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# Mid-Continent Regional Science Association

# 2015 Conference Proceedings

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**John Leatherman, Compiler**

**with assistance from**

**Rebecca Bishop, Extension Associate**

**Department of Agricultural Economics**

**Kansas State University**

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2015 MCRSA Conference Proceedings

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# CITY DEVELOPMENT: AN IMPACT MODEL OF A GREEN-FIELD DEVELOPMENT PROJECT

**Megan Sexton**
**Brinda Mahalingam**
**Jeff Thompson**
*The University of Alabama in Huntsville - USA*

**Abstract**

The development of a city, in collaboration with private developers has long been an economic and political issue. The determination of how an area develops can be viewed from the perspective of an economist by using an economic development model and calculating the income, tax, and employment impacts on the community. This study develops a template by examining recent attempts by a city, to develop a green-field area in collaboration with a private developer. The project involves development of a shopping center with a mix of typical stores, such as restaurants and retail stores. In addition, a sports complex is included and its impact on the neighboring community is assessed. The study uses the IMPLAN model to calculate the multiplier effect and estimates the period of time required to recover the initial investment. The model is versatile and may be used by any city to calculate the impact of various development projects by suitably altering input revenues scaled to the size of the city.

## 1. Background

An economic impact study is often conducted to estimate an impact on the region when there is a change in activity in the region. The impact studied can be undertaken for a variety of reasons. A local city can look at the impact on projects it undertakes, a private firm may examine the impact it has on the local economy, and a state may study the impact of the taxes it collects and the economic impact on the region's employment, and so on. Income, labor income, employment and taxes are all impacts that can be studied.

There are programs that can compute economic impacts for any region that economists and researchers have utilized. MIG Incorporated is a company that has developed software called IMPLAN that can compute impacts. Data for different regions can be bought and the software allows customization so that different scenarios can be examined.

A city or local government often is faced with decisions on how it manages its region and a comprehensive impact study can provide some insights to the planner. However, an impact study can be an expensive proposition and so this study provides a template which any city can use to get a quick overall idea of how a project will benefit its region.

Recently, the city of Huntsville, Alabama went through a process whereby the city wanted to develop a park that was in disrepair. Using the process that the city of Huntsville undertook, we propose and develop a simplified template on how a typical city can view redevelopment or development of a particular region.

## 2. Introduction

The city of Huntsville, nicknamed "The Rocket City" for its close history with U.S. space missions, is a city centrally located in the northernmost part of the state of Alabama. Huntsville is the county seat of Madison County, and the fourth-largest city in Alabama. The 2013 estimated census reports that Huntsville's population is about 186,000 and has had a 3.3% population growth since the 2010 estimated census. A significant source of Huntsville's economic influence is the military and aerospace technology, Redstone Arsenal, Cummings Research Park, and NASA's Marshall Space Flight Center that comprise the main hubs for the area's technology-driven economy. Fifty-seven fortune 500 companies have locations in Huntsville as well. Huntsville's quality of life is second to none and it has successfully combined the rich heritage of Southern hospitality with innovative high-tech ventures and cultural diversity into one city. Huntsville is still what people call "a big little city" implying that Huntsville is not quite so big and it does not have the problems that big cities face.

However, like other cities, Huntsville has to manage its scarce resources to provide services to its citizens and maximize the usage of the resources at its disposal. Many cities have underdeveloped parks and/or parcels within their city and do not have the ability to upgrade and maintain them as they would like. Huntsville is no different from any of these cities.

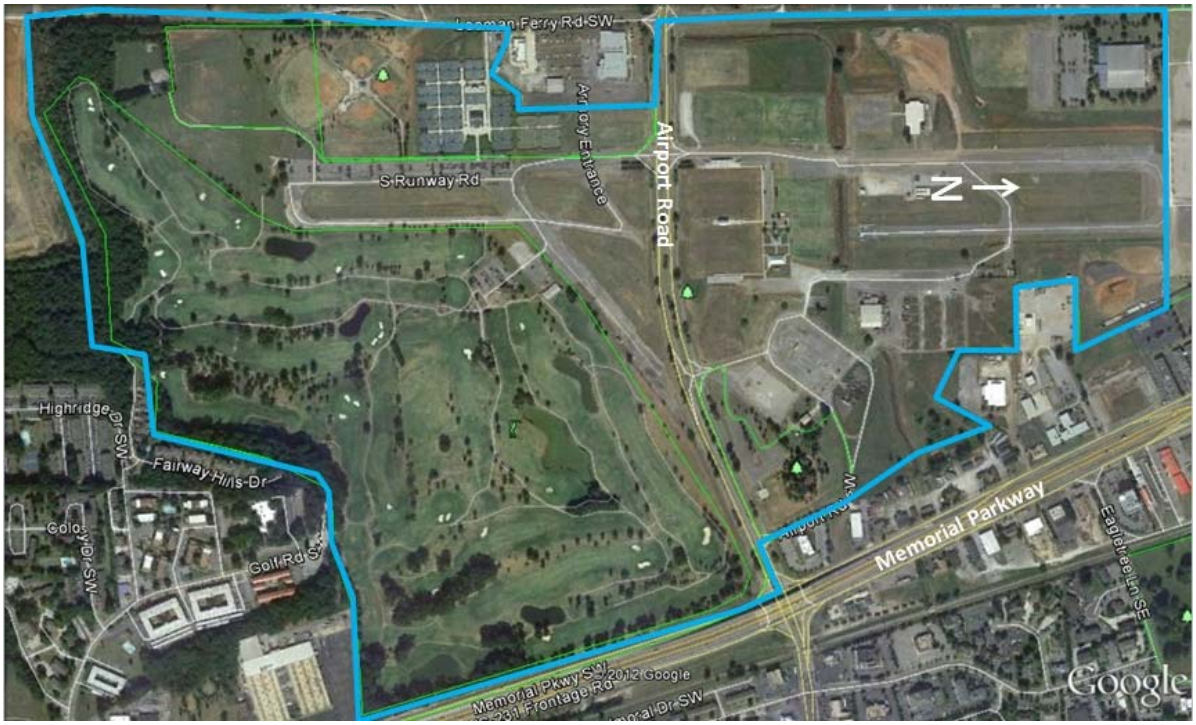


**Figure 1. An aerial view of the underdeveloped park in the city of Huntsville.**
Source: http://huntsvilledevelopment.blogspot.com/2012/10/the-john-hunt-park-master-plan.html

Twenty years ago, the City Council christened 428 acres in Southeast Huntsville as John Hunt Park in honor of the area's first settler. Originally, home to Huntsville's first airport, the park now boasts four baseball fields, multiple tennis courts, a golf course, more than a dozen soccer fields, and the Kid's Space playground. However, there are some things that don't quite fit. For example, parts of the park aren't very park-like, including old military equipment behind the Veterans Memorial Museum, fields of dirt and gravel, and vast stretches of pavement where remnants of the old runway are still present as can be seen in Figure 1.

The City of Huntsville decided to re-develop this land to enhance some its features and usefulness to the community. Using the process that the city undertook, this study will explain how a city with no excess funds, can use this study as a template and as a low cost alternative to a formal economic impact study to weigh their options of doing a park re-development.

## 3. Purpose

Two questions arise when a city has an underdeveloped park/parcel. First, how could the city afford to redevelop their old parks and second, how could a city benefit through redevelopment of their park/parcel without upsetting the majority of its citizens? After all, it's the citizens who would be the ones pushing

for and benefitting from the redevelopment of the park.

When a city is faced with the problem of an underdeveloped park, it has four options:

(i) Let the park/parcel exist in its current state. This option would not drain the city's resources. However, it may not maximize utilization of the city's scarce resources.

(ii) The city could sell the property to a private developer to develop the land. This option would provide extra money for the city however, it also means that the city could lose control of the property and possibly lose a place for recreation.

(iii) The city could undertake the full cost of the re-development project. This option would still leave the city in control of the property so that they can oversee its development, but may require more resources than are available to undertake and maintain such a project

(iv) Finally, the city could sell a portion of the park/parcel to a private developer. This could result in generating enough revenues to upgrade and continue to maintain the park which can provide better facilities to its citizens. The fourth option still comes with the usual risks of losing control of that property that has been when dealing with a private developer. It is possible that the private developer may not develop the land at all or once developed, the property may not bring in the revenue the city had expected.

