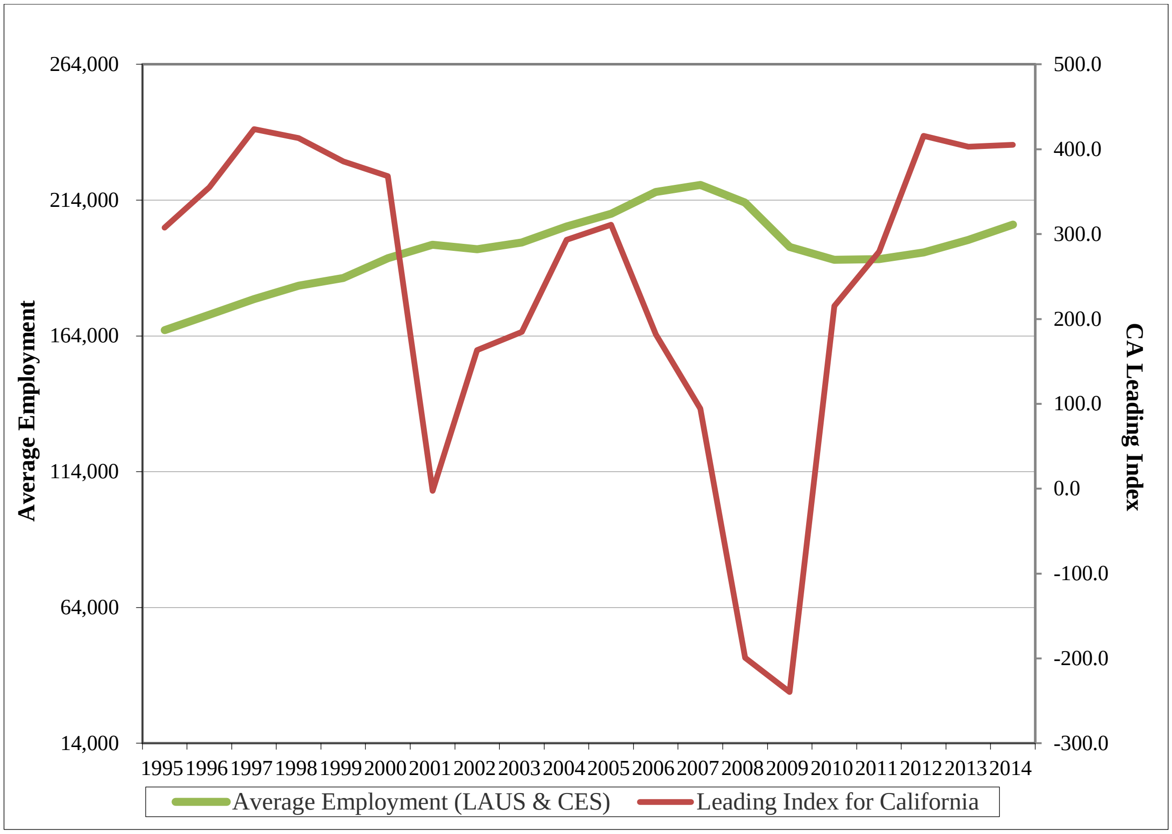
Figure C-32. Comparison of Gross Product and California Leading Index Series

Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. California Leading Index series from "Leading Index for California." Federal Reserve Bank of St. Louis. Data is available monthly, 1983-June 2015.

Figure C-32 compares Reno MSA GDP and the California leading index series. The relationship between the two series is difficult to determine from this Figure.

Figure C-33. Comparison of Average Employment and California Leading Index Series



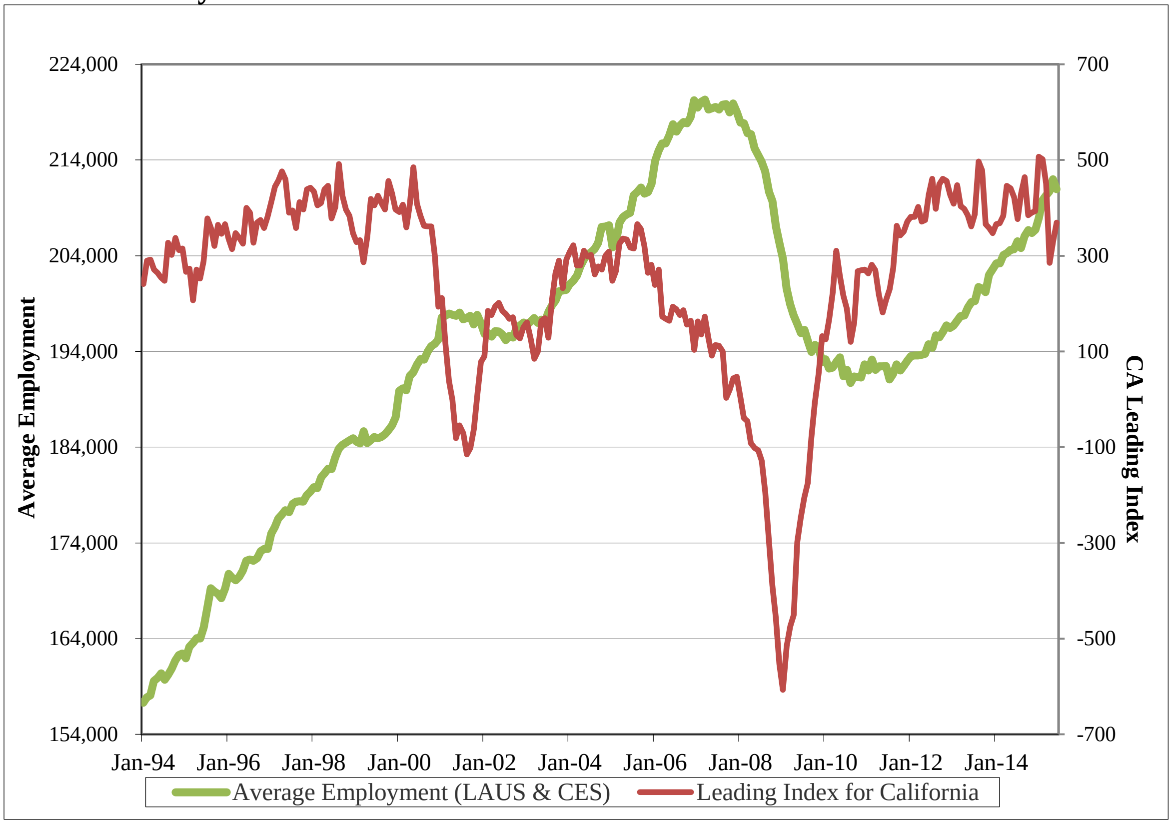
Source:

1. Reno MSA employment data from “Local Area Unemployment Statistics (LAUS),” Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from “State and Area Employment, Hours, and Earnings (CES),” Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. California Leading Index series from “Leading Index for California.” Federal Reserve Bank of St. Louis. Data is available monthly, 1980-July 2015.

Figure C-33 compares regional employment and California leading index series. The Figure provides a clearer representation of a leading relationship between the two series, though it is still difficult to determine due to larger changes in the index series than the employment series. The California leading index series is also relatively good at showing cyclical fluctuations represented by employment data.

However, the California leading index data has a number of erratic fluctuations; this is shown more clearly in Figure C-34. The Figure shows a number of strong fluctuations that do not correspond to changes in the employment series. As a result, this series should not be used in the Reno MSA leading index.

Figure C-34. Comparison of Average Employment and California Leading Index Series-Monthly



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. California Leading Index series from "Leading Index for California." Federal Reserve Bank of St. Louis. Data is available monthly, 1980-July 2015.

Hotel/Motel Occupancy Rate

The Las Vegas leading index used the hotel/motel occupancy rate series in its index. This is also an important series for the Reno MSA economy as its location quotient indicates the Accommodation industry makes up a large portion of the county's employment.

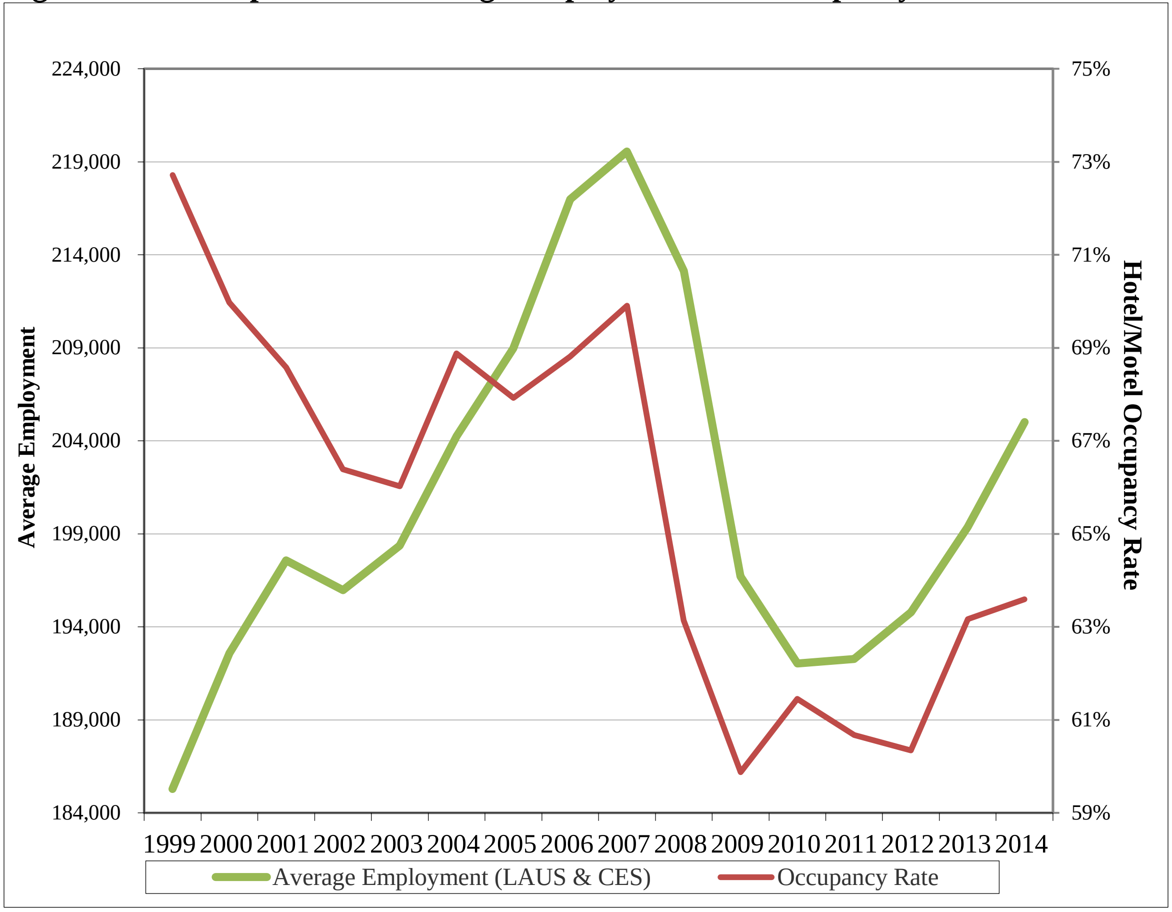
Hotel occupancy data is collected by the Reno Sparks Convention and Visitors Authority (RSCVA) and is available monthly. As with visitors, no consistent, monthly occupancy data is available for Storey County. For Washoe County, monthly occupancy data is available starting July 1999, which may be insufficient to use this series in the leading index.

Figure C-35. Comparison of Gross Product and Occupancy Series

Source:
1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Washoe County hotel/motel occupancy data from "Room Statistics." Reno Sparks Convention and Visitors Authority. Data is available monthly, July 1999-June 2015.

Figure C-35 compares Reno MSA GDP and the hotel/motel occupancy data for Washoe County. The figure shows a somewhat coincident relationship, though it is difficult to determine due to data fluctuations.

Figure C-36. Comparison of Average Employment and Occupancy Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Washoe County hotel/motel occupancy data from "Room Statistics." Reno Sparks Convention and Visitors Authority. Data is available monthly, July 1999-June 2015.

Figure C-36 compares regional employment and hotel/motel occupancy series. The Figure shows multiple erratic fluctuations in the occupancy data compared to employment data. This makes it difficult to determine the type of a relationship between the series and whether occupancy series captures cyclical changes in employment. As a result, this series should not be used in the Reno MSA index.

Single Family Sold and Median Sales Price

Though not used in any of the sample indices, these series may be important to the Reno MSA economy. The number of single family homes sold is not only an indication of the population growth in the area, but also of the disposable income of area residents. An increase in the number of homes sold indicates economic growth in the region. Median sales prices increase with growth in demand for single family homes, its growth also represents growth in the economy.

A review of Storey County sales data from the Assessor's office indicated multiple missing sales data, especially prior to 1998. A conversation with the Assessor's office indicated the Office does not have information for the missing data points. Additionally, it is unknown whether any data points are missing since 1998. As a result, Storey County single family sold and median sales price data will not be used in the analysis. From the data available from the Storey County Assessor's Office, approximately 74 single family homes were sold in 2013 and 70 in 2014, this is 1.0 percent and 1.1 percent respectively of Washoe County's single family home sales in the same years. As a result, the exclusion of Storey County sales and median sales price data from the index is not expected to have a strong impact on the index.