In 2012, the fourth option of selling part of the park to develop the rest of the park is what the city of Huntsville elected to pursue. The city of Huntsville decided to sell a 25-acre tract of the park to a private developer for retail development and use that money and further commit 25% of its sales tax revenues generated from the retail development to create a revenue stream to fund and support the construction of a brand new sportsplex as well as for the ongoing development and maintenance of the park. The goal of the John Hunt Park Master Plan is to tie together all of the great facilities that already exist and convert the remaining balance of the 387-acres of the park into "the Rocket City's version of New York's Central Park" as Mayor Battle called it. The city estimated that the $100 million plan to overhaul the park will be completed in phases over several years gradually transforming the site of Huntsville's first airport into a lush setting for concerts, picnics, team sports, family outings and more. The plan for the park is shown in Figure 2.


**Figure 2. Plan for the redevelopment of the park in the city of Huntsville.**
Source: http://huntsvilledevelopment.blogspot.com/2012/10/the-john-hunt-park-master-plan.html

In 2013, the City of Huntsville selected a private developer from Nashville, TN to develop the mixed-use retail facility. However, in June 2014, negotiations ended with the developer and the property is back on the market. Even if this plan for the redevelopment of the park is not implemented, the city's plan can be used as a template for other cities to evaluate similar development opportunities.

Since not all cities can afford to undertake the costs of conducting a comprehensive economic impact study, this template could be used to quantify the benefits and impact of using this option tailored to their specific situation. This template could be used to estimate how much of the property would need to be sold in order to generate sufficient revenues to further upgrade and maintain the rest of the park.

## 4. Methodology

The template developed in this paper requires the city to compile a list of the

typical developers who have retail developments in their region and the annual revenues from these retail developments customized to the region. Then the city would use the regional multiplier to estimate the impact and the potential revenue stream that would be generated from this option.


**Figure 3. Plan for the retail space.**
Source: http://www.gbtrealty.com/uploads/project_534c71a2aa5c2.pdf

We first used the developer's plan for the mixed-use retail facility as shown in Figure 3 above, and tailored it to estimate the typical suite sizes and to estimate a list of the typical occupants based on past developments in the Huntsville area. Then this information is used to estimate the capital expenditures cost per square foot of the mixed-use retail facility and the sportsplex, based on industry averages in the area constructed. The industry averages for the construction are about $300 per square feet for the mixed-use retail facility and about $123 per square feet for the sportsplex for this region (data provided by Mr. Thompson, Director of CMER, BAB, UAH). The same method is used to estimate revenues per square foot for the mixed-use retail facility and the sportsplex based on industry averages. The industry gross sales averages for the mixed-use retail facility are about $500 per square feet about $30 per square feet for the sportsplex.

Assuming a two percent real revenue growth for the first five years, the annual revenues were then calculated for the retail facility and sportsplex. The results are given in Table 3.

**Table 1. Estimated Capital Expenditure.***

| Inputs | Sq. Ft. | Cost per Sq. Ft. | Total Cost |
|---|---|---|---|
| Retail | $181,850 | $150 | $27,277,500 |
| Restaurant | $16,260 | $150 | $4,878,000 |
| Recreational | $150,000 | $120 | $18,000,000 |
| Equipment | $150,000 | $3 | $450,000 |

* Stated in 2015 Dollars

Source: Jeff Thompson, Director of Center for Management & Economic Research

**Table 2. Estimated First year Annual Revenue.***

| Inputs | Sq. Ft. | Sales per Sq. Ft. | Total Cost |
|---|---|---|---|
| Retail | $181,850 | $200 | $36,370,000 |
| Restaurant | $16,260 | $300 | $4,878,000 |
| Recreational | $150,000 | $30 | $4,500,000 |

* Stated in 2015 Dollars

Source: Jeff Thompson, Director of Center for Management & Economic Research

From Table 3, it is evident that the first year will generate about $45.7 million, the second year will generate about $47.6 million, the third year will generate about $49.5 million, the fourth year will generate about $51.5 million, and the fifth year will generate about $53.5 million. Thus over five years, the mixed-use retail facility and sportsplex will generate about $247.8 million.

**Table 3: Estimated Annual Revenues.**

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Total |
|---|---|---|---|---|---|---|
| Retail | $36,370,000 | $37,824,800 | $39,337,792 | $40,911,304 | $42,547,756 | $196,991,652 |
| Restaurant | $4,878,000 | $5,073,120 | $5,276,045 | $5,487,087 | $5,706,570 | $26,420,821 |
| Recreational | $4,500,000 | $4,680,000 | $4,867,200 | $5,061,888 | $5,264,364 | $24,373,452 |
| Total | $45,748,000 | $47,577,920 | $49,481,037 | $51,460,278 | $53,518,689 | $247,785,924 |

Estimated at a 2% Real Revenue Growth

*Stated in 2015 Dollars

Cumulative revenues for the first ten, twenty and thirty years for the mixed-use retail facility and sportsplex were then generated, holding the real revenue growth constant after the first five years. The results are presented in Table 4. It is

evident from table 4 that the total cumulative revenues generated will be about $515.4 million in the first 10 years, it will be about $1,050.6 million in the first 20 years, and it will be about $1,585.8 million in the first 30 years.

**Table 4: Estimated Cumulative Revenues.***

| | Year 10 | Year 20 | Year 30 |
|---|---|---|---|
| Retail | $409,730,431 | $835,207,989 | $1,260,685,547 |
| Restaurant | $54,953,672 | $112,019,372 | $169,085,073 |
| Recreational | $50,695,269 | $103,338,904 | $155,982,540 |
| Total | $515,379,371 | $1,050,566,266 | $1,585,753,160 |

Estimated at a Constant Real Revenue Growth
*Stated in 2015 Dollars

Following these estimates, the revenues and construction expenses were inserted into IMPLAN to estimate the total economic impact. Table 5A provides the impact of construction of both the sportsplex and retail stores. Starting with year zero, the revenues generated from constructing the mixed-use retail facility and sportsplex has a direct impact of about $54 million dollars. This is the direct expenditures for the construction and/or spending by a particular industry which results in production and/or spending by other directly related industries such as building materials and product purchases. This direct spending will also stimulate the creation of goods and services consumed by the project which is called an indirect impact. Other spending by the project employees, such as spending in restaurants, grocery stores, or other spending by companies that are not directly related to the project results in an induced impact.

**Table 5A: John Hunt Park Redevelopment Estimated Economic Impact.***

| | | Year 0 |
|---|---|---|
| Capital Expenditures (in millions) | Revenue | $50.6 |
| Impacts (in millions) | Direct | $54.0 |
| | Indirect | $18.3 |
| | Total | $72.3 |
| Jobs Impact | Direct | $405.7 |
| | Indirect | $139.4 |
| | Total | $545.1 |

*Stated in 2015 Dollars

However, Table 5 A and 5B show the direct and indirect impact. Note that indirect impact in these tables is the sum of both the indirect and the induced impacts for constructing the mixed-use retail facility and sportsplex. This amount is about $18.3 million. The total impact, including the direct and indirect impacts of the capital expenditures is about $72.3 million.

A similar procedure is implemented in order to estimate the jobs impact. For constructing the mixed-use retail facility and sportsplex, the direct impact result is 405.7 jobs and an indirect impact of 139.4 jobs. Thus the total jobs impact is about 545.1 new jobs to the area during construction.

**Table 5B: John Hunt Park Redevelopment Estimated Economic Impact (in millions).***

| | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Totals |
|---|---|---|---|---|---|---|---|
| Retail/ Restaurant/ SportsPlex Revenue (in millions) | Revenue | $45.7 | $45.7 | $49.5 | $51.5 | $53.5 | $247.8 |
| Impacts (in millions) | Direct | $21.5 | $22.1 | $22.7 | $23.3 | $23.9 | $113.5 |
| | Indirect | $9.5 | $9.8 | $10.0 | $10.3 | $10.6 | $50.1 |
| | Total | $31.0 | $31.8 | $32.7 | $33.6 | $34.5 | $163.7 |
| Jobs Impact | Direct | 386.7 | 396.4 | 406.4 | 416.6 | 427.2 | 427.2 |
| | Indirect | 75.7 | 77.8 | 79.9 | 82.0 | 84.2 | 84.2 |
| | Total | 462.5 | 474.2 | 486.3 | 498.6 | 511.4 | 511.4 |

*Stated in 2015 Dollars

Table 5B gives the total economic impact of the revenues. Over the first five years of operations of the mixed-use retail facility and sportsplex. In year one, the total impact is $31 million and a total jobs impact of about 462.5 jobs, in year two there is a total impact of about $31.8 million and the addition of about 11.7 jobs which creates a total jobs impact of 474.2, in year three there is a total impact of about $32.7 million with the addition of about 12.1 jobs which creates a total job impact of about 486.3, in year four, there is a total impact of about $33.6 million and the addition of about 12.3 jobs which creates a total jobs impact of 498.6, and in year five the total impact is $34.5 million and the addition of about 12.8 jobs creates a total job impact of 511.4. At the end of five years, the total cumulative impact is about $163.7 million and the total jobs impact is about 511.4 jobs.

IMPLAN was used to estimate the total impact from the cumulative 10, 20,

and 30 year revenues, however, IMPLAN does not calculate that far into the future. IMPLAN calculates impacts for the cumulative 10 year revenues. Since IMPLAN does not provide impact analysis beyond 15 years, the multiplier for the 10th year from IMPLAN was used to create the cumulative impact for year 20 and year 30, keeping real revenue growth constant after the first five years.

The estimated cumulative ten year total impact is about $312.4 million, the estimated cumulative twenty year total impact is about $1,975.5 million, and the estimated cumulative thirty year total impact is about $2,981.8 million.

**Table 5C: John Hunt Park Redevelopment Estimated Cumulative Economic Impact***

| | | Year 10 | Year 20 | Year 30 |
|---|---|---|---|---|
| Retail/Restaurant/ SportsPlex Revenue (in millions) | Revenue | $515.4 | $1,050.5 | $1,585.7 |
| Impacts (in millions) | Direct | $216.9 | $442.1 | $667.3 |
| | Indirect | $95.5 | $194.6 | $293.8 |
| | Total | $312.4 | $293.8 | $961.1 |
| Jobs Impacts** | Direct | $427.2 | $427.2 | $427.2 |
| | Indirect | $84.2 | $84.2 | $84.2 |
| | Total | $511.4 | $511.4 | $511.4 |

*Stated in 2015 Dollars
**Held Constant After 5 Years

**Table 6A: Estimated Sales Tax Revenue (in millions)***

| | Retail/ Restaurant Revenue | Retail/ Restaurant Sales Taxes | SportsPlex Revenue | SportsPlex Sales Tax | Total Revenue | Total Sales Tax | 25% of Sales Tax |
|---|---|---|---|---|---|---|---|
| **Year 0** | $32.2 | $1.6 | $18.5 | $0.9 | $50.6 | $2.5 | $0.6 |
| **Year 1** | $41.2 | $2.1 | $4.5 | $0.2 | $45.7 | $2.3 | $0.6 |
| **Year 2** | $42.9 | $2.1 | $4.7 | $0.2 | $47.6 | $2.4 | $0.6 |
| **Year 3** | $44.6 | $2.2 | $4.9 | $0.2 | $49.5 | $2.5 | $0.6 |
| **Year 4** | $46.4 | $2.3 | $5.1 | $0.3 | $51.5 | $2.6 | $0.6 |
| **Year 5** | $48.3 | $2.4 | $5.3 | $0.3 | $53.5 | $2.7 | $0.7 |
| **Total:** | $255.6 | $12.8 | $42.8 | $2.1 | $298.4 | $14.9 | $3.7 |

Based on a 5% sales tax rate (city and county only). *Stated in 2015 Dollars
Source: City of Huntsville, AL

Once the sportsplex and retail stores are established, the number of jobs would remain constant. Hence the assumption that jobs remained constant after the first five years was made and the jobs impact remains constant in Table 5C.

The purpose of choosing this option of selling a portion of the park was to use a fraction of the sales tax revenues generated from the retail development and sportsplex to create a revenue stream to fund and support the ongoing development and maintenance of the park. The estimated sales tax revenues is calculated by multiplying the estimated sales revenues by a conservative 5% sales tax rate.

Now, if a city uses 25% of this generated sales tax revenue, as was Huntsville's plan, the city will have about $3.7 million dollars to put towards the ongoing development and maintenance of the park during the first five years of operations.

Table 6B shows the accumulation of tax revenues for the city of Huntsville. In ten years, this plan would have generated about $25.8 million in total sales tax revenue and about $6.4 million of that would go towards the ongoing development and maintenance of the park. Accumulation of sales tax after twenty years, this plan would have generated about $52.5 million dollars in total sales tax revenue and about $13.1 million of that would be directed towards the ongoing development and maintenance of the park. Thus over thirty years, this plan would have generated about $79.3 million in total sales tax revenue and about $19.8 million of that would go towards the ongoing development and maintenance of the park.

Table 6B: Estimated Sales Tax Revenue (in millions)*

| | Retail/ Restaurant Revenue | Retail/ Restaurant Taxes | SportsPlex Revenue | SportsPlex Tax | Total Revenue | Total Sales Tax | 25% of Sales Tax |
|---|---|---|---|---|---|---|---|
| **Year 10** | $464.7 | $23.2 | $50.7 | $2.5 | $515.4 | $25.8 | $6.4 |
| **Year 20** | $947.2 | $47.4 | $103.3 | $5.2 | $1,050.6 | $52.5 | $13.1 |
| **Year 30** | $1,429.8 | $71.5 | $156.0 | $7.8 | $1,585.8 | $79.3 | $19.8 |

Based on a 5% sales tax rate (city and county only)
Source: City of Huntsville, AL
*Stated in 2015 Dollars

In summary, if the city elects to pursue the option, of selling a portion of the park to a developer, then after the accumulation of thirty years the economic impact of the project will be $961.1 million. This project will have created about 511 jobs over 30 years.

## 5. Conclusion

The problem that many cities face when they have an underdeveloped park/parcel is that they lack the resources for upgrading and maintaining a redevelopment project. However, this study has shown that there is a possible approach for these cities to evaluate a continuous revenue stream for the upgrades and continued maintenance of such a redevelopment project that will not only benefit the city but it will benefit the community as well. Since many cities lack the resources for undertaking such a project, the cities also lack the resources of even weighing this option, since doing a full economic impact study of such a project can cost the city anywhere between $5,000 to $20,000 depending on the details needed.

As an affordable and cost effective alternative, the methodology reported in this paper can be used as a template to weigh their option of undertaking a re-development project. There are still risks involved in pursuing this option.

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Industry Averages Jeff Thompson, Director of the Center for Management & Economic Research (CMER)

Software and Data: www.IMPLAN.com

# GDP AND ENERGY CONSUMPTION: GRANGER CAUSALITY IN THE 50 STATES IN THE US

**Brinda Mahalingam**
**Wafa Orman**
*The University of Alabama in Huntsville - USA*

**Abstract**

Economists have studied the relationship between energy consumption and GDP for many decades and results have not been consistent. Growth and energy conservation seem somewhat contradictory and as governments impose energy conservation, the fear of impeding growth is natural. As the US federal government imposes energy restrictions, many states have protested claiming that compliance would be expensive and will impede production. This study uses panel/pooled data to study the relationship between energy consumption and GDP in the US. Studies done previously have used aggregate data series to model GDP and other inputs like capital, labor, and energy, while this study uses pooled data for the states. This panel data will be used to test for stationarity. Generalized method of moment technique on the panel VARs to investigate the relationship between GDP and energy for the 50 states of the U.S. The panel data is used to test the causality between GDP and energy in all the fifty states to identify patterns. Lee and Chang (2007) have done a similar panel data study for 22 developed and 18 developing countries to find that there is bidirectional causality between energy and GDP in developed countries and GDP to energy causality in developing countries. Results may aid policy decisions and different policies may be required for each state.

## 1. Introduction

The relationship between economic growth and energy consumption has been examined and re-examined by many economists over the past few decades. Will energy consumption and conservation efforts derail growth? Economists have examined different countries, regions, divided and subdivided groups of countries to find a pattern. This article contributes to the existing literature by disaggregating the data for the United States and examining the relationship between GDP and energy consumption in different states.

The United States is a country that is very diverse both in terms of geography and culture. Different regions of the US have different needs and follow different patterns of growth. The relationship between energy consumption and

income not only vary between regions but also over time. This paper examines both aspects in the fifty states of US.

Granger causality is a term that has been used by researchers in many fields, from economists, and finance professional and to neuroscience. Granger (1969) in his seminal paper defines causality and feedback and provides a testable model. Granger causality in practice is a method used by economists that is used to examine this relationship between energy consumption and growth. Many researchers have found causality runs from income to energy in the US (Kraft and Kraft, 1978), in South Korea (Yu and Choi, 1985 and Soytas and Sari, 2003), Italy (Soytas and Sari, 2003), and energy to income in Philippines (Yu and Choi, 1985) and Japan ( Erol and Yu, 1987). There have also been studies that showed bi-directional causality in countries such as South Korea (Oh and Lee, 2004), India (Paul and Bhattacharya, 2004), Taiwan (Yang, 2000), and United States (Lee 2006, and Lee and Chang 2007). The method of testing adopted, and time periods investigated vary in these cases, thus revealing that these estimates are both sensitive to methods and time periods considered.