Data for both series is collected by Washoe County Assessor based on actual sales data in the region. Data is published in "Sales Reports" files by the Assessor's Office and requires some analysis, which is done by the Center for Regional Studies at the University of Nevada, Reno on a monthly basis. Data is available from the Center for Regional Studies (CRS) starting 1994, through July 2015. Data is not revised and CRS methodology for summarizing sales data has remained the same. As a result both series are adequate for use in the leading index.

Figure C-37 shows the relationship between GDP and number of single family homes sold in Washoe County. The Figure shows a leading relationship between the two series.

Figure C-37. Comparison of Gross Product and Single Family Homes Sold Series

Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Washoe County number of single family homes sold from "Sales Reports," Washoe County Assessor. Data is available monthly, 1994-June 2015. Data analysis starting 2006 from Center for Regional Studies from same source.

Figure C-38 compares average regional employment and the number of single family homes sold in Washoe County. The Figure also shows a leading relationship between the two series. Furthermore, single family homes sold data follows cyclical fluctuations shown by the employment series. However, the data does show some fluctuations different from the employment series. This series will need to be reviewed further for significance.

Figure C-38. Comparison of Average Employment and Single Family Homes Sold Series

Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Washoe County number of single family homes sold from "Sales Reports," Washoe County Assessor. Data is available monthly, 1994-June 2015. Data analysis starting 2006 from Center for Regional Studies from same source.

Figure C-39 compares Reno MSA GDP and the median sales price for single family homes in Washoe County. The figure shows a leading relationship between the median home sales price and GDP

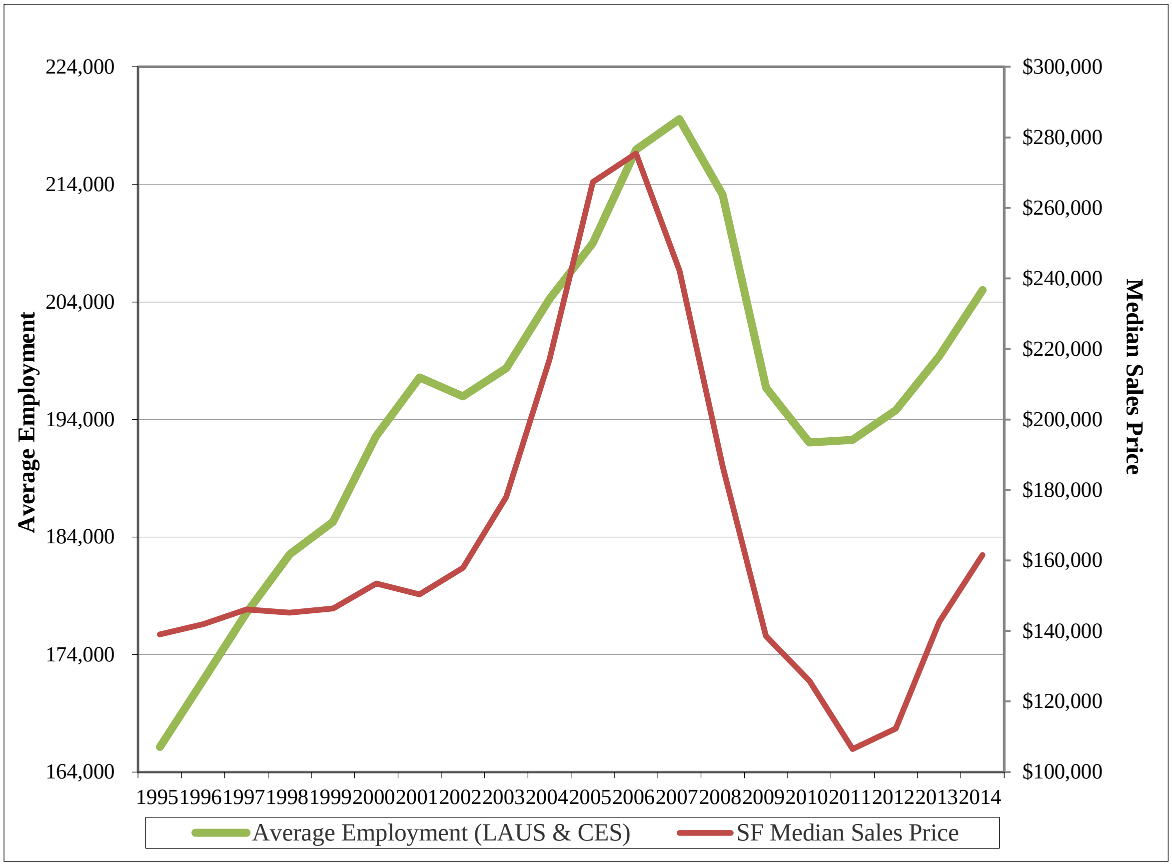
Figure C-39. Comparison of Gross Product and Single Family Median Sale Price Series

Source:

1. Real metropolitan Gross Product (GDP) data for Reno MSA from "Gross Domestic Product (GDP) by Metropolitan Area," Bureau of Economic Analysis. Data is available annually between 2001-2013.
2. Washoe County single family home median sales price from "Sales Reports," Washoe County Assessor. Data is available monthly, 1994-June 2015. Data analysis starting 2006 from Center for Regional Studies from same source. Data is inflation adjusted.

Figure C-40 compares regional employment to single family median sale price data. The Figure shows that home price data had a leading relationship with employment prior to 2009. Since 2009 the relationship between the two series has become lagging. As a result, this series should not be used in the leading index, especially since a similar, number of homes sold series can be used.

Figure C-40. Comparison of Average Employment and Single Family Median Sale Price Series



Source:

1. Reno MSA employment data from "Local Area Unemployment Statistics (LAUS)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015 and from "State and Area Employment, Hours, and Earnings (CES)," Bureau of Labor Statistics. Data is available monthly, 1990-June 2015. Average employment data is the average of LAUS and CES series data.
2. Washoe County single family home median sales price from "Sales Reports," Washoe County Assessor. Data is available monthly, 1994-June 2015. Data analysis starting 2006 from Center for Regional Studies from same source. Data is inflation adjusted.

New Business Incorporations

A number of national and state sampled indices used new business incorporations or new business licenses issued data series. Nevada Secretary of State provides incorporation data for sale, allowing a user to download various incorporation related data for a fee, including date of the filing of Articles of Incorporation for each corporation by county. If used in the index, this series would require a monthly purchase of incorporation data and analysis of these data to obtain monthly incorporation data. This could lead to errors in data and become expensive with costs of $125 per report. Additionally, Senate Bill 483 (SB 483) introduced in Nevada in 2015 increased the State license fee for corporations from $200 to $500, while keeping the fee for other business types at $200 (SB 483 2015). There likely to be a shift in the type of new businesses filing for operations Nevada from corporations to other businesses. This change would impact the effectiveness of the index in predicting economic changes.

Business permit data would need to be collected separately from each of the public entities in the Reno MSA (City of Reno, City of Sparks and Washoe and Storey counties). Each entity has a different methodology for collecting these data and most don’t differentiate between filings for new businesses, changes in ownership, renewals, relocations, or other filing types.

The only source of reliable data regarding the number of businesses operating in the Reno MSA is the Quarterly Employment & Wages database offered by the Nevada Department of Employment, Training, and Rehabilitation. However, these data are available quarterly, not monthly. As a result, the analysis does not include any series related to business incorporations or licensing. These would be ideal leading indicator series, but are not available for the region.

Commercial Occupancy and Rental Rates

Similarly, data regarding commercial occupancy and rental rates may be a good indicator of the economy's movement. A growing economy is likely to increase demand for commercial space (retail, hotel, office, hospital, etc.), leading to an increase in commercial construction and rental rates and a decrease in vacancy rates for these properties. However, a search of data published by commercial real estate companies such as Colliers International and CB Richard Ellis for the Reno area is unavailable for a long-term historical period. As a result, these indicators will not be used in either the coincident or the leading indices.

APPENDIX D
SUMMARY OF GRANGER CAUSALITY RESULTS FOR LEADING INDICATORS ADJUSTED FOR SEASONALITY USING A MOVING AVERAGE METHODOLOGY[29][30]

Variable Name	1 lag		2 lags		3 lags		4 lags		5 lags		6 lags	
	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.
unempl	344.740	0.000***	31.661	0.000***	32.947	0.000***	33.958	0.000***	32.004	0.000***	30.979	0.000***
uslead	789.150	0.000***	39.603	0.000***	39.193	0.000***	40.718	0.000***	39.775	0.000***	39.114	0.000***
sfprice	110.520	0.000***	0.772	0.680	15.515	0.001***	17.052	0.002***	17.653	0.003***	21.584	0.001***
caind	258.730	0.000***	32.383	0.000***	33.615	0.000***	31.819	0.000***	29.955	0.000***	28.807	0.000***
gaming	15.262	0.000***	6.814	0.033**	15.039	0.002***	15.651	0.004***	15.118	0.010***	17.310	0.008***
sfhomes	112.090	0.000***	16.717	0.000***	23.403	0.000***	24.077	0.000***	25.153	0.000***	25.794	0.000***
stockprice	67.578	0.000***	17.813	0.000***	17.524	0.001***	21.137	0.000***	22.742	0.000***	22.100	0.001***
taxsales	84.010	0.000***	17.389	0.000***	17.611	0.001***	16.978	0.002***	15.475	0.009***	15.981	0.014**
intrate	77.268	0.000***	6.999	0.030**	8.061	0.045**	15.825	0.003***	17.499	0.004***	19.022	0.004***
gassales	0.058	0.809	10.963	0.004***	10.504	0.015**	12.473	0.014**	23.376	0.000***	24.019	0.001***
respermval	100.510	0.000***	2.932	0.231	5.688	0.128	5.979	0.201	23.756	0.000***	25.930	0.000***
moneysupl	2.291	0.130	7.295	0.026**	6.896	0.075*	7.975	0.093*	18.396	0.002***	16.682	0.011**
passengers	12.535	0.000***	9.260	0.010**	9.417	0.024**	12.533	0.014**	12.331	0.031**	15.944	0.014**
cargo	4.172	0.041**	7.218	0.027**	6.890	0.075*	13.198	0.010**	12.384	0.030**	12.411	0.053*
compermits	34.903	0.000***	4.183	0.124	8.807	0.032**	8.846	0.065*	9.150	0.103	9.251	0.160
respermits	67.615	0.000***	0.098	0.952	3.172	0.366	3.830	0.430	9.781	0.082*	15.349	0.018**
compermval	0.442	0.506	14.303	0.001***	14.051	0.003***	12.618	0.013**	11.101	0.049**	9.086	0.169
visitors	58.663	0.000***	3.927	0.140	6.496	0.090*	5.609	0.230	5.566	0.351	5.907	0.434
exrate	10.843	0.001***	1.831	0.400	2.530	0.470	4.996	0.288	7.334	0.197	10.982	0.089*
occrate	0.517	0.472	0.495	0.781	1.081	0.782	3.819	0.431	3.486	0.625	8.759	0.188

Variable Name	7 lags		8 lags		9 lags		10 lags		11 lags		12 lags	
	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.	Chi^2	Prob.
unempl	27.581	0.000***	28.050	0.000***	33.235	0.000***	33.689	0.000***	35.979	0.000***	35.682	0.000***
uslead	38.215	0.000***	40.939	0.000***	40.654	0.000***	41.352	0.000***	41.043	0.000***	42.805	0.000***
sfprice	22.422	0.002***	24.413	0.002***	24.997	0.003***	27.009	0.003***	32.757	0.001***	37.871	0.000***
caind	28.006	0.000***	30.301	0.000***	34.372	0.000***	33.411	0.000***	39.014	0.000***	39.951	0.000***
gaming	14.871	0.038**	18.063	0.021**	21.029	0.013**	24.800	0.006***	25.206	0.009***	27.377	0.007***
sfhomes	33.343	0.000***	32.750	0.000***	33.385	0.000***	38.576	0.000***	41.326	0.000***	42.418	0.000***
stockprice	26.114	0.000***	26.310	0.001***	25.675	0.002***	24.873	0.006***	26.199	0.006***	27.627	0.006***
taxsales	15.643	0.029**	16.335	0.038**	18.646	0.028**	20.222	0.027**	18.721	0.066*	19.113	0.086*
intrate	14.266	0.047**	12.333	0.137	13.780	0.130	19.457	0.035**	20.374	0.040**	22.896	0.029**
gassales	18.631	0.009***	15.568	0.049**	16.303	0.061*	19.785	0.031**	24.111	0.012**	23.381	0.025**
respermval	29.263	0.000***	30.123	0.000***	30.420	0.000***	29.661	0.001***	34.041	0.000***	32.943	.001***
moneysupl	13.807	0.055*	12.914	0.115	13.855	0.128	16.156	0.095*	17.369	0.097*	17.124	0.145
passengers	13.090	0.070*	15.256	0.054*	15.957	0.068*	16.982	0.075*	17.121	0.104	17.265	0.140
cargo	15.351	0.032**	17.189	0.028**	17.071	0.048**	18.921	.041**	16.999	0.108	17.490	0.132
compermits	11.838	0.106	11.102	0.196	12.164	0.204	13.653	1.189	14.211	0.222	16.034	0.190
respermits	16.378	0.022**	16.469	0.036**	16.578	0.056*	16.303	0.091*	17.921	0.083*	17.669	0.126
compermval	9.222	0.237	15.174	0.056*	15.523	0.078*	17.004	0.074*	15.931	0.144	20.559	0.057*
visitors	8.401	0.299	9.070	0.336	10.142	0.339	10.561	0.393	11.987	0.365	15.581	0.211
exrate	8.990	0.253	9.175	0.328	9.452	0.397	9.954	0.445	12.228	0.347	12.284	0.423
occrate	11.090	0.135	9.827	0.277	16.126	0.064*	17.471	0.065*	18.489	0.071*	23.500	0.024**

[29] Asterisks represent the significance of the coefficient at the level of significance of 10 percent-*, 5 percent-**, and 1 percent-***.