The results of these studies have been ambiguous with causality test being sensitive to time periods, econometric methods and models used. Broadly these studies can be divided into three, with the first set studies that have been conducted testing for Granger causality after testing for unit roots and cointegration. The second set studies have used the Toda-Yamamoto methodology of testing for unit roots and then using sufficient lags to test for Granger causality. The third set of studies have focused on panel studies using a combination of time series and cross section, with data on several countries. Cointegration and Causation are inter-related (Zapata and Rambaldi, 1997). If the model is cointegrated and corrected for cointegration, then the probability of rejecting Granger causality is very high (Clarke and Mirza, 2006).

## 2. Literature Survey

The explosion of research on GDP-Energy causality in the past few decades, especially after the oil shocks, and subsequent recessions, provides a rich background for any study on the topic. Lee (2006) gives a brief summary and Caraiani et al, (2015) provides a more exhaustive list. This paper will focus on only those studies that have used a VAR (vector autoregression) analysis to examine the Granger causality between Income and energy consumption. One of the earliest such studies was done by Kraft and Kraft (1978) in which the relationship between GNP and Energy consumption was examined. Stern (1993) used a multivariate approach to examine the relationship between GDP and energy. He developed an index for energy that is weighted by the fuel composition. Stern examines the physical basis of including energy and proceeds to include other variables,

capital and labor to the VAR. In a subsequent study Stern (2000), he tests for cointegration and while using a Cobb Douglas production function for specification tests. He finds that energy Granger causes GDP. Stern subsequently has produced a number of studies regarding this topic, including one with Enflo (2013) which examines the same relationship for Sweden over 150 years. Here they examine the causality tests using the Toda and Yamamoto procedure (1995), conduct cointegration analysis and use a vector error correction model (VECM) and then also include an energy price index in the demand function to examine the energy and GDP relationship. Masih and Masih (1996) studied 6 Asian economies using a VECM and examine causality in all the countries and finds mixed results, with some countries exhibiting unidirectional causation between energy consumption and growth and some indicating bidirectional causation.

While Stern's focus in his first two studies was the United States, Ghali and Sakka (2004) used a similar multivariate model to study the relationship between Energy use and GDP for Canada. They tested for unit roots, integration and cointegration and then used a VECM to analyze the relationship. Oh and Lee (2004) also use a multivariate model and use an energy aggregate instead of total energy. They test for cointegration and examine both a short run and long run relationship, for South Korea. Chiang Lee (2006) explores the relationship between energy consumption and GDP for the G11 countries. He uses the Toda and Yamamoto procedure to examine the Granger Causality. His model does not include capital and labor. He finds mixed results among the countries. Subsequently Lee along with Chang (2007) use a panel data for 22 developed and 18 developing countries. Here again the variables are energy and GDP and they divide the countries into two groups, developed and developing countries. They use a VECM model after testing for cointegration. The results are again mixed for different sets of economies.

More recently Liddle and Lung (2015) develop a model, hypothesize the relationship between energy and GDP and then employ a production function and a demand function. Energy is disaggregated and they examine electricity usage in the demand function and total energy consumed in different sectors. Countries in the OECD are used and a panel causality test is used to determine the relationship. Caraiani et al, (2015) examine long run and short run relationship between energy and GDP for five emerging European economies. They use various energy sources and find different causality relationships in each country with different sources. Azam et al, (2015) examine five ASEAN countries and use multivariate VAR to study the relationship between energy consumption and economic growth.

They include gross capital formation and exports in their model.

Many studies on Granger causality have been undertaken to analyze the interaction between energy and growth. A few studies have focused on the United States and the results have not all been consistent. Lee (2006) and Lee and Chiang for example find bidirectional causation, while Stern (1993, 2000) found that energy granger causes GDP. The difference in the results could be due to the time period examined, methodology and even a change in the relationship. In this study we examine the fifty states with the hypotheses that there could be changes within the US.

## 3. Data

The data for this study is measured annually. The energy consumption data for all the states is from the U.S. Energy Information Administration website. Total energy consumption from all sources was included in this study. The GDP for the states is from the Bureau of Economic Analysis (BEA). In 1997, there was a reclassification of industry codes whereby the BEA moved from SIC (Standard Industrial Classification) to NAICS (North American Industrial Classification Codes) codes. So data gathered for the states is in the SIC method of classification prior to 1997 and in the NAICS classification system from 1997. The BEA has not combined the data between these two groups and warn against combining the data. The data for real GDP for all the states extends to 1977. Since 1997 was the year the Kyoto Protocol treaty, the countries around the world became more conscientious about energy conservation. This also becomes the natural point to divide the data into two subgroups, one from 1977 to 1997 and another from 1997 to 2012.

## 4. Methodology

Since the data is time series in nature, the first step is to check the data for unit roots. The two subgroups were tested for unit roots with the Augmented Dickey Fuller (ADF) test. ADF test reveals that GDP in all fifty states, in both groups have unit roots implying that the data are non-stationary. Energy consumption for the fifty states, however, did not contain unit roots in the first subgroup, from 1977 to 1997 but was found non-stationary in the second subgroup, 1997 to 2012, in all fifty states. Taking the first differences of the time series data for all fifty states, indicates that the data becomes stationary implying that degree of integration is one for all fifty states.

We then conduct a test to determine the lag length. We use the Akaike Information Criteria (AIC) and the Schwartz Bayesian Information criterion (SBC) to the find the optimal lag length. According to Toda and Yamamoto even if data is non stationary, adding the correct lag length, gives estimates that are reliable, as long as the order of integration is smaller than the lag length required. Here the order of integration is one and lag length required is two in most states and three in a few states.

Hence we decided to include three lags for all fifty states.

The VAR that was estimated was based on the model:

$$\ln EC = \alpha_0 + \alpha_1 \ln EC_{t-1} + \alpha_2 \ln EC_{t-2} + \alpha_3 \ln EC_{t-3} + \beta_1 \ln GDP_{t-1} + \beta_2 \ln GDP_{t-2} + \beta_3 \ln GDP_{t-3}$$

$$\ln GDP = \gamma_0 + \gamma_1 \ln EC_{t-1} + \gamma_2 \ln EC_{t-2} + \gamma_3 \ln EC_{t-3} + \delta_1 \ln GDP_{t-1} + \delta_2 \ln GDP_{t-2} + \delta_3 \ln GDP_{t-3}$$

where EC is energy consumption and GDP is the Gross Domestic Product. The null hypothesis for the first equation, of $\beta_1 = \beta_1 = \beta_3 = 0$ was tested. The null hypothesis in the case of Granger causality indicates that GDP does not Granger cause Energy consumption. The null hypothesis for the second equation, of $\gamma_1 = \gamma_2 = \gamma_3 = 0$ was also tested. This null hypothesis of Granger causality indicates that Energy consumption does not Granger cause GDP. Rejection of both hypothesis would suggest there is bidirectional causation and acceptance of both hypothesis indicates that the neutrality hypothesis holds which would imply that GDP and Energy consumption are independent.

We also run a misspecification test on the error terms to make sure the error terms in the equation are white noise. The error terms did show that there was no misspecification, in both time periods.

## 5. Results

The results of the Unit root tests and the results for the lag length are presented in Appendix A. The results of the Granger-Causality tests in tabular form is in Appendix B. We also mapped the results of the Granger-Causality tests to the fifty states for the two groups of time periods. These are shown in Figures 1 and 2.