[30] Indicators highlighted in green and orange are used in the index, with the index tested for each orange variable to ensure the indicator's ability to benefit index. Variables in red are not used.

APPENDIX E
RESULTS FOR REGRESSION LEADING INDEX METHODOLOGY

Table E-1. Regression Results-All Variables, All Years

Variable	Coefficient	Probability	Joint Significance
Unempl (-4)	-0.0349	0.5830	
Unempl (-5)	-0.0013	0.9900	0.0021
Unempl (-6)	-0.0215	0.7280	
USlead (-4)	-0.0906	0.2070	
USlead (-5)	0.0484	0.6000	0.4233
USlead (-6)	0.0580	0.4060	
SFPrice (-4)	0.0040	0.6830	
SFPrice (-5)	0.0089	0.4180	0.1115
SFPrice (-6)	0.0077	0.4410	
CAInd (-4)	-0.0065	0.0240	
CAInd (-5)	0.0021	0.5560	0.0905
CAInd (-6)	-0.0001	0.9610	
Gaming (-4)	-0.2654	0.0100	
Gaming (-5)	-0.0880	0.5450	0.0002
Gaming (-6)	0.3584	0.0000	
SFHomes (-4)	-0.0411	0.0790	
SFHomes (-5)	-0.0187	0.6340	0.0002
SFHomes (-6)	0.0459	0.0700	
StockPrice (-4)	0.0377	0.4010	
StockPrice (-5)	0.0755	0.3660	0.0006
StockPrice (-6)	-0.1101	0.0190	
TaxSales (-4)	0.3703	0.0000	
TaxSales (-5)	-0.0878	0.5590	0.0000
TaxSales (-6)	0.0241	0.8030	
IntRate (-4)	0.0035	0.9820	
IntRate (-5)	-0.0277	0.8940	0.0003
IntRate (-6)	-0.3326	0.0250	
GasSales (-4)	0.1012	0.0930	
GasSales (-5)	-0.0015	0.9840	0.0273
GasSales (-6)	-0.0395	0.4850	
ResPermVal (-4)	-0.0081	0.3800	
ResPermVal (-5)	0.0035	0.7860	0.6745
ResPermVal (-6)	-0.0001	0.9880	
MoneySupl (-4)	0.0869	0.0850	
MoneySupl (-5)	-0.0996	0.2040	0.0012
MoneySupl (-6)	0.0765	0.1240	
Passengers (-4)	-0.0730	0.4170	
Passengers (-5)	0.0625	0.6860	0.0000
Passengers (-6)	-0.0432	0.6240	
Cargo (-4)	-0.0435	0.1440	
Cargo (-5)	0.0412	0.3820	0.0000
Cargo (-6)	0.0548	0.0770	
Constant	97.9761	0.0000	
R-Squared	0.9970	Adj. R-Squared	0.9964

Table E-2. Regression Results-Final Variables, All Years

Variable	Coefficient	Probability	Joint Significance
Unempl (-4)	-0.0527	0.3900	0.0000
Unempl (-5)	0.0305	0.7640	
Unempl (-6)	-0.0372	0.5340	
Gaming (-4)	-0.2784	0.0060	0.0001
Gaming (-5)	-0.0886	0.5380	
Gaming (-6)	0.3358	0.0010	
SFHomes (-4)	-0.0497	0.0310	0.0000
SFHomes (-5)	-0.0141	0.7200	
SFHomes (-6)	0.0401	0.0990	
StockPrice (-4)	0.0199	0.6420	0.0000
StockPrice (-5)	0.0882	0.2870	
StockPrice (-6)	-0.1025	0.0230	
TaxSales (-4)	0.3945	0.0000	0.0000
TaxSales (-5)	-0.0856	0.5720	
TaxSales (-6)	0.0620	0.5170	
IntRate (-4)	-0.0500	0.7320	0.0000
IntRate (-5)	-0.0745	0.7240	
IntRate (-6)	-0.3284	0.0240	
GasSales (-4)	0.0654	0.2720	0.0166
GasSales (-5)	-0.0141	0.8520	
GasSales (-6)	0.0164	0.7700	
MoneySupl (-4)	0.0958	0.0460	0.0034
MoneySupl (-5)	-0.0923	0.2330	
MoneySupl (-6)	0.0473	0.3320	
Passengers (-4)	-0.0532	0.5560	0.0000
Passengers (-5)	0.0731	0.6410	
Passengers (-6)	-0.0831	0.3450	
Cargo (-4)	-0.0600	0.0420	0.0000
Cargo (-5)	0.0395	0.3990	
Cargo (-6)	0.0651	0.0250	
Constant	110.5087	0.0000	
R-Squared	0.9966	Adj. R-Squared	0.9962

Table E-3. Regression Results-All Variables, Data Starting 2002

Variable	Coefficient	Probability	Joint Significance
Unempl (-4)	0.0098	0.8490	0.0000
Unempl (-5)	0.1001	0.1630	
Unempl (-6)	0.0021	0.9620	
USlead (-4)	-0.0445	0.3460	0.4990
USlead (-5)	-0.0236	0.7030	
USlead (-6)	0.0515	0.2900	
SFPrice (-4)	0.0093	0.1020	0.0007
SFPrice (-5)	0.0096	0.1320	
SFPrice (-6)	0.0077	0.2030	
CAInd (-4)	-0.0037	0.0580	0.1175
CAInd (-5)	0.0017	0.4580	
CAInd (-6)	0.0016	0.3700	
Gaming (-4)	0.0697	0.4380	0.4174
Gaming (-5)	0.0185	0.8630	

Gaming (-6)	-0.0532	0.5090	
SFHomes (-4)	-0.0587	0.0000	0.0000
SFHomes (-5)	-0.0001	0.9970	
SFHomes (-6)	-0.0110	0.5020	
StockPrice (-4)	0.0714	0.0280	0.0000
StockPrice (-5)	0.0222	0.6960	
StockPrice (-6)	-0.0822	0.0090	
TaxSales (-4)	0.1336	0.0530	0.0000
TaxSales (-5)	-0.0527	0.5520	
TaxSales (-6)	0.2226	0.0000	
IntRate (-4)	-0.0256	0.8040	0.1411
IntRate (-5)	0.1438	0.2560	
IntRate (-6)	0.0574	0.5650	
GasSales (-4)	-0.0397	0.5300	0.0687
GasSales (-5)	0.0519	0.5160	
GasSales (-6)	0.0571	0.3610	
ResPermVal (-4)	-0.0032	0.5910	0.0312
ResPermVal (-5)	0.0049	0.5370	
ResPermVal (-6)	-0.0109	0.0520	
MoneySupl (-4)	0.0494	0.0930	0.0000
MoneySupl (-5)	-0.0403	0.3410	
MoneySupl (-6)	0.0843	0.0040	
Passengers (-4)	0.2513	0.0040	0.0002
Passengers (-5)	-0.1377	0.2520	
Passengers (-6)	-0.1579	0.0540	
Cargo (-4)	-0.0381	0.0640	0.0035
Cargo (-5)	0.0018	0.9470	
Cargo (-6)	0.0032	0.8800	
Constant	53.4558	0.0000	
R-Squared	0.9984	Adj. R-Squared	0.9978

Table E-4. Regression Results-Remaining Variables, Data Starting 2002

Variable	Coefficient	Probability	Joint Significance
Unempl (-4)	-0.0997	0.0330	0.0000
Unempl (-5)	0.1477	0.0500	
Unempl (-6)	0.0007	0.9870	
SFPrice (-4)	0.0051	0.3990	0.7775
SFPrice (-5)	0.0006	0.9240	
SFPrice (-6)	-0.0017	0.7830	
SFHomes (-4)	-0.0584	0.0000	0.0000
SFHomes (-5)	-0.0056	0.8350	
SFHomes (-6)	-0.0045	0.7900	
StockPrice (-4)	0.0494	0.1360	0.0000
StockPrice (-5)	0.0763	0.2130	
StockPrice (-6)	-0.1187	0.0000	
TaxSales (-4)	0.2435	0.0000	0.0000
TaxSales (-5)	-0.0543	0.5390	
TaxSales (-6)	0.1870	0.0020	
ResPermVal (-4)	0.0047	0.3970	0.3238
ResPermVal (-5)	0.0033	0.6810	
ResPermVal (-6)	-0.0078	0.1550	

MoneySupl (-4)	0.0557	0.0450	0.0000
MoneySupl (-5)	-0.0543	0.2250	
MoneySupl (-6)	0.0759	0.0070	
Passengers (-4)	0.3038	0.0000	0.0000
Passengers (-5)	-0.0555	0.6520	
Passengers (-6)	-0.2948	0.0000	
Cargo (-4)	-0.0302	0.1470	0.0119
Cargo (-5)	-0.0022	0.9400	
Cargo (-6)	0.0072	0.7170	
Constant	79.1409	0.0000	
R-Squared	0.9977	Adj. R-Squared	0.9972

Table E-5. Regression Results-Final Variables, Data Starting 2002

Variable	Coefficient	Probability	Joint Significance
Unempl (-4)	-0.1060	0.0210	0.0000
Unempl (-5)	0.1585	0.0300	
Unempl (-6)	-0.0117	0.7890	
SFHomes (-4)	-0.0535	0.0000	0.0000
SFHomes (-5)	-0.0136	0.6020	
SFHomes (-6)	0.0015	0.9240	
StockPrice (-4)	0.0444	0.1510	0.0000
StockPrice (-5)	0.0799	0.1750	
StockPrice (-6)	-0.1171	0.0000	
TaxSales (-4)	0.2673	0.0000	0.0000
TaxSales (-5)	-0.0592	0.5000	
TaxSales (-6)	0.1776	0.0030	
MoneySupl (-4)	0.0631	0.0170	0.0000
MoneySupl (-5)	-0.0677	0.1210	
MoneySupl (-6)	0.0862	0.0020	
Passengers (-4)	0.3077	0.0000	0.0000
Passengers (-5)	-0.0366	0.7620	
Passengers (-6)	-0.3102	0.0000	
Cargo (-4)	-0.0251	0.1900	0.0147
Cargo (-5)	-0.0055	0.8440	
Cargo (-6)	0.0064	0.7180	
Constant	77.0573	0.0000	
R-Squared	0.9976	Adj. R-Squared	0.9972

APPENDIX F
COMPARISON OF LAS VEGAS AND RENO MSA LEADING INDEX REGRESSION METHODOLOGY

As discussed above, the Kennelly Las Vegas leading index used the coincident index data in its regression formula for estimating the leading index:

$$Coin_t = c + \sum_{i=n}^{m} a_i \, Coin_{t-i} + \sum_{j=1}^{r} \sum_{i=n}^{m} b_{j,i} \, x_{j,t-i} + \varepsilon_t \qquad \text{(F.1)}$$

Regarding this, Kennelly noted "this regression is very similar to a Granger Causality Test. We deem this a "hollowed out" regression - referring to the first few lags, which are included in the Granger test that we omit from this our equation. This "hollowing out" technique tells us which variables are able to lead our coincident index in the desired time period of four to six months" (Kennelly 2012).

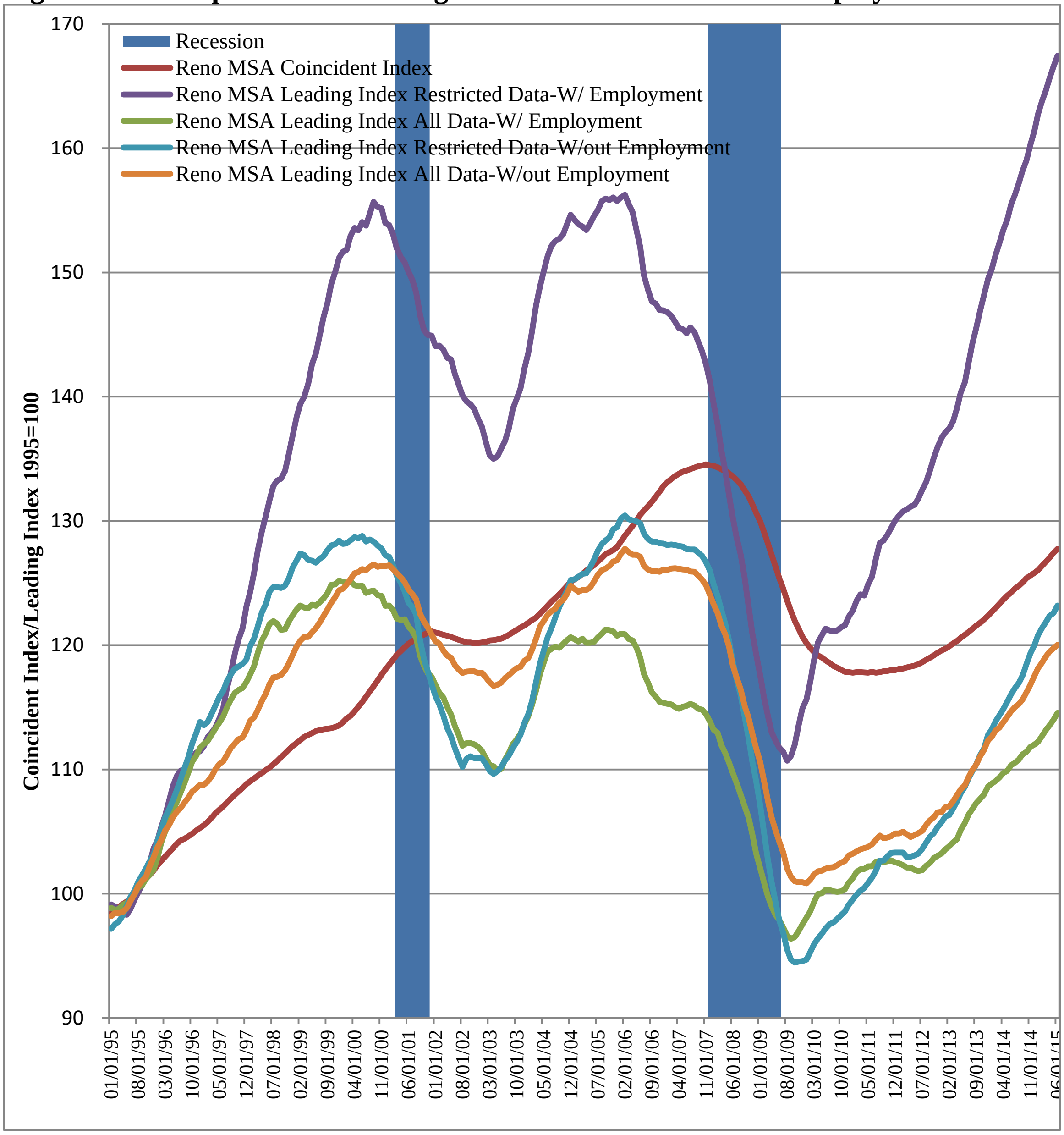
This regression was used to test variables for their significance using an F-test, dropping insignificant variables until a final model was created. Coefficients of the leading variables produced from this model were then used to estimate weights for these variables for the leading index.

As the coefficient of the coincident data was not used in the weight estimate, I wanted to see the results of excluding the coincident variable from the above equation, using only the equation to determine usable variables and obtain coefficients to be used as weights.

$$Coin_t = c + \sum_{j=1}^{r} \sum_{i=n}^{m} b_{j,i} \, x_{j,t-i} + \varepsilon_t \qquad \text{(F.2)}$$

Figure F-1 shows a comparison of multiple leading indices created using Kennelly's methodology of a regression model including coincident (employment) data and my adjusted methodology without employment data. The figure shows indices estimated using each of the w/ and w/out employment calculations using all available data (1995-2015) and restricted data (2002 to 2015).

Figure F-1. Comparison of Leading Indices With and Without Employment Data



The figure shows the Reno MSA Leading Index All Data-W/out Employment has the closes relationship to the estimated coincident index. As a result, the w/out employment methodology is used and discussed throughout the main body of the paper.

APPENDIX G
DEFINITIONS OF RELEVANT IMPLAN TERMS

Direct Effects - The set of expenditures applied to the predictive model (i.e., I/O multipliers) for impact analysis. It is a series (or single) of production changes or expenditures made by producers/consumers as a result of an activity or policy. These initial changes are determined by an analyst to be a result of this activity or policy. Applying these initial changes to the multipliers in an IMPLAN model will then display how the region will respond, economically to these initial changes.

Economic Impact Modeling - Economic Impact Modeling is a software, data, or even a technique that allows an analyst to trace spending through an economy and measure the cumulative effects of that spending. The need for an EIA is normally triggered by an economic event, catastrophe, change in government policy, justification for funding, or as needed for planning (schools, streets, sewers, and public utilities).

Employment – Please see Jobs.

Employment Multipliers - I-O multipliers used to estimate the total number of jobs (both full-time and part-time) throughout the economy that are needed, directly and indirectly, to deliver $1 million of final demand for a specific commodity.

Expenditures - Expenditures are the values of the amounts that buyers pay, or agree to pay, to sellers in exchange for goods or services that sellers provide to them or to other institutional units designated by the buyers.

Indirect Effects - The impact of local industries buying goods and services from other local industries. The cycle of spending works its way backward through the supply chain until all money leaks from the local economy, either through imports or by payments to value added. The impacts are calculated by applying Direct Effects to the Type I Multipliers.

Induced Effects - The response by an economy to an initial change (direct effect) that occurs through re-spending of income received by a component of value added. IMPLAN's default multiplier recognizes that labor income (employee compensation and proprietor income components of value added) is not a leakage to the regional economy.

This money is recirculated through the household spending patterns causing further local economic activity.

I-O Analysis - A type of applied economic analysis that tracks the interdependence among various producing and consuming sectors of an economy. More particularly, it measures the relationship between a given set of demands for final goods and services and the inputs required to satisfy those demands.

Jobs – A job in IMPLAN = the annual average of monthly jobs in that industry (this is the same definition used by QCEW, BLS, and BEA nationally). Thus, 1 job lasting 12 months = 2 jobs lasting 6 months each = 3 jobs lasting 4 months each. A job can be either full-time or part-time.

Labor Income - All forms of employment income, including Employee Compensation (wages and benefits) and Proprietor Income.

Multipliers - Total production requirements within the Study Area for every unit of production sold to Final Demand. Total production will vary depending on whether Induced Effects are included and the method of inclusion. Multipliers may be constructed for output, employment, and every component of Value Added (IMPLAN 2015).

APPENDIX H
WASHOE COUNTY FISCAL IMPACT MODEL
MODEL SCREENSHOTS-SAMPLE PROJECT

FISCAL IMPACT MODEL

MODULE 1
WASHOE COUNTY FISCAL IMPACT MODEL
DEVELOPMENT DATA

PLEASE INPUT RELEVANT INFORMATION INTO CELLS HIGHLIGHTED IN GREEN

YEAR	RESIDENTIAL UNITS CONSTRUCTED	COMMERCIAL SQ. FT. CONSTRUCTED	USE TYPE	VALUE OF LAND IMPROVS.	VALUE OF BUILDING IMPROVS.	ESTIMATED # OF ANNUAL EMPLOYEES	ESTIMATED # OF CUMULAT. EMPLOYEES	ESTIMATED NEW ANNUAL RESID. INCOME	ESTIMATED NEW CUMULAT. RESID. INCOME
Year 1	100		Single-family	$ 9,375,000	$ 28,125,000			$ 10,242,221	$ 10,242,221
	75		Multi-family	3,750,000	11,250,000			4,351,434	4,351,434
		10,000	Hotel	500,000	2,000,000	3	3		
		30,000	Casino	1,500,000	6,000,000	110	110		
		15,000	Commercial	750,000	3,000,000	28	28		
		15,000	Office	750,000	3,000,000	32	32		
		50,000	Industrial	2,500,000	6,250,000	35	35		
Subtotal	**175**	**120,000**		**19,125,000**	**59,625,000**	**207**	**207**	**14,593,654**	**14,593,654**
Year 2	100		Single-family	9,375,000	28,125,000			10,242,221	20,484,441
	75		Multi-family	3,750,000	11,250,000			4,351,434	8,702,867
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**29,187,309**
Year 3	100		Single-family	9,375,000	28,125,000			10,242,221	30,726,662
	75		Multi-family	3,750,000	11,250,000			4,351,434	13,054,301
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**43,780,963**
Year 4	100		Single-family	9,375,000	28,125,000			10,242,221	40,968,883
	75		Multi-family	3,750,000	11,250,000			4,351,434	17,405,735
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**58,374,617**
Year 5	100		Single-family	9,375,000	28,125,000			10,242,221	51,211,103
	75		Multi-family	3,750,000	11,250,000			4,351,434	21,757,169
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**72,968,272**
Year 6	100		Single-family	9,375,000	28,125,000			10,242,221	61,453,324
	75		Multi-family	3,750,000	11,250,000			4,351,434	26,108,602
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**87,561,926**
Year 7	100		Single-family	9,375,000	28,125,000			10,242,221	71,695,544
	75		Multi-family	3,750,000	11,250,000			4,351,434	30,460,036
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**102,155,580**

MODULE 1
WASHOE COUNTY FISCAL IMPACT MODEL
DEVELOPMENT DATA

Year 8	100		Single-family	9,375,000	28,125,000			10,242,221	81,937,765
	75		Multi-family	3,750,000	11,250,000			4,351,434	34,811,470
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**116,749,236**
Year 9	100		Single-family	9,375,000	28,125,000			10,242,221	92,179,986
	75		Multi-family	3,750,000	11,250,000			4,351,434	39,162,903
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**131,342,889**
Year 10	100		Single-family	9,375,000	28,125,000			10,242,221	102,422,206
	75		Multi-family	3,750,000	11,250,000			4,351,434	43,514,337
		-	Hotel	-	-	-	3		
		-	Casino	-	-	-	110		
		-	Commercial	-	-	-	28		
		-	Office	-	-	-	32		
		-	Industrial	-	-	-	35		
Subtotal	**175**	**-**		**13,125,000**	**39,375,000**	**-**	**207**	**14,593,654**	**145,936,543**
TOTAL	**1,750**	**120,000**		**$ 137,250,000**	**$ 414,000,000**	**207**		**145,936,543**	

MODULE 1, ASSUMPTIONS:

1. The following is project buildout information on which the remainder of the analysis is based:

	# of Units	Commercial Square Feet	Total Land Improv. Cost*	Total Building Improv. Cost	Notes
Single-family	1,000		$ 93,750,000	$ 281,250,000	Includes attached and detached units (condominiums and townhomes)
Multi-family	750		37,500,000	112,500,000	
Hotel		10,000	500,000	2,000,000	
Casino		30,000	1,500,000	6,000,000	Includes casino space only, add hotel information to the Hotel section
Commercial		15,000	750,000	3,000,000	Includes retail, F&B, and services uses
Office		15,000	750,000	3,000,000	
Industrial		50,000	2,500,000	6,250,000	
Total	**1,750**	**120,000**	**$ 137,250,000**	**$ 414,000,000**	

*Please include only the cost associated with physical land improvements, such as grading, concrete, pipework, etc. Do not include the cost of land purchase.

2. Please enter the total number of employees projected for each component of the project. If unknown, please leave the fields blank:

	Total # of Employees @
Hotel	-
Casino	-
Commercial	-
Office	-
Industrial	-
Total	-

If no employee information is provided, employees per square foot information from the Center of Regional Studies, UNR is used, developed based on Washoe County employee and building square feet by industry data from the Washoe County Assessor and Department of Employment, Training and Rehabilitation. This information is as follows:

	Washoe County Sq.Ft./Employee
Hotel	3,907
Casino	273
Commercial	527
Office	475
Industrial	1,429

3. If known, please input the average household income targeted for purchasers of residential units:

	Est. Household Income
Single-family	$ -
Multi-family	-

MODULE 1
WASHOE COUNTY FISCAL IMPACT MODEL
DEVELOPMENT DATA

If unavailable, household income of new residents will be estimated using home construction costs provided above, plus the following calculation:

		Single-Family		Multi-Family	
					based on project land improvement and building construction cost information provided above, plus a 20% land mark-up.
Home Price	$	450,000	$	240,000	Source: Center for Regional Studies, UNR.
Monthly Mortgage Payment	$	2,148	$	1,146	30-year note, 4% interest rate
Annual Mortgage Payment	$	25,780	$	13,750	Monthly payment * 12 months
Mortgage Insurance	$	129	$	69	Center for Regional Studies, UNR
Property Tax Cost	$	4,500	$	2,400	Estimated at 1% of home price, Center for Regional Studies, UNR
Utilities	$	2,400	$	2,400	Estimated at $200 per month, Center for Regional Studies, UNR
Home Insurance	$	990	$	528	Estimated at 0.22% of home price, Center for Regional Studies, UNR
Total Home-Ownership Cost	**$**	**33,799**	**$**	**19,146**	
Estimated HH Income	$	102,422	$	58,019	Assumes home costs are 30% of total household income. Source: "The HUD Home Buying Guide." US Department of Housing and Urban Development, August 2004.