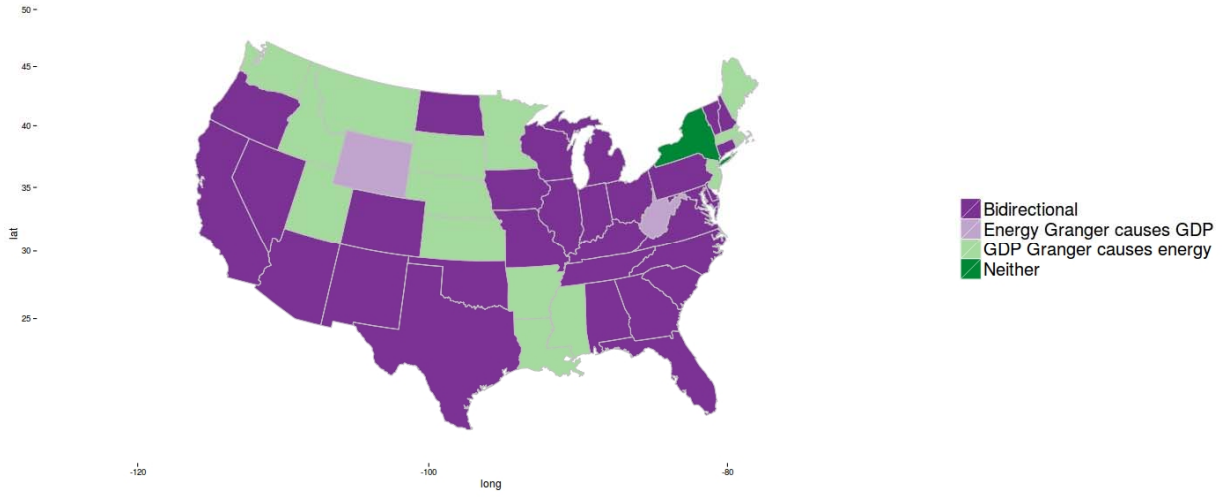


**Figure 1. Group 1 (1977 to 1997)**

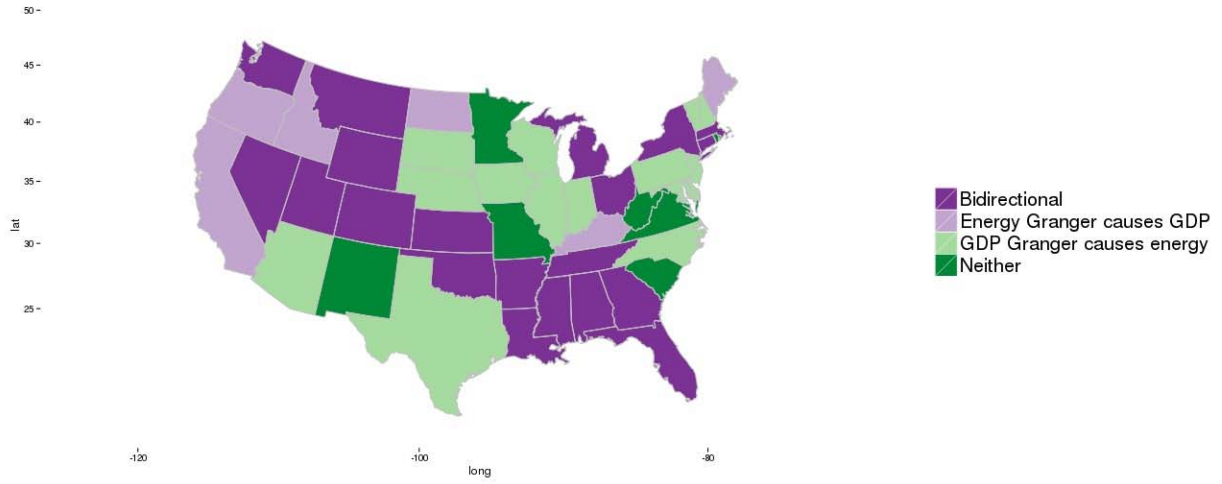


**Figure 2. Group 2 (1997 to 2007)**

Alaska, not represented in the map, had GDP granger causing energy for 1977 to 1997 and then became bidirectional for 1997 to 2007. Hawaii, also not represented in the map, was bidirectional for 1977 to 1997 and then had Energy Consumption Granger cause GDP for 1997 to 2007.

As can be seen from Figures 1 and 2, the relationship between Energy Consumption and GDP in many states changed between the two time periods. More specifically the direction of Granger causality for thirty nine states have changed between the time periods, 1977 to 1997 and 1997 to 2007. More interestingly the states that have not changed have remained bidirectional in both time periods.

## 6. Conclusion

The results show that there are differences within the United States. The overall results of the US as a whole being bidirectional as reported by Lee (2006) and Chang and Lee (2007) can be explained in that many states do show a bidirectional Granger causality in each of the two time periods. The results due to Stern (2000) that GDP Granger causing energy can also be explained since some states do display this behavior. However as noted earlier in the paper in the introduction, the results of the Granger causality for all the fifty states show that these tests are very sensitive to the time period tested. Energy conservation attempts should be sensitive to the fact that each region may be affected differently as shown by the results. Some states can conserve or change the methods of energy production to enhance growth and this may be a time sensitive issue as well.

In terms of ongoing and future work the next natural step is to utilize the panel data for the fifty states and extract more information that provides additional insight into how the states interact with each other and analyze the interaction between Energy consumption and Gross Domestic Product. The inclusion of capital and labor into the equation to see how these other inputs interact with Energy consumption would provide additional insight on how Energy conservation affects economic growth.

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**Appendix A**
Results of ADF unit-root tests

| | 1977-1997 | | | | 1997-2007 | | | |
|---|---|---|---|---|---|---|---|---|
| **State** | **GDP** | **lag (GDP)** | **Energy** | **Lag (energy)** | **GDP** | **lag (GDP)** | **Energy** | **Lag (energy)** |
| Alabama | 0.988026 | 1 | 0.988026 | 1 | 0.307129 | 1 | 0.41663 | 1 |
| Alaska | 0.000979 | 1 | 0.000979 | 1 | 0.622638 | 1 | 0.727211 | 1 |
| Arizona | 0.992139 | 1 | 0.992139 | 1 | 0.296275 | 2 | 0.305414 | 2 |
| Arkansas | 0.997001 | 1 | 0.997001 | 2 | 0.759461 | 1 | 0.005335 | 5 |
| California | 0.997001 | 1 | 0.997001 | 2 | 0.513266 | 1 | 0.763729 | 1 |
| Colorado | 0.998637 | 1 | 0.998637 | 1 | 0.585744 | 3 | 0.357574 | 1 |
| Connecticut | 0.729589 | 1 | 0.729589 | 2 | 0.656601 | 1 | 0.783028 | 2 |
| Delaware | 0.69761 | 1 | 0.69761 | 2 | 0.623206 | 1 | 0.493577 | 2 |
| District of Columbia | 0.806617 | 1 | 0.806617 | 2 | 0.049753 | 1 | 0.885281 | 1 |
| Florida | 0.658147 | 1 | 0.658147 | 1 | 0.330813 | 1 | 0.325591 | 1 |
| Georgia | 0.889247 | 1 | 0.889247 | 1 | 0.125867 | 2 | 0.350121 | 2 |
| Hawaii | 0.726965 | 1 | 0.726965 | 1 | 0.668783 | 2 | 0.465235 | 2 |
| Idaho | 0.998469 | 1 | 0.998469 | 1 | 0.71915 | 1 | 0.147326 | 1 |
| Illinois | 0.990357 | 1 | 0.990357 | 1 | 0.520135 | 1 | 0.054519 | 1 |
| Indiana | 0.98821 | 1 | 0.98821 | 1 | 0.780923 | 1 | 0.05558 | 2 |
| Iowa | 0.994327 | 1 | 0.994327 | 1 | 0.851356 | 1 | 0.801073 | 2 |
| Kansas | 0.997814 | 1 | 0.997814 | 2 | 0.911948 | 2 | 0.211281 | 2 |
| Kentucky | 0.998055 | 1 | 0.998055 | 1 | 0.776689 | 2 | 0.183416 | 2 |
| Louisiana | 0.993695 | 2 | 0.993695 | 1 | 0.753124 | 1 | 0.264419 | 1 |
| Maine | 0.762857 | 1 | 0.762857 | 1 | 0.385665 | 1 | 0.97512 | 1 |
| Maryland | 0.786699 | 1 | 0.786699 | 1 | 0.134495 | 1 | 0.452889 | 1 |
| Massachusetts | 0.754974 | 1 | 0.754974 | 1 | 0.859738 | 1 | 0.819215 | 1 |
| Michigan | 0.975403 | 1 | 0.975403 | 1 | 0.414936 | 1 | 0.956221 | 1 |
| Minnesota | 0.986894 | 1 | 0.986894 | 2 | 0.848659 | 1 | 0.074719 | 1 |
| Mississippi | 0.994657 | 1 | 0.994657 | 2 | 0.744902 | 1 | 0.001034 | 3 |
| Missouri | 0.98356 | 1 | 0.98356 | 1 | 0.50023 | 1 | 0.508672 | 3 |
| Montana | 0.801702 | 1 | 0.801702 | 3 | 0.833409 | 1 | 0.494792 | 1 |
| Nebraska | 0.998827 | 1 | 0.998827 | 1 | 0.946628 | 1 | 0.988585 | 1 |
| Nevada | 0.997729 | 1 | 0.997729 | 1 | 0.350752 | 1 | 0.243506 | 1 |
| New Hampshire | 0.776589 | 1 | 0.776589 | 1 | 0.503638 | 1 | 0.493423 | 1 |
| New Jersey | 0.535653 | 1 | 0.535653 | 1 | 0.621437 | 1 | 0.791264 | 1 |
| New Mexico | 0.994346 | 1 | 0.994346 | 1 | 0.462763 | 1 | 0.232525 | 1 |