This estimated amount is multiplied by the number of new residential units to determine the total new income added to the region from the residential development.

4. Please put "1" in the service area in which the project will be located. If located in incorporated cities, Washoe County will not provide certain public safety, roads, and other services and certain revenues.

Incorporated City of Reno/City of Sparks	-
Unincorporated Washoe County	1

FISCAL IMPACT MODEL

MODULE 2
WASHOE COUNTY FISCAL IMPACT MODEL
RESULTS OF IMPLAN IMPACTS

YEAR	USE TYPE	EST. NEW CUMULAT. RESID. INCOME	EST. # OF CUMULAT. EMPLOYEES	ESTIMATED INDIRECT EMPLOYEES	ESTIMATED INDUCED EMPLOYEES	ESTIMATED TOTAL EMPLOYEES	ESTIMATED DIRECT LABOR INC.	ESTIMATED INDIRECT LABOR INC.	ESTIMATED INDUCED LABOR INC.	ESTIMATED TOTAL LABOR INC.	ESTIMATED DIRECT OUTPUT	ESTIMATED INDIRECT OUTPUT	ESTIMATED INDUCED OUTPUT	ESTIMATED TOTAL OUTPUT
Year 1	Single-family	$ 10,242,221			80	80			$ 3,372,624	$ 3,372,624			$ 10,380,211	$ 10,380,211
	Multi-family	4,351,434			36	36			1,531,876	1,531,876			4,712,458	4,712,458
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**14,593,654**	**207**	**76**	**176**	**460**	**7,728,170**	**3,035,759**	**7,469,470**	**18,233,399**	**23,579,055**	**9,520,952**	**22,957,840**	**56,057,847**
Year 2	Single-family	20,484,441			159	159			6,745,248	6,745,248			20,760,421	20,760,421
	Multi-family	8,702,867			72	72			3,063,751	3,063,751			9,424,915	9,424,915
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**29,187,309**	**207**	**76**	**292**	**575**	**7,728,170**	**3,035,759**	**12,373,970**	**23,137,898**	**23,579,055**	**9,520,952**	**38,050,508**	**71,150,515**
Year 3	Single-family	30,726,662			239	239			10,117,872	10,117,872			31,140,632	31,140,632
	Multi-family	13,054,301			109	109			4,595,627	4,595,627			14,137,373	14,137,373
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**43,780,963**	**207**	**76**	**408**	**691**	**7,728,170**	**3,035,759**	**17,278,469**	**28,042,398**	**23,579,055**	**9,520,952**	**53,143,176**	**86,243,183**
Year 4	Single-family	40,968,883			318	318			13,490,496	13,490,496			41,520,842	41,520,842
	Multi-family	17,405,735			145	145			6,127,503	6,127,503			18,849,830	18,849,830
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**58,374,617**	**207**	**76**	**523**	**807**	**7,728,170**	**3,035,759**	**22,182,969**	**32,946,898**	**23,579,055**	**9,520,952**	**68,235,844**	**101,335,851**
Year 5	Single-family	51,211,103			398	398			16,863,120	16,863,120			51,901,053	51,901,053
	Multi-family	21,757,169			181	181			7,659,378	7,659,378			23,562,288	23,562,288
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**72,968,272**	**207**	**76**	**639**	**922**	**7,728,170**	**3,035,759**	**27,087,469**	**37,851,397**	**23,579,055**	**9,520,952**	**83,328,512**	**116,428,520**

MODULE 2
WASHOE COUNTY FISCAL IMPACT MODEL
RESULTS OF IMPLAN IMPACTS

Year 6	Single-family	61,453,324			477	477			20,235,744	20,235,744			62,281,263	62,281,263
	Multi-family	26,108,602			217	217			9,191,254	9,191,254			28,274,745	28,274,745
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**87,561,926**	**207**	**76**	**755**	**1,038**	**7,728,170**	**3,035,759**	**31,991,968**	**42,755,897**	**23,579,055**	**9,520,952**	**98,421,180**	**131,521,188**
Year 7	Single-family	71,695,544			557	557			23,608,368	23,608,368			72,661,474	72,661,474
	Multi-family	30,460,036			253	253			10,723,130	10,723,130			32,987,203	32,987,203
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**102,155,580**	**207**	**76**	**870**	**1,154**	**7,728,170**	**3,035,759**	**36,896,468**	**47,660,397**	**23,579,055**	**9,520,952**	**113,513,848**	**146,613,856**
Year 8	Single-family	81,937,765			636	636			26,980,992	26,980,992			83,041,684	83,041,684
	Multi-family	34,811,470			289	289			12,255,005	12,255,005			37,699,660	37,699,660
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**116,749,235**	**207**	**76**	**986**	**1,269**	**7,728,170**	**3,035,759**	**41,800,968**	**52,564,896**	**23,579,055**	**9,520,952**	**128,606,516**	**161,706,524**
Year 9	Single-family	92,179,986			716	716			30,353,616	30,353,616			93,421,895	93,421,895
	Multi-family	39,162,903			326	326			13,786,881	13,786,881			42,412,118	42,412,118
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**131,342,889**	**207**	**76**	**1,102**	**1,385**	**7,728,170**	**3,035,759**	**46,705,468**	**57,469,396**	**23,579,055**	**9,520,952**	**143,699,185**	**176,799,192**
Year 10	Single-family	102,422,206			795	795			33,726,240	33,726,240			103,802,105	103,802,105
	Multi-family	43,514,337			362	362			15,318,757	15,318,757			47,124,575	47,124,575
	Hotel		3	1	1	4	96,843	28,370	29,870	155,082	257,258	83,169	91,593	432,020
	Casino		110	46	29	185	3,291,637	1,871,167	1,232,294	6,395,098	14,085,290	5,927,085	3,778,780	23,791,155
	Commercial		28	5	6	40	928,589	222,638	273,246	1,424,473	2,039,488	735,890	837,822	3,613,201
	Office		32	10	13	54	1,818,598	420,070	532,019	2,770,687	3,587,533	1,189,792	1,631,299	6,408,624
	Industrial		35	13	12	60	1,592,501	493,515	497,543	2,583,559	3,609,487	1,585,016	1,525,677	6,720,180
Sub total		**145,936,543**	**207**	**76**	**1,217**	**1,501**	**7,728,170**	**3,035,759**	**51,609,967**	**62,373,896**	**23,579,055**	**9,520,952**	**158,791,853**	**191,891,860**

MODULE 2, ASSUMPTIONS:

1. The following are ratios used to estimated indirect and induced impacts of employment, labor income, and output from an increase in the household (HH) income in the County:

MODULE 2
WASHOE COUNTY FISCAL IMPACT MODEL
RESULTS OF IMPLAN IMPACTS

Household Income	Employment/ $1,000 HHIncome	Labor Income/ $1,000 HHIncome	Output/ $1,000 HHIncome
$25,000-$35,000	0.009	$ 375	$ 1,140
$35,000-$50,000	0.008	$ 352	$ 1,083
$50,000-$75,000	0.008	$ 329	$ 1,013
$75,000-$100,000	0.007	$ 311	$ 960
$100,000-$150,000	0.007	$ 287	$ 876
>$150,000	0.004	$ 173	$ 531

Source: IMPLAN database for Washoe County, latest data available-2013. IMPLAN, Inc.

1. The following are values and multiplies used to estimated direct, indirect and induced impacts of employment, labor income, and output from an increase in industry production in the County:

		Employment Multipliers		Labor Income Multipliers			Output Multipliers		
	IMPLAN Cod	Indirect Multiplier	Induced Multiplier	Labor Income/ Employee	Indirect Multiplier	Induced Multiplier	Output/ Employee	Indirect Multiplier	Induced Multiplier
Hotel	499	0.2468	0.2752	$ 37,837	0.2929	0.3084	$ 100,511	0.3233	0.3560
Casino	495	0.4214	0.2644	$ 29,954	0.5685	0.3744	$ 128,176	0.4208	0.2683
Commer	396-406, 501-503, 509, 512	0.1932	0.2264	$ 32,624	0.2398	0.2943	$ 71,654	0.3608	0.4108
Office	47-466, 475-47	0.3257	0.3973	$ 57,589	0.2310	0.2925	$ 113,605	0.3316	0.4547
Industrial	416	0.3816	0.3353	$ 45,514	0.3099	0.3124	$ 103,159	0.4391	0.4227

Source: IMPLAN database for Washoe County, latest data available-2013. IMPLAN, Inc.

FISCAL IMPACT MODEL

MODULE 3
WASHOE COUNTY FISCAL IMPACT MODEL
LABOR MARKET IMPACTS-ESTIMATED EMPLOYEES AND POPULATION

YEAR	USE TYPE	TOTAL NEW EMPLOYEES	TOTAL NEW POPULATION	TOTAL NEW LABOR FORCE	CUMMULATIVE TOTAL NEW IN-COMM	TOTAL NEW OUT-COMM	TOTAL NEW LABOR INCOME	TOTAL NEW WAGES
Year 1	Single-family	80	166	85	2	1	$ 3,372,624	$ 2,347,346
	Multi-family	36	76	39	1	1	1,531,876	1,066,185
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**460**	**959**	**490**	**9**	**6**	**18,233,399**	**12,690,445**
Year 2	Single-family	159	331	170	3	2	6,745,248	4,694,693
	Multi-family	72	151	77	1	1	3,063,751	2,132,371
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**575**	**1,199**	**614**	**11**	**7**	**23,137,898**	**16,103,977**
Year 3	Single-family	239	496	254	4	3	10,117,872	7,042,039
	Multi-family	109	226	116	2	1	4,595,627	3,198,556
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**691**	**1,439**	**737**	**13**	**8**	**28,042,398**	**19,517,509**
Year 4	Single-family	318	660	339	5	3	13,490,496	9,389,385
	Multi-family	145	301	154	3	2	6,127,503	4,264,742
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**807**	**1,679**	**860**	**14**	**9**	**32,946,898**	**22,931,041**
Year 5	Single-family	398	824	424	6	4	16,863,120	11,736,732
	Multi-family	181	376	193	3	2	7,659,378	5,330,927
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**922**	**1,918**	**983**	**16**	**10**	**37,851,397**	**26,344,573**
Year 6	Single-family	477	989	509	7	5	20,235,744	14,084,078
	Multi-family	217	451	231	4	2	9,191,254	6,397,113
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**1,038**	**2,157**	**1,107**	**18**	**12**	**42,755,897**	**29,758,104**
Year 7	Single-family	557	1,153	593	8	6	23,608,368	16,431,424
	Multi-family	253	526	270	4	3	10,723,130	7,463,298
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**1,154**	**2,396**	**1,230**	**19**	**13**	**47,660,397**	**33,171,636**

MODULE 3
WASHOE COUNTY FISCAL IMPACT MODEL
LABOR MARKET IMPACTS-ESTIMATED EMPLOYEES AND POPULATION

YEAR	USE TYPE	TOTAL NEW EMPLOYEES	TOTAL NEW POPULATION	TOTAL NEW LABOR FORCE	CUMMULATIVE TOTAL NEW IN-COMM	TOTAL NEW OUT-COMM	TOTAL NEW LABOR INCOME	TOTAL NEW WAGES
Year 8	Single-family	636	1,317	678	9	6	26,980,992	18,778,771
	Multi-family	289	601	308	5	3	12,255,005	8,529,484
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**1,269**	**2,635**	**1,353**	**20**	**14**	**52,564,896**	**36,585,168**
Year 9	Single-family	716	1,481	763	10	7	30,353,616	21,126,117
	Multi-family	326	676	347	5	3	13,786,881	9,595,669
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**1,385**	**2,874**	**1,477**	**22**	**15**	**57,469,396**	**39,998,700**
Year 10	Single-family	795	1,644	847	11	8	33,726,240	23,473,463
	Multi-family	362	750	386	6	4	15,318,757	10,661,855
	Hotel	4	8	4	0	0	155,082	107,937
	Casino	185	385	198	3	2	6,395,098	4,450,988
	Commercial	40	85	43	1	1	1,424,473	991,433
	Office	54	114	58	1	1	2,770,687	1,928,398
	Industrial	60	126	64	1	1	2,583,559	1,798,157
Subtotal		**1,501**	**3,112**	**1,600**	**23**	**16**	**62,373,896**	**43,412,231**

MODULE 3, ASSUMPTIONS:

1. Total Employee estimates from Module 2.
2. Estimated New Population is the population generated by the project for the County. This is estimated using the Population equation of the Labor Impact Module, using information generated by Labor Force, In-Commuting, and Out-Commuting equations of the Labor Impact Module, as follows:

Population Model= **0.688** plus **0.487** times dependency rate, plus **0.996** times % change in labor force.

Labor Force Model= **0.357** plus **0.901** time % change in employment, plus **0.102** times % change in unemployment, plus **-0.004** times % change in out-commuters.

In-Commuters Model= **-2.438** plus **0.591** time % change in employment, plus **0.240** times % change in unemployment, plus **10.802** times % change in contiguous employment, plus **-10.474** times % change in contiguous labor force.

Out-Commuters Model= **-3.427** plus **0.740** time % change in employment, plus **0.143** times % change in unemployment, plus **11.131** times % change in contiguous employment, plus **-10.805** times % change in contiguous labor force.

It should be noted that area density is not expected to change due to the project, as a result, no calculation for this variable is included. Other variables, such as contiguous labor force and contiguous employment may change, but are excluded from this analysis as the project's impact on these variables is unknown. Unemployment is estimated to remain at **4.9%** of employment, the average of unemployment to employment ratio in Washoe County between 1990 and 2007 (pre-recession). Source: "Labor Force and Unemployment (LAUS)." Nevada Department of Employment, Training, and Rehabilitation (DETR).

All inputs into the models are adjusted to their natural log form and resulting output adjusted to their original form.

3. Analysis does not estimate population changes resulting directly from the residential portion of the project, as these residents are likely captured in the population impacts of the project or are employees of other commercial space in the region.
4. Total Labor Income information from Module 2. Labor Income includes wages and benefits payments to employees. The Fiscal Impact Module requires only wages data for new employees, as a result, Labor Income must be adjusted to exclude benefit payments.

According to BLS data, on average between 2004 and 2015, employee benefits made up **30.4%** of total compensation (labor income). This ratio is used to adjust labor income to arrive at wage payments only. Source: "Employer Costs for Employee Compensation." Bureau of Labor Statistics (BLS). Data for US, 2004-2015, All Civilian Total benefits for All occupations; Percent of total compensation.

MODULE 4
WASHOE COUNTY FISCAL IMPACT MODEL
FISCAL IMPACTS-COMPARISON OF ESTIMATED REVENUE TO ESTIMATED COSTS

	Base Year FY 14-15	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	10-YEAR TOTAL
GENERAL FUND												
REVENUE												
Taxes												
Ad Valorem General[1]	Module 5	$ -	$272,676	$ 454,460	$ 636,244	$ 818,027	$ 999,811	$1,181,595	$1,363,379	$1,545,163	$1,726,947	$ 8,998,302
Ad Valorem Detention Facility[1]	Module 5	-	21,333	35,556	49,778	64,000	78,222	92,445	106,667	120,889	135,111	704,001
Ad Valorem Indigent Insurance[1]	Module 5	-	4,134	6,891	9,647	12,403	15,159	17,916	20,672	23,428	26,184	136,434
Ad Valorem China Springs[1]	Module 5	-	2,398	3,997	5,595	7,194	8,792	10,391	11,990	13,588	15,187	79,132
Ad Valorem Family Court[1]	Module 5	-	5,292	8,820	12,348	15,876	19,404	22,932	26,460	29,988	33,516	174,636
Ad Valorem AB104[1]	Module 5	-	4,998	8,330	11,662	14,994	18,326	21,658	24,990	28,322	31,654	164,932
Room Tax[4]	315,000	-	-	-	-	-	-	-	-	-	-	-
Subtotal		$ -	$310,831	$ 518,062	$ 725,273	$ 932,494	$1,139,715	$1,346,936	$1,554,157	$1,761,378	$1,968,599	$ 10,257,438
Licenses and Permits												
Business Licenses/Permits												
Business Licenses[2]	$ 700,000	$ 1,553	$ 1,942	$ 2,330	$ 2,718	$ 3,106	$ 3,493	$ 3,880	$ 4,266	$ 4,653	$ 5,039	$ 32,979
Business Licenses/Elect and Telecom[2]	4,827,300	10,708	13,392	16,070	18,744	21,416	24,086	26,754	29,421	32,086	34,750	227,426
Liquor Licenses[2]	254,600	565	706	848	989	1,130	1,270	1,411	1,552	1,692	1,833	11,995
Local Gaming Licenses[2]	677,800	1,504	1,880	2,256	2,632	3,007	3,382	3,757	4,131	4,505	4,879	31,933
Franchise Fees[2]	1,415,000	3,139	3,925	4,710	5,494	6,278	7,060	7,842	8,624	9,405	10,186	66,664
County Gaming Licenses[2]	234,300	520	650	780	910	1,039	1,169	1,299	1,428	1,557	1,687	11,038
AB104 Gaming Licenses[2]	30,000	67	83	100	116	133	150	166	183	199	216	1,413
Nonbusiness Licenses and Permits												-
Marriage Affidavits[2]	175,000	388	485	583	680	776	873	970	1,067	1,163	1,260	8,245
Mobile Home Permits[2]	200	0	1	1	1	1	1	1	1	1	1	9
Other[4]	300	-	-	-	-	-	-	-	-	-	-	-
Subtotal		$ 18,443	$ 23,065	$ 27,677	$ 32,284	$ 36,886	$ 41,484	$ 46,079	$ 50,672	$ 55,262	$ 59,851	$ 391,702
Intergovernmental Revenue												
Federal/State Grants/Revenues[2]	$ 7,074,875	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
State Gaming Licenses[2]	146,986	9,335	82,360	100,081	117,802	135,523	153,244	170,965	188,686	206,407	224,128	1,388,532
BCCRT/SCCRT[4]	Module 6	64,639	82,360	100,081	117,802	135,523	153,244	170,965	188,686	206,407	224,128	1,443,837
Remainder C-Tax Revenue Sources[5]	15,812,572	35,076	43,866	52,639	61,400	70,152	78,897	87,637	96,372	105,102	113,829	744,968
AB 104 Sales Tax[4]	Module 6	9,339	11,899	14,459	17,019	19,579	22,140	24,700	27,260	29,820	32,381	208,596
Remainder AB 104 Revenue[6]	629,904	1,397	1,747	2,097	2,446	2,795	3,143	3,491	3,839	4,187	4,534	29,676
Other Revenue[4]	200,433	-	-	-	-	-	-	-	-	-	-	-
Subtotal		$119,786	$222,233	$ 269,367	$ 316,469	$ 363,572	$ 410,668	$ 457,758	$ 504,843	$ 551,923	$ 598,999	$ 3,815,609
Charges for Services												
General Government-Clerk/Recorder[2]	$ 2,462,000	$ 5,461	$ 6,830	$ 8,196	$ 9,560	$ 10,923	$ 12,284	$ 13,645	$ 15,006	$ 16,364	$ 17,723	$ 115,991
General Government-Other[2]	14,481,454	32,123	40,173	48,207	56,231	64,246	72,256	80,259	88,259	96,254	104,246	682,256
Judicial[2]	1,815,872	4,028	5,037	6,045	7,051	8,056	9,060	10,064	11,067	12,070	13,072	85,550
Public Safety[2]	4,887,878	10,842	13,560	16,271	18,979	21,685	24,388	27,090	29,790	32,488	35,186	230,280
Public Works[2]	180,550	400	501	601	701	801	901	1,001	1,100	1,200	1,300	8,506
Welfare[2]	5,000	11	14	17	19	22	25	28	30	33	36	236
Cultural and Recreation[4]	782,128	1,735	2,170	2,604	3,037	3,470	3,902	4,335	4,767	5,199	5,630	36,848
Subtotal		$ 54,601	$ 68,285	$ 81,941	$ 95,579	$ 109,203	$ 122,817	$ 136,421	$ 150,018	$ 163,609	$ 177,193	$ 1,159,666
Fines and Forfeits												
Fines[2]	$ 5,931,530	$ 13,157	$ 16,455	$ 19,746	$ 23,032	$ 26,315	$ 29,596	$ 32,874	$ 36,150	$ 39,425	$ 42,699	$ 279,448
Forfeits[4]	1,621,824	3,598	4,499	5,399	6,297	7,195	8,092	8,989	9,884	10,780	11,675	76,408
Subtotal		$ 16,755	$ 20,954	$ 25,144	$ 29,329	$ 33,510	$ 37,688	$ 41,862	$ 46,035	$ 50,205	$ 54,374	$ 356,856

MODULE 4
WASHOE COUNTY FISCAL IMPACT MODEL
FISCAL IMPACTS-COMPARISON OF ESTIMATED REVENUE TO ESTIMATED COSTS

	Base Year FY 14-15	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	10-YEAR TOTAL
Miscellaneous												
Miscellaneous[2]	$ 3,675,753	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
REVENUE TOTAL		$209,584	$645,368	$ 922,172	$1,198,934	$1,475,665	$1,752,371	$2,029,057	$2,305,725	$2,582,377	$2,859,016	$ 15,980,270
EXPENDITURES												
General Government												
General Government												
Commissioners[8]	$ 594,070	$ 1,485	$ 1,993	$ 2,257	$ 2,759	$ 3,022	$ 3,522	$ 4,023	$ 4,285	$ 4,548	$ 5,047	$ **32,942**
County Manager[8]	4,132,082	10,330	13,864	15,702	19,188	21,020	24,500	27,980	29,807	31,632	35,108	**229,129**
Elections[9]	1,508,359	3,335	4,171	5,005	5,837	6,670	7,501	8,332	9,162	9,992	10,822	**70,827**
Finance[8]	4,511,382	11,278	15,137	17,143	20,949	22,949	26,749	30,548	32,543	34,536	38,330	**250,162**
Human Resources[8]	2,107,818	5,269	7,072	8,010	9,788	10,722	12,498	14,273	15,205	16,136	17,909	**116,881**
Technology Services[8]	10,980,828	27,451	36,843	41,727	50,990	55,858	65,109	74,355	79,210	84,061	93,297	**608,902**
OPEB[8]	18,700,000	46,749	62,743	71,060	86,835	95,125	110,879	126,624	134,891	143,153	158,881	**1,036,940**
Accrued Benefits[8]	1,942,121	4,855	6,516	7,380	9,018	9,879	11,515	13,151	14,009	14,867	16,501	**107,693**
Centrally Managed Activities[8]	1,517,701	3,794	5,092	5,767	7,048	7,720	8,999	10,277	10,948	11,618	12,895	**84,159**
Assessor[9]	6,050,088	13,420	16,784	20,140	23,492	26,841	30,187	33,531	36,873	40,213	43,552	**285,034**
Clerk[9]	1,180,396	2,618	3,275	3,929	4,583	5,237	5,890	6,542	7,194	7,846	8,497	**55,611**
Recorder[9]	1,795,876	3,984	4,982	5,978	6,973	7,967	8,961	9,953	10,945	11,937	12,928	**84,608**
General Government Total		**$134,569**	**$178,472**	**$ 204,101**	**$ 247,460**	**$ 273,011**	**$ 316,311**	**$ 359,589**	**$ 385,072**	**$ 410,539**	**$ 453,767**	**$ 2,962,889**
Judicial												
District Courts[9]	$15,107,053	$ 33,511	$ 41,909	$ 50,290	$ 58,660	$ 67,022	$ 75,377	$ 83,727	$ 92,072	$ 100,413	$ 108,750	$ **711,729**
District Attorney[9]	17,638,783	39,126	48,932	58,718	68,491	78,254	88,009	97,758	107,502	117,240	126,975	**831,005**
Public Defender[9]	11,270,217	25,000	31,265	37,518	43,762	50,000	56,233	62,462	68,688	74,910	81,130	**530,967**
Justice Courts[9]	7,962,786	17,663	22,090	26,507	30,919	35,327	39,731	44,132	48,530	52,927	57,321	**375,146**
Incline Constable[10]	117,288	-	-	-	-	-	-	-	-	-	-	-
Judicial Total		**$115,300**	**$144,196**	**$ 173,033**	**$ 201,832**	**$ 230,602**	**$ 259,350**	**$ 288,078**	**$ 316,791**	**$ 345,490**	**$ 374,176**	**$ 2,448,847**
Public Safety												
Sheriff and Detention												
Operations[11]	Module 7	$186,065	$277,696	$ 279,232	$ 370,706	$ 372,134	$ 463,525	$ 554,886	$ 556,221	$ 557,534	$ 648,826	$ **4,266,826**
Administration[9]	$ 7,032,922	15,600	19,510	23,412	27,309	31,201	35,091	38,978	42,863	46,746	50,627	**331,338**
Detention[*]	52,211,452	115,816	144,841	173,807	202,735	231,634	260,510	289,368	318,209	347,036	375,850	**2,459,806**
Subtotal		$317,481	$442,048	$ 476,451	$ 600,749	$ 634,969	$ 759,126	$ 883,232	$ 917,293	$ 951,315	$1,075,303	$ 7,057,969
Medical Examiner												
Medical Examiner[9]	$ 2,285,032	$ 5,069	$ 6,339	$ 7,607	$ 8,873	$ 10,137	$ 11,401	$ 12,664	$ 13,926	$ 15,188	$ 16,449	$ **107,653**
Fire												
Fire Suppression[9]	$ 914,815	$ 2,029	$ 2,538	$ 3,045	$ 3,552	$ 4,069	$ 4,564	$ 5,070	$ 5,575	$ 6,081	$ 6,585	$ **43,099**
Corrections												
Juvenile Services[9]	$13,245,662	$ 29,382	$ 36,745	$ 44,094	$ 51,432	$ 58,764	$ 66,090	$ 73,410	$ 80,727	$ 88,040	$ 95,350	$ **624,035**