| | 1977-1997 | | | | 1997-2007 | | | |
|---|---|---|---|---|---|---|---|---|
| State | GDP | lag (GDP) | Energy | Lag (energy) | GDP | lag (GDP) | Energy | Lag (energy) |
| New York | 0.830586 | 1 | 0.830586 | 1 | 0.06913 | 2 | 0.95356 | 2 |
| North Carolina | 0.982206 | 1 | 0.982206 | 1 | 0.577674 | 2 | 0.345139 | 2 |
| North Dakota | 0.828 | 1 | 0.828 | 1 | 0.998636 | 1 | 0.986105 | 2 |
| Ohio | 0.989321 | 1 | 0.989321 | 1 | 0.50116 | 1 | 0.69942 | 2 |
| Oklahoma | 0.980746 | 2 | 0.980746 | 1 | 0.852867 | 1 | 0.722647 | 1 |
| Oregon | 0.998784 | 1 | 0.998784 | 1 | 0.966465 | 1 | 0.423805 | 1 |
| Pennsylvania | 0.976159 | 1 | 0.976159 | 2 | 0.310118 | 1 | 0.699563 | 2 |
| Rhode Island | 0.758735 | 1 | 0.758735 | 1 | 0.382338 | 1 | 0.659513 | 2 |
| South Carolina | 0.924688 | 1 | 0.924688 | 1 | 0.538145 | 2 | 0.429597 | 1 |
| South Dakota | 0.975448 | 1 | 0.975448 | 1 | 0.458974 | 2 | 0.903832 | 1 |
| Tennessee | 0.990072 | 1 | 0.990072 | 1 | 0.108607 | 1 | 0.927716 | 3 |
| Texas | 0.998644 | 2 | 0.998644 | 1 | 0.949355 | 1 | 0.476715 | 3 |
| Utah | 0.998371 | 1 | 0.998371 | 1 | 0.740027 | 2 | 0.724988 | 1 |
| Vermont | 0.795783 | 1 | 0.795783 | 2 | 0.660297 | 2 | 0.604392 | 1 |
| Virginia | 0.82794 | 1 | 0.82794 | 1 | 0.048301 | 1 | 0.361681 | 1 |
| Washington | 0.990744 | 1 | 0.990744 | 1 | 0.935166 | 1 | 0.008309 | 1 |
| West Virginia | 0.990373 | 1 | 0.990373 | 1 | 0.996845 | 1 | 0.285346 | 2 |
| Wisconsin | 0.998482 | 1 | 0.998482 | 1 | 0.610132 | 1 | 0.539792 | 2 |
| Wyoming | 0.986997 | 2 | 0.986997 | 1 | 0.830494 | 1 | 0.887655 | 1 |

**Appendix B**

Results for the Granger Causality tests

| State | Causality (77-97) | Causality (97-12) |
|---|---|---|
| Alabama | Bidirectional | Bidirectional |
| Alaska | GDP Granger causes energy | Bidirectional |
| Arizona | Bidirectional | GDP Granger causes energy |
| Arkansas | GDP Granger causes energy | Bidirectional |
| Arkansas | Bidirectional | Energy Granger causes GDP |
| Colorado | Bidirectional | Bidirectional |
| Connecticut | Bidirectional | Bidirectional |
| Delaware | Bidirectional | GDP Granger causes energy |
| District of Columbia | Energy Granger causes GDP | Bidirectional |
| Florida | Bidirectional | Bidirectional |
| Georgia | Bidirectional | Bidirectional |
| Hawaii | Bidirectional | Energy Granger causes GDP |
| Idaho | GDP Granger causes energy | Energy Granger causes GDP |
| Illinois | Bidirectional | GDP Granger causes energy |
| Indiana | Bidirectional | GDP Granger causes energy |
| Iowa | Bidirectional | GDP Granger causes energy |
| Kansas | GDP Granger causes energy | Bidirectional |
| Kentucky | Bidirectional | Energy Granger causes GDP |
| Louisiana | GDP Granger causes energy | Bidirectional |
| Maine | GDP Granger causes energy | Energy Granger causes GDP |
| Maryland | Bidirectional | GDP Granger causes energy |

| State | Causality (77-97) | Causality (97-12) |
|---|---|---|
| Massachusetts | GDP Granger causes energy | Bidirectional |
| Michigan | Bidirectional | Bidirectional |
| Minnesota | GDP Granger causes energy | Neither |
| Mississippi | GDP Granger causes energy | Bidirectional |
| Missouri | Bidirectional | Neither |
| Montana | GDP Granger causes energy | Bidirectional |
| Nebraska | GDP Granger causes energy | GDP Granger causes energy |
| Nevada | Bidirectional | Bidirectional |
| New Hampshire | Bidirectional | GDP Granger causes energy |
| New Jersey | GDP Granger causes energy | GDP Granger causes energy |
| New Mexico | Bidirectional | Neither |
| New York | Neither | Bidirectional |
| North Carolina | Bidirectional | GDP Granger causes energy |
| North Dakota | Bidirectional | Energy Granger causes GDP |
| Ohio | Bidirectional | Bidirectional |
| Oklahoma | Bidirectional | Bidirectional |
| Oregon | Bidirectional | Energy Granger causes GDP |
| Pennsylvania | Bidirectional | GDP Granger causes energy |
| Rhode Island | GDP Granger causes energy | Neither |
| South Carolina | Bidirectional | Neither |
| South Dakota | GDP Granger causes energy | GDP Granger causes energy |
| Tennessee | Bidirectional | Bidirectional |
| Texas | Bidirectional | GDP Granger causes energy |
| Utah | GDP Granger causes energy | Bidirectional |

| State | Causality (77-97) | Causality (97-12) |
|---|---|---|
| Vermont | Bidirectional | GDP Granger causes energy |
| Virginia | Bidirectional | Neither |
| Washington | GDP Granger causes energy | Bidirectional |
| West Virginia | Energy Granger causes GDP | Neither |
| Wisconsin | Bidirectional | GDP Granger causes energy |
| Wyoming | Energy Granger causes GDP | Bidirectional |

# WINE INDUSTRY COMPETIVENESS: A SURVEY OF THE SHAWNEE HILLS AMERICAN VITICULTURAL AREA

**Garrett A Hoemmen**
**C. Matthew Rendleman**
**Ira Altman**
**Brad Taylor**
**Wanki Moon**
**Sylvia Smith**
*Southern Illinois University Carbondale -USA*

**Abstract**

There is a growing consumer preference for regional or "terroir" based products (Guy 2011). The designation of American Viticultural Area (AVA) status has the potential to increase the development of consumer identification with regional wine products. The presence of a distinguishing terroir is one of the prerequisites for the establishment of a federally recognized AVA. The Tobacco Tax and Trade Bureau (TTB) granted the Shawnee Hills, located in southern Illinois, this designation at their request in 2006 (MKF 2005).

The goal of the present research is to determine the key factors enhancing or constraining the competitive performance of wine businesses in the Shawnee Hills American Viticultural Area. A winery competiveness survey was administered to all owner/operators in the Shawnee Hills to determine whether the infrastructure was in place to sustain a regional wine quality program. The specific aim of this survey was to understand key factors influencing the competitive performance of wine businesses in the Shawnee Hills AVA.

Shawnee Hill's AVA winery owner/operators regard increases in regional tourism, growth in the U.S. wine market continuous innovation, unique services and processes, and flow of information from customers to have the most enhancing effects on their businesses, and that confidence/trust in Illinois state political systems, tax systems, and administrative/bureaucratic regulations were the most constraining factors. Furthermore the Shawnee Hills AVA has growing competition, yet

consists of innovative winery owners. It may currently lack external financial support, but with a community focus on product differentiation, the Shawnee Hills AVA has a chance, owners believe, to capture a portion of the growing market for regional products.