MODULE 4
WASHOE COUNTY FISCAL IMPACT MODEL
FISCAL IMPACTS-COMPARISON OF ESTIMATED REVENUE TO ESTIMATED COSTS

	Base Year FY 14-15	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	10-YEAR TOTAL
Protective Services												
Alternative Sentencing[9]	$ 727,813	$ 1,614	$ 2,019	$ 2,423	$ 2,826	$ 3,229	$ 3,631	$ 4,034	$ 4,436	$ 4,838	$ 5,239	$ 34,289
Emergency Management[9]	148,348	329	412	494	576	658	740	822	904	986	1,068	6,989
Public Administrator[9]	994,921	2,207	2,760	3,312	3,863	4,414	4,964	5,514	6,064	6,613	7,162	46,873
Public Guardian[9]	1,555,047	3,449	4,314	5,177	6,038	6,899	7,759	8,618	9,477	10,336	11,194	73,262
Subtotal		$ 7,600	$ 9,505	$ 11,405	$ 13,304	$ 15,200	$ 17,095	$ 18,988	$ 20,881	$ 22,773	$ 24,663	$ 161,413
Public Safety Total		$ 361,561	$ 497,174	$ 542,602	$ 677,910	$ 723,129	$ 858,276	$ 993,365	$1,038,403	$1,083,397	$1,218,352	$ 7,994,169
Public Works												
Public Works												
Community Services[10]	$15,322,396	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Public Works Total		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Welfare												
Social Services												
Human Services[9]	$ 1,056,861	$ 2,344	$ 2,932	$ 3,518	$ 4,104	$ 4,689	$ 5,273	$ 5,857	$ 6,441	$ 7,025	$ 7,608	$ 49,791
Indigent Services[9]	15,520,243	34,427	43,055	51,666	60,264	68,855	77,439	86,017	94,590	103,159	111,724	731,196
Welfare Total		$ 36,771	$ 45,987	$ 55,184	$ 64,368	$ 73,544	$ 82,712	$ 91,874	$ 101,031	$ 110,184	$ 119,332	$ 780,987
Culture and Recreation												
Culture and Recreation												
Library[9]	$ 7,752,059	$ 17,196	$ 21,505	$ 25,806	$ 30,101	$ 34,392	$ 38,679	$ 42,964	$ 47,246	$ 51,526	$ 55,804	$ 365,218
Regional Parks/Open Space[9]	4,005,100	8,884	11,111	13,333	15,552	17,768	19,984	22,197	24,410	26,621	28,831	188,690
Culture and Recreation Total		$ 26,080	$ 32,616	$ 39,139	$ 45,663	$ 52,160	$ 58,663	$ 65,161	$ 71,666	$ 78,147	$ 84,635	$ 553,908
Community Support[8]	$ 318,151	795	1,067	1,209	1,477	1,618	1,886	2,154	2,295	2,436	2,703	$ 17,642
Intergovernmental Expenditures												
Indigent Ins. Program[12]	$ 1,883,975	$ -	$ 4,134	$ 6,891	$ 9,647	$ 12,403	$ 15,159	$ 17,916	$ 20,672	$ 23,428	$ 26,184	$ 136,434
China Springs Youth Facility[12]	1,154,933	-	2,398	3,997	5,595	7,194	8,792	10,391	11,990	13,588	15,187	79,132
Groundwater Basins[10]	20,000	-	-	-	-	-	-	-	-	-	-	-
TM Regional Planning[10]	205,162	-	-	-	-	-	-	-	-	-	-	-
Ethics Commission Assessment[10]	25,000	-	-	-	-	-	-	-	-	-	-	-
Intergovernmental Expenditures		$ -	$ 6,532	$ 10,887	$ 15,242	$ 19,597	$ 23,952	$ 28,307	$ 32,662	$ 37,016	$ 41,371	$ 215,566
EXPENDITURES SUBTOTAL		$ 675,076	$ 906,045	$ 1,026,154	$1,253,942	$1,373,661	$1,601,149	$1,828,528	$1,947,909	$2,067,208	$2,294,336	$ 14,974,008
CONTINGENCY @	3%	$ 20,252	$ 27,181	$ 30,785	$ 37,618	$ 41,210	$ 48,034	$ 54,856	$ 58,437	$ 62,016	$ 68,830	$ 449,220
EXPENDITURES TOTAL		$ 695,328	$ 933,226	$ 1,056,939	$1,291,561	$1,414,870	$1,649,184	$1,883,384	$2,006,346	$2,129,224	$2,363,166	$ 15,423,228
GENERAL FUND SURPLUS/DEFICIT		$ (485,744)	$ (287,858)	$ (134,767)	$ (92,626)	$ 60,795	$ 103,188	$ 145,673	$ 299,379	$ 453,153	$ 495,850	$ 557,043

MODULE 4, ASSUMPTIONS:

Revenues

1 See Module 5 for real property tax revenue calculation. In the General Fund, revenue is divided among restricted and unrestricted sources as follows:

MODULE 4
WASHOE COUNTY FISCAL IMPACT MODEL
FISCAL IMPACTS-COMPARISON OF ESTIMATED REVENUE TO ESTIMATED COSTS

General Fund	Base Year FY 14-15	YEAR 1 Property Tax Rate	YEAR 2 % of General	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	10-YEAR TOTAL
General		0.9893	89.2%									
Detention Facility		0.0774	7.0%									
Indigent Insurance		0.015	1.4%									
China Springs		0.0087	0.8%									
Family Court		0.0192	1.7%									
Total		**1.1096**	**100.0%**	Source: Washoe County Budget, FY 2015-16.								

2 It is expected that an increase in population will lead to an increase in these revenues. However, as it is difficult to estimate how the development will impact these revenue sources, the analysis conservatively does not estimate revenue generated from these sources.

3 Per Capita Method: Revenues are calculated based on estimated FY 2014-15 Washoe County per capita revenue applied to estimated annual population generated by the project. Per capita revenue is calculated by dividing estimated FY 2014-15 revenues by Washoe County FY 2014-15 population of **432,324** Source: Washoe County Budget, FY 2015-16.

4 For calculation of BCCRT, SCCRT, and AB 104 revenue see Module 6.

5 In addition to CCRT revenue, Consolidated tax (C-tax) for the County includes revenue from Real Property Transfer Tax (RPTT), GST (MVPT), Cigarette and Liquor taxes. A per capita methodology as explained in footnote 3 is applied to estimate this revenue. Washoe County revenues from RPTT, GST, Cigarette and Liquor Tax was $30,841,006 in FY 2014-15. The County is estimated to receive **51.27%** of all County C-tax revenue. As a result, the County's portion of RPTT, GST, Cigarette and Liquor Tax revenue is estimated at **$ 15,812,572** which is used to estimate development impacts using the per capita methodology in footnote 3. Source: Nevada Department of Taxation. "Consolidated Tax Distribution FY 2014-15."

6 In addition to sales tax revenue, AB 104 revenue for the County includes revenue from property, gaming, MVPT, and RPTT taxes. A per capita methodology as explained in footnote 3 is applied to estimate this revenue. Washoe County revenues from these sources totaled **$ 944,865** in FY 2014-15, this excludes property tax revenue which is calculated separately and gaming revenue on which the development is likely to have a minor impact. The County is estimated to receive **66.67%** of all County AB104 revenue. As a result, the County's portion of the remainder of AB104 revenue is estimated at **$ 629,904** which is used to estimate development impacts using the methodology in footnote 3. Source: Nevada Department of Taxation. "Local Government Tax Act Distribution FY 2014-15."

Expenditures

8 Administration service (indirect) costs assumed to be impacted by the development are calcul **20%** of all direct service costs. Percent indirect costs of direct costs for FY 2014-15. Source: Washoe County Budget, FY 2015-16.

9 Per Capita Method: Expenditures are calculated based on estimated FY 2014-15 Washoe County per capita expenditures applied to estimated annual population of the development. Per capita cost is calculated by dividing FY 2014-15 expenditures for each source by Washoe County FY 2014-15 population. Source: Washoe County Budget FY 2015-16.

10 As the impact of the development on these expenditures is difficult to estimate, the analysis does not estimate costs associated with these expenditures. Alternately, no costs associated with the project are expected to occur.

11 See Module 7 for calculation of Operations costs.

12 The amount of the expenditure is the same as the revenue estimated to be generated by the ad valorem rate for this source.

MODULE 5
WASHOE COUNTY FISCAL IMPACT MODEL
ESTIMATED REAL PROPERTY TAX REVENUE

		TAXABLE		CUMULATIVE ASSESED											
YEAR	USE TYPE	LAND IMPROVS. VALUE	BUILDING IMPROVS. VALUE	LAND IMPROV. VALUE	BUILDING VALUE	GENERAL FUND REVENUE	AB104 REVENUE	LIBRARY EXPANSION REVENUE	ANIMAL SERVICES REVENUE	INDIGENT TAX LEVY REVENUE	CHILD PROTECT. REVENUE	SENIOR SERVICES REVENUE	OTHER SPECIAL REVENUE	CAPITAL FACILITIES REVENUE	DEBT SERVICE REVENUE
Year 1	Single-family	$ 9,375,000	$ 28,125,000	$ 3,281,250	$ 9,843,750	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Multi-family	3,750,000	11,250,000	1,312,500	3,937,500	-	-	-	-	-	-	-	-	-	-
	Hotel	500,000	2,000,000	175,000	700,000	-	-	-	-	-	-	-	-	-	-
	Casino	1,500,000	6,000,000	525,000	2,100,000	-	-	-	-	-	-	-	-	-	-
	Commercial	750,000	3,000,000	262,500	1,050,000	-	-	-	-	-	-	-	-	-	-
	Office	750,000	3,000,000	262,500	1,050,000	-	-	-	-	-	-	-	-	-	-
	Industrial	2,500,000	6,250,000	875,000	2,187,500	-	-	-	-	-	-	-	-	-	-
Subtotal		**19,125,000**	**59,625,000**	**6,693,750**	**20,868,750**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Year 2	Single-family	9,375,000	28,125,000	6,562,500	19,687,500	145,635	3,570	2,625	3,938	7,875	5,250	1,313	1,313	6,563	4,581
	Multi-family	3,750,000	11,250,000	2,625,000	7,875,000	58,254	1,428	1,050	1,575	3,150	2,100	525	525	2,625	1,832
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,050	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**11,287,500**	**34,650,000**	**305,834**	**7,497**	**5,513**	**8,269**	**16,538**	**11,025**	**2,756**	**2,756**	**13,781**	**9,619**
Year 3	Single-family	9,375,000	28,125,000	9,843,750	29,531,250	291,270	7,140	5,250	7,875	15,750	10,500	2,625	2,625	13,125	9,161
	Multi-family	3,750,000	11,250,000	3,937,500	11,812,500	116,508	2,856	2,100	3,150	6,300	4,200	1,050	1,050	5,250	3,665
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,050	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**15,881,250**	**48,431,250**	**509,723**	**12,495**	**9,188**	**13,781**	**27,563**	**18,375**	**4,594**	**4,594**	**22,969**	**16,032**
Year 4	Single-family	9,375,000	28,125,000	13,125,000	39,375,000	436,905	10,710	7,875	11,813	23,625	15,750	3,938	3,938	19,688	13,742
	Multi-family	3,750,000	11,250,000	5,250,000	15,750,000	174,762	4,284	3,150	4,725	9,450	6,300	1,575	1,575	7,875	5,497
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,050	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**20,475,000**	**62,212,500**	**713,612**	**17,493**	**12,863**	**19,294**	**38,588**	**25,725**	**6,431**	**6,431**	**32,156**	**22,445**
Year 5	Single-family	9,375,000	28,125,000	16,406,250	49,218,750	582,540	14,280	10,500	15,750	31,500	21,000	5,250	5,250	26,250	18,323
	Multi-family	3,750,000	11,250,000	6,562,500	19,687,500	233,016	5,712	4,200	6,300	12,600	8,400	2,100	2,100	10,500	7,329
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,050	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**25,068,750**	**75,993,750**	**917,501**	**22,491**	**16,538**	**24,806**	**49,613**	**33,075**	**8,269**	**8,269**	**41,344**	**28,858**