## 1. Introduction

Since the end of Prohibition in the USA, wine consumption has grown by a noticeable 751 million gallons a year. United States wine consumption per resident increased by over 900% from 1934 to 2012 (Wine Institute 2011). Grapes are now the highest value crop in the country and the grape crop in the United States has more than tripled over the last two decades. In Illinois alone there are over 90 wineries (MKF Research LLC 2009). About 85 percent of these wineries have been established within the last fifteen years. The average annual production of Illinois wine is 357,000 gallons. The industry provides over 2,000 full-time employment positions. With total revenues of $247,513,000 and total wages paid of $71,466,000, the full economic impact has been estimated at almost $319 million (MKF Research LLC 2009).

Many reasons have been identified as to why this resurgence of winegrape and wine production has occurred in Illinois. These include the new crop appeal, a growing understanding of which grape varieties are best suited to its *terroir*, a more fluid procurement process of out of state grapes and juice, and the rising demand for wine (MKF Research LLC 2006).

The wineries and vineyards of Southern Illinois and specifically those within the Shawnee Hills American Viticulutural Area (AVA) are leading the way in the resurgence of wine in Illinois. Five of the top 17 counties that contain 54 percent of Illinois' vineyards are in part within the boundaries of the Shawnee Hills AVA including the top two grape producing counties, Jackson and Union counties, with 32 percent of all grapes planted within the southern region of the state (Shoemaker and Campbell 2007).

*Terroir* is a concept relating the sensory attributes of the wine to the environmental conditions in which the grapes are grown. Favorable *terroir* elements support the area's wineries and vineyards, whose recent era began with the opening of Alto Vineyards in 1984. By 1995 enough wineries existed for the establishment of the Shawnee Hills Wine Trail, and in only seven years it had catered to over 100,000 visitors and grossed over $2 million. All of these factors contribute to Shawnee Hills' unique *terroir*, and are part of what encouraged the decision to petition the Alcohol and Tobacco Tax and Trade Bureau to become an American Viticulture Area, a petition was granted in December 2006 (MKF Research LLC 2006). An AVA designation allows wineries to identify the geographical

origin of the grapes used in their wine production, and prevents producers from outside the AVA from making false claims about the nature and origin of their own wines (Cross, Plantinga, and Stavins 2011).

Despite the rising revenues, job growth, and tax dollars that the wine industry of the Shawnee Hills AVA produces, it is struggling to develop the consumer interest that many industry experts feel its unique *terroir* could provide and its wines deserve. Many experts see the continued growth of the wine industry throughout all of the 50 states, as Americans are increasingly interested in lifestyles with food and wine. Current per capita consumption is only about five percent of that of France or Italy (Wine Institute 2011). The Shawnee Hills AVA is an area that has the foundations present for the capture of some of the growing American market share. Illinois is the fifth largest wine market in the United States and the city of Chicago is the third largest US metropolitan wine market (MKF Research LLC 2006).

Americans are not only demanding more wine, they are demanding better wine, and there is potential for growth in the wine quality reputation of the Shawnee Hills. However, thus far this has not translated into national consumer recognition for the wines of the Shawnee Hills AVA as 70 percent of all cases of wine are sold in winery tasting rooms (Ward 2012), and 60 percent of all visitors to the tasting rooms are local, traveling 50 miles or less to reach the winery (Smith, Davis, and Pike 2010). The present research is important because it will potentially help to find a way to bring broader consumer recognition to the 20 wineries in the Shawnee AVA and their wines. Furthermore as wine consumption and wine awareness continue to rise in the United States, the industry has the potential to enhance overall economic growth.

AVAs are much less detailed and prescriptive when compared to geographic appellation designations granted in many European wine regions. European requirements can dictate what grapes may be grown, maximum grape yields, alcohol level, irrigation, and other quality factors, before an appellation name may legally appear on a wine bottle label (Love 1997). The only requirement to use the AVA name on the wine label is that 85 percent of the wine must have come from grapes grown within the geographical AVA boundaries (TTB 2012). Since AVAs were first introduced in 1982 many wineries in the U.S. are turning to geographic designations to distinguish their wines and today there are well over 100 in the U.S. (Love 1997).

The Regulatory Flexibility Act provision within any U.S. Alcohol and Tobacco Tax and Trade Bureau (TTB) approved AVA petition states:

> *The proposed regulation imposes no new reporting, recordkeeping, or*

> *other administrative requirement. Any benefit derived from the use of a viticultural area name would be the result of a proprietor's efforts and consumer acceptance of wines from that area.*

The specific objective of the present research is to determine the key factors enhancing or constraining the competitive performance of wine businesses in the Shawnee Hills American Viticultural Area (AVA). A winery competiveness survey was administered to all winery owner/operators within the Shawnee Hills American Viticultural Area. They were selected to participate in this study because of their knowledge of the area. Owner/operators are also those most responsible for the success and failure of strategy and operations. The goal of the survey was to discover the strengths and weaknesses of the current business environment within the Shawnee Hills AVA, and determine whether the infrastructure was in place to sustain a more prescriptive regional wine quality program.

## 2. Previous Work

We first looked at research that sought to answer questions about what programs and strategies had been successful elsewhere.

Cross, Plantinga, and Stavins (2011) attempted to place an economic value on *terroir* by conducting a hedonic pricing analysis of the sales of vineyards in Oregon's Willamette Valley. The results showed no evidence of significant effects of a designated appellation on vineyard prices; however they did find that vineyard prices are strongly determined by a location within specific sub-AVAs.

The Lodi Rules Sustainable Winegrowing Program (SWP) was established in 1995 by the Lodi Winegrape Commission (LWC) with the goal of consistently transferring the *terroir* influences to their wines and effectively translating this to consumers. Hillis, Luebell, and Hoffman (2010) investigated the winegrower perceptions of the LWC and its Lodi Rules Sustainable Winegrowing Program. Survey respondents were asked whether or not they participate in various LWC outreach and education activities, how successful they think the LWC has been across a range of objectives, and the degree to which they support local and statewide programs. The researchers concluded that growers are heavily influenced by economic factors, and therefore are more likely to avoid apparently costly program participation activities. Even with the improving consumer perception of the region, growers are struggling to associate financial success with the LWC and its SWP program (Hillis, Luebell, and Hoffman 2010).

Shaw, Luebell, and Ohmart (2011) analyzed the evolution and effectiveness of the Sustainable Winegrowing Program in Lodi, California. They sought to specifically discover the complementary effects of three different

aspects of wine-grape grower behavior; diffusion of innovation, cultural change, and social capital. Their regression analysis confirmed that participation in the Sustainable Winegrowing Program was positively associated with the adoption of sustainable practices. Although the results of the analysis were not sufficient to claim that partnerships are guaranteed to reach longer-term goals of sustainability, they do provide evidence of the necessary short-term goal of adoption.

Foti, Pilato, and Timpanaro (2011) conducted an assessment of the control systems in the Sicilian winemaking industry. They looked at the implementation process of each quality program and the level of satisfaction reached by each company. They found that quality is an integral tool in the optimization of the management and production process. Furthermore, the reputation and the value of production of wine are increased. These effects accomplish a number of significant benefits such as breaking into new markets, guaranteeing product quality and safety, traceability, environmental protection, and the improvement of overall performance. They concluded that heightened consumer demand for higher quality and standardized products was a primary driver of this shift (Foti, Pilato, and Timpanaro 2011). This is consistent with the findings of both Cross, Plantinga, and Stavins (2011) and Shaw, Luebell, and Ohmart (2011), highlighting the importance of quality production and regional reputation across the global wine market.

Chiodo, Casolani, and Fantini (2011) examined how different aspects related to regulation can influence consumers' quality perception. Unlike previous studies, which examined the effects of single quality factors, they sought to examine the product as a whole. They considered the following often-used distinctions to differentiate products in labeling and presentation: organic farming, using additional producer organization brands (PDOs), specific indications about production methods such as name of producer and bottler, and the content of sulphor dioxide in the wines (Chiodo, Casolani, and Fantini 2011).

The results of Chiodo, Casolani, and Fantini confirmed that aspects of wine labeling and presentation directly linked to regulatory policies affect Italian consumer perception, especially when linked to quality control, naturality, and safety aspects. Furthermore, attributes such as the membership of a Protected Designations of Origin Consortium (DOC) and the indication of production methods, exhibit higher importance than the organic certification.

Van Rooyen, Esterhuizen, and Stroebel (2011) conducting a study whose methodology we employed in our own survey. Their purpose was to analyze the competitive performance of the South African wine industry employing a four-step framework focusing on the environment in which

the wine industry executives make decisions.