MODULE 5
WASHOE COUNTY FISCAL IMPACT MODEL
ESTIMATED REAL PROPERTY TAX REVENUE

Year 6	Single-family	9,375,000	28,125,000	19,687,500	59,062,500	728,175	17,850	13,125	19,688	39,375	26,250	6,563	6,563	32,813	22,903
	Multi-family	3,750,000	11,250,000	7,875,000	23,625,000	291,270	7,140	5,250	7,875	15,750	10,500	2,625	2,625	13,125	9,161
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,060	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**29,662,500**	**89,775,000**	**1,121,390**	**27,489**	**20,213**	**30,319**	**60,638**	**40,425**	**10,106**	**10,106**	**50,531**	**35,271**
Year 7	Single-family	9,375,000	28,125,000	22,968,750	68,906,250	873,810	21,420	15,750	23,625	47,250	31,500	7,875	7,875	39,375	27,484
	Multi-family	3,750,000	11,250,000	9,187,500	27,562,500	349,524	8,568	6,300	9,450	18,900	12,600	3,150	3,150	15,750	10,994
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,060	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**34,256,250**	**103,556,250**	**1,325,279**	**32,487**	**23,888**	**35,831**	**71,663**	**47,775**	**11,944**	**11,944**	**59,719**	**41,684**
Year 8	Single-family	9,375,000	28,125,000	26,250,000	78,750,000	1,019,445	24,990	18,375	27,563	55,125	36,750	9,188	9,188	45,938	32,064
	Multi-family	3,750,000	11,250,000	10,500,000	31,500,000	407,778	9,996	7,350	11,025	22,050	14,700	3,675	3,675	18,375	12,826
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,060	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**38,850,000**	**117,337,500**	**1,529,168**	**37,485**	**27,563**	**41,344**	**82,688**	**55,125**	**13,781**	**13,781**	**68,906**	**48,097**
Year 9	Single-family	9,375,000	28,125,000	29,531,250	88,593,750	1,165,080	28,560	21,000	31,500	63,000	42,000	10,500	10,500	52,500	36,645
	Multi-family	3,750,000	11,250,000	11,812,500	35,437,500	466,032	11,424	8,400	12,600	25,200	16,800	4,200	4,200	21,000	14,658
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,060	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**43,443,750**	**131,118,750**	**1,733,057**	**42,483**	**31,238**	**46,856**	**93,713**	**62,475**	**15,619**	**15,619**	**78,094**	**54,509**
Year 1(	Single-family	9,375,000	28,125,000	32,812,500	98,437,500	1,310,715	32,130	23,625	35,438	70,875	47,250	11,813	11,813	59,063	41,226
	Multi-family	3,750,000	11,250,000	13,125,000	39,375,000	524,286	12,852	9,450	14,175	28,350	18,900	4,725	4,725	23,625	16,490
	Hotel	-	-	175,000	700,000	9,709	238	175	263	525	350	88	88	438	305
	Casino	-	-	525,000	2,100,000	29,127	714	525	788	1,575	1,060	263	263	1,313	916
	Commercial	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Office	-	-	262,500	1,050,000	14,564	357	263	394	788	525	131	131	656	458
	Industrial	-	-	875,000	2,187,500	33,982	833	613	919	1,838	1,225	306	306	1,531	1,069
Subtotal		**13,125,000**	**39,375,000**	**48,037,500**	**144,900,000**	**1,936,946**	**47,481**	**34,913**	**52,369**	**104,738**	**69,825**	**17,456**	**17,456**	**87,281**	**60,922**
TOTAL		**$ 137,250,000**	**$ 414,000,000**			**$ 10,092,506**	**$ 247,401**	**$ 181,913**	**$ 272,869**	**$ 545,738**	**$ 363,825**	**$ 90,956**	**$ 90,956**	**$ 454,781**	**$ 317,437**

MODULE 5, ASSUMPTIONS:

1. Assessed land and building improvement values are estimating by adjusting taxable values estimated in Module 1 by 35%.

MODULE 5
WASHOE COUNTY FISCAL IMPACT MODEL
ESTIMATED REAL PROPERTY TAX REVENUE

2. Operating tax rate is assumed to remain constant at FY 2015-16 amount. Washoe County is to receive the following property tax rates by project location:

General Fund	$	1.1096	
AB104		0.0272	Of this revenue, Washoe County received **66.7%** between FY 2012-13 and FY 2014-15. Source: Nevada Department of Taxation.
Library Expansion		0.0200	Libraries rate expires FY 2024-25, analysis assumes the rate will continue through the analysis period.
Animal Services		0.0300	Animal Shelter rate expires FY 2032-33, analysis assumes the rate will continue through the analysis period.
Indigent Tax Levy		0.0600	
Child Protective Services		0.0400	
Senior Services		0.0100	
Other Restricted Special Revenue		0.0100	
Capital Facilities		0.0500	
Debt		0.0349	
Total County Rate	**$**	**1.3917**	Source: Nevada Department of Taxation. "Property Tax Rates for Nevada Local Governments." FY 2015-16.

General Fund and AB104 revenue are distributed to the General Fund. Revenue from other tax rates is distributed to other special revenue funds. It is shown about, but is not included in Module 4.

3. Building and land improvement values are estimated to be added to the County rolls, generating property tax revenue, the year following construction to account for work in progress.

MODULE 6
WASHOE COUNTY FISCAL IMPACT MODEL
ESTIMATED SALES TAX REVENUE

YEAR	USE TYPE	TOTAL NEW WAGES	TAXABLE EXPENDITURES	CCRT TAX REVENUE	AB 104 TAX REVENUE	PUBLIC MASS TRANSPORT.	RAILROAD GRADE	INFRASTRUCT. REVENUE
Year 1	Single-family	$ 3,372,624	$ 1,075,154	$ 12,186	$ 1,761	$ 3,961	$ 1,320	$ 1,320
	Multi-family	1,531,876	488,344	5,535	800	1,799	600	600
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**18,233,399**	**5,703,070**	**64,639**	**9,339**	**21,012**	**7,004**	**7,004**
Year 2	Single-family	6,745,248	2,150,308	24,372	3,521	7,923	2,641	2,641
	Multi-family	3,063,751	976,689	11,070	1,599	3,598	1,199	1,199
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**23,137,898**	**7,266,568**	**82,360**	**11,899**	**26,773**	**8,924**	**8,924**
Year 3	Single-family	10,117,872	3,225,462	36,558	5,282	11,884	3,961	3,961
	Multi-family	4,595,627	1,465,033	16,605	2,399	5,398	1,799	1,799
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**28,042,398**	**8,830,067**	**100,081**	**14,459**	**32,533**	**10,844**	**10,844**
Year 4	Single-family	13,490,496	4,300,616	48,744	7,042	15,845	5,282	5,282
	Multi-family	6,127,503	1,953,378	22,140	3,199	7,197	2,399	2,399
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**32,946,898**	**10,393,565**	**117,802**	**17,019**	**38,294**	**12,765**	**12,765**
Year 5	Single-family	16,863,120	5,375,770	60,930	8,803	19,806	6,602	6,602
	Multi-family	7,659,378	2,441,722	27,675	3,998	8,996	2,999	2,999
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**37,851,397**	**11,957,064**	**135,523**	**19,579**	**44,054**	**14,685**	**14,685**
Year 6	Single-family	20,235,744	6,450,924	73,116	10,563	23,768	7,923	7,923
	Multi-family	9,191,254	2,930,067	33,210	4,798	10,795	3,598	3,598
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**42,755,897**	**13,520,562**	**153,244**	**22,140**	**49,815**	**16,605**	**16,605**
Year 7	Single-family	23,608,368	7,526,078	85,302	12,324	27,729	9,243	9,243
	Multi-family	10,723,130	3,418,411	38,745	5,598	12,595	4,198	4,198
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**47,660,397**	**15,084,061**	**170,965**	**24,700**	**55,575**	**18,525**	**18,525**

MODULE 6
WASHOE COUNTY FISCAL IMPACT MODEL
ESTIMATED SALES TAX REVENUE

YEAR	USE TYPE	TOTAL NEW WAGES	TAXABLE EXPENDITURES	CCRT TAX REVENUE	AB 104 TAX REVENUE	PUBLIC MASS TRANSPORT.	RAILROAD GRADE	INFRASTRUCT. REVENUE
Year 8	Single-family	26,980,992	8,601,232	97,488	14,084	31,690	10,563	10,563
	Multi-family	12,255,005	3,906,756	44,280	6,397	14,394	4,798	4,798
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**52,564,896**	**16,647,559**	**188,686**	**27,260**	**61,336**	**20,445**	**20,445**
Year 9	Single-family	30,353,616	9,676,386	109,674	15,845	35,651	11,884	11,884
	Multi-family	13,786,881	4,395,100	49,815	7,197	16,193	5,398	5,398
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**57,469,396**	**18,211,058**	**206,407**	**29,820**	**67,096**	**22,365**	**22,366**
Year 10	Single-family	33,726,240	10,751,540	121,860	17,605	39,613	13,204	13,204
	Multi-family	15,318,757	4,883,445	55,350	7,997	17,992	5,997	5,997
	Hotel	155,082	49,438	560	81	182	61	61
	Casino	6,395,098	2,038,684	23,107	3,338	7,511	2,504	2,504
	Commercial	1,424,473	454,106	5,147	744	1,673	558	558
	Office	2,770,687	773,734	8,770	1,267	2,851	950	950
	Industrial	2,583,559	823,609	9,335	1,349	3,034	1,011	1,011
Subtotal		**62,373,896**	**19,774,556**	**224,128**	**32,381**	**72,857**	**24,286**	**24,286**
TOTAL		**$ 403,036,472**	**$ 127,388,132**	**$ 1,443,837**	**$ 208,596**	**$ 469,346**	**$ 156,449**	**$ 156,449**

MODULE 6, ASSUMPTIONS:

1. Total new wages from Module 3-Estimated Total Labor Income.
2. A portion of new wages will be spent on items taxable for sales tax purposes. A breakdown of the percent of taxable expenditures of wages (income) is provided below by level of income:

Use Type	Average Employee Income	Taxable Expenditure as % of Employee Income
Single-family	$ 29,524	31.88%
Multi-family	29,476	31.88%
Hotel	27,708	31.88%
Casino	24,026	31.88%
Commercial	24,538	31.88%
Office	35,443	27.93%
Industrial	29,932	31.88%

Source: "Income before taxes: Annual expenditure means, shares, standard errors, and coefficients of variation, 2014." Consumer Expenditure Survey, Bureau of Labor Statistics.

3. Sales tax rates applicable to Washoe County are as follows:
   - **0.500%** Basic City County Relief Tax (BCCRT)
   - **1.750%** Supplemental City County Relief Tax (SCCRT)
   - **0.250%** Fair Share (AB 104)
   - **0.375%** Public Mass Transportation
   - **0.125%** Washoe Railroad Grade
   - **0.125%** Infrastructure

   Of these, only the BCCRT, SCCRT, and AB 104 revenue is distributed to the General Fund, other revenues are estimated above, but are not shown in Module 4.
4. BCCRT and SCCRT (CCRT) sales tax revenue generated in the County is distributed to Washoe County at **51.3%** of total.
   Source: Distribution based on average percentage share of Washoe County C-Tax distribution from FY 2012-13 to FY 14-15. Data from Nevada Department of Taxation "Consolidated Tax Distribution: Revenue Summary by County."
5. AB104 sales tax revenue generated in the County is distributed to Washoe County at **66.7%** of total.
   Source: Distribution based on average percentage share of Washoe County AB104 distribution from FY 2012-13 to FY 14-15. Data from Nevada Department of Taxation. "Local Government Tax Act Distribution."
6. A State administrative fee of **1.75%** of all sales tax revenue is subtracted for State uses. Source: AB 552.

MODULE 7
WASHOE COUNTY FISCAL IMPACT MODEL
SHERIFF OPERATIONS COST PROJECTIONS

YEAR	ESTIMATED POPULATION	OFFICERS REQUIRED	SALARY/ BENEFITS	SERVICES/ SUPPLIES	VEHICLE PURCHASE	TOTAL COST
Year 1	959	1.582	$ 153,485	$ 32,580	$ -	$ 186,065
Year 2	1,199	1.979	191,952	40,745	45,000	277,696
Year 3	1,439	2.375	230,339	48,893	-	279,232
Year 4	1,679	2.770	268,675	57,031	45,000	370,706
Year 5	1,918	3.165	306,974	65,160	-	372,134
Year 6	2,157	3.559	345,242	73,283	45,000	463,525
Year 7	2,396	3.953	383,486	81,401	90,000	554,886
Year 8	2,635	4.348	421,708	89,514	45,000	556,221
Year 9	2,874	4.741	459,911	97,623	-	557,534
Year 10	3,112	5.135	498,097	105,729	45,000	648,826
TOTAL			**$ 3,259,868**	**$ 691,957**	**$ 315,000**	**$ 4,266,826**

MODULE 7, ASSUMPTIONS:

1. See Module 3 for population estimates.
2. The analysis uses Western States average of **1.7** uniformed officers per 1,000 of population. Source: Washoe County Sheriff's Office. This includes all uniformed officers for the Department, including patrol, detectives, etc. No officers are estimated if the project is located in the City of Reno or Sparks as indicated in Module 1.
3. Compensation is estimated at **$ 97,000** including benefits.
4. Services/Supplies costs calculated at **21.2%** of salaries and benefits.
   Source: Three-year average FY 2013-14 through FY 2015-16 from Washoe County Budget FY 2015-16.
5. Two vehicles are added per three rotation shift at a cost of **$ 45,000** Life of vehicle is 5 years.
   Source: Washoe County Sheriff's Office. The analysis assumes 3 vehicles will be added.

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