The first step was to measure competitive performance through the Wine Competiveness Rating (WCR), which was based on trade performance as measured by the Relative Trade Advantage (RTA) method (Balassa 1989). The second step was to identify the major factors impacting competitive performance through interviews with industry experts through a Wine Executive Survey (WES). The WES was divided into five sections: *production factors; related and supporting industries; firm strategy, structure and rivalry; government support and policies; demand conditions; chance factors.* Respondents rated factors within each section as (1) mostly constraining, (2) modestly enhancing, or (3) most enhancing. The third step was to analyze the major factors and establish Determinants of Competiveness (DC), using Michael Porter's (1990) "new" competiveness theory. The final step was to use the information obtained in the first three steps to identify and analyze changes over time in the "competitive space" of the South African wine industry, then determine an industry agenda for improving competitive performance. The same survey instrument was administered in both 2005 and 2008.

The *production factors* with enhancing effects in both years were the availability/cost of low-level skilled labor, the quality and availability of technology, water availability and the general efficiency of infrastructure. From 2005 to 2008 most factors declined. In 2005 the most constraining factors were the high cost of financing and labor administration cost. In 2008 these were also included, in addition to the quality of low-skilled labor, cost of transport, infrastructure and technology, availability of skilled labor and the overall cost of doing business.

The factors of *related and supporting industries* were rated a 1.9 overall in 2005 and declined to a competiveness rating of 1.6 in 2008. Most factors showed declining ratings, with electricity supplies leading the decline. The prestige of supporting research institutions and the sustainability of local suppliers were rated as the highest contributors in both periods.

The results of the section regarding *firm strategy, structure and rivalry* were rated an average overall 2.5 in 2005 and then in 2008 an average of 2.1. In both periods most factors had enhancing impacts with the most enhancing being the ease of entry of new competitors, international entry into the local market, affordability of high quality products and the fierce competition in the local market. In 2008 the only constraining factors, even though only slight constraining, were a declining expenditure on R&D and incentives to support management performance.

The results of the section regarding *government support and policies* were rated an average score of 1.3 in 2005, but had

improved by 2008 to 1.5. Although still constraining this upward trend was attributed by Van Rooyen, Esterhuizen, and Stroebel to policies such as the restructuring of the wine industry's representative body to better represent its stakeholders. In both years the major constraining factors identified were administrative regulations, the competence of the personnel in the public sector, the tax system's impact on investments and risk taking, and resource policies related to land.

The results of the section regarding *demand conditions* were rated an enhancing average score of 2 in 2005, but declined to a somewhat constraining average score of 1.8 in 2008. The authors partially attribute this decline to currency revaluation and fluctuations and tighter competition in global markets. In both 2005 and 2008 the most constraining factors were the size of and growth in the local market. Modestly enhancing factors were found to be wine-savvy South African consumers who were also buying environmentally friendly products and who were concerned with ethics and the integrity of production.

Finally *chance factors* were rated as the most constraining to competitive performance. In 2005 the average rating was 1.3 and in 2008 the average rating was a 1.4. The most constraining factors in both 2005 and 2008 were the South African exchange rate, the global political/economic developments, the cost of crime, and the cost of HIV/Aids.

Based on the results of their analyses, Van Rooyen, Esterhuizen, and Stroebel (2011) concluded that South Africa's wines are increasingly internationally competitive, with a strong positive trend since 1990. Recently however, this trend has declined. In order to attempt to reverse this downward trend, the researchers identified the role of regulation and the presence of supportive government policy environment to be highly relevant. To facilitate this the researchers recommended more "lobby discussions" and to build more trusting relationship between industry and government (Van Rooyen, Esterhuizen, and Stroebel 2011).

Some impact analyses have been conducted on the Illinois wine sector. Rendleman, Peterson, Menke, and Beck (2002) used an IMPLAN impact analysis to measure the contribution of the grape and wine sectors of the Illinois economy. They divided the areas of impact into sections: effect of Illinois grown grapes, the effect of wine sales using only Illinois grown grapes, and the total effect of Illinois wine sales. In 2000 Illinois produced 530 tons of grapes resulting in $477,000 in sales. This represented $333,839 in value added. The total economic impact of grapes was found to be $876,370 (a combination of direct, indirect, and the induced impacts.

The 530 tons of Illinois grown grapes went on to make approximately 74,000 gallons of wine resulting in a total impact of $6,516,405. This total impact includes $3,353,395 of direct winery sales, plus

$1,076,152 of indirect sales, and $2,086,858 of induced impact.

Thirty-one percent of all Illinois wines in 2000 were produced using nothing but Illinois grapes. The total output effect of the entire thing was found to be $18,998,366, with the indirect portion equaling $2,209,771 and the induced effect equaling $6,013,443 (Rendleman et al. 2002).

As of 2011 only 44 percent of Illinois wine was produced from Illinois grapes. However in the southern region of the state 83 percent comes from Illinois grapes (Ward 2012). This is a favorable percentage as many midwest wine quality programs rely on the use of regional fruit as a source of differentiation (Edwards 2011).

Hoemmen, Rendleman, Taylor, Altman, and Hand (2013) analyzed the structural changes that occurred over time within the developing Lodi and Central Coast regions. The objective of the research was to determine the most effective method of improving the reputation of wine quality in the Shawnee Hills AVA. To accomplish the objective, American Viticultural Areas similar to the Shawnee Hills that possess a unique and advantageous terroir, while also exhibiting a similar trend of growth in wine production were selected for analysis. The Lodi and the Central Coast AVAs, both located in California, were chosen because only recently did many consumers associate quality with their wines. Furthermore both the Lodi and the Central Coast areas were recommended by industry professionals based on common structural changes that led to increased price for grapes and mutual data availability. In examining these areas, two primary questions were asked: What were the structural changes in production or marketing that best explain or predict the change in grower's return per ton? Are these effects statistically significant?

The dependent variable in the model, weighted average grower return per ton (price), is used as a proxy to represent quality. The structural events identified as potentially being most influential were (1) the approval of each region's AVA designation, (2) the formation of the regional wine industry groups, and (3) the creation of a regional wine quality program.

In Lodi approval of the AVA designation had the most impact on the weighted average grower return per ton (price), $173.73. The creation of the regional quality wine program also exhibited a very substantial effect, $165.81, on the weighted average grower return per ton. This shows the importance of expanding and improving a region after it has achieved an AVA status.

In the California Central Coast AVA creation of the regional quality wine program exhibited the greatest impact, $372.88 per ton. Although the creation of the regional quality wine standards program variable exhibited the greatest

effect, the establishment of the Central Coast AVA also exhibited a substantial effect on grower return of $179.60 per ton. This suggests the importance of achieving the American Viticultural Area status as it may have acted as a facilitator for each of the events that followed (Love, 1997). In both cases it appears important to achieve an AVA status and develop a regional quality wine standards program. However in the case of the Central Coast the regional wine quality standards program was considerably greater.

## 3. Data and Methods

The wine competiveness survey is based on a similar study conducted by Van Rooyen, Esterhuizen, and Stroebel (2011), to discover the strengths and weaknesses of the current business environment within the Shawnee Hills AVA, and determine whether the infrastructure was in place to sustain a regional wine quality program. The specific aim of this survey is to understand key factors influencing the competitive performance of wine businesses in the Shawnee Hills American Viticultural Area (AVA). (All questions are reproduced in Appendix A.) Competitive performance is the ability to sustain sales and growth against competition (Van Rooyen, Esterhuizen, and Stroebel, 2011).

The focus of this inquiry was individual wineries. As with all firms, wineries are competitive when they are able to continue to increase their sales and improve their product quality in a global market environment. Owners and operators were surveyed because they were directly responsible for the success and failure of strategy and operations. Knowledge gained will better inform all participants in the Shawnee Hills AVA as to where its strengths and weaknesses lie, and where additional investment might best be made. Answers to these questions are important as they provide the basis for understanding an evolving situation, while helping to compete for survival and growth (Porter 1990).

Our survey consisted of five total sections of related factors, four identified by the economist Michael Porter who grouped these key determinants of competitive performance into the "Porter Diamond." (Porter 1990)(Appendix B). Section one was *production factors*, which examined the industry's endowment in factors of production, such as climate, terroir, skilled labor, infrastructure, etc. necessary to compete. Section two, *relating and supporting industries*, looked into the presence or absence of competitive suppliers and other related industries. Section three looked into *firm strategy, structure and rivalry* or the way companies are created, organized and managed, as well as the nature of domestic rivalry. Section four analyzed *government support and policy*. This section was included because like in the South African wine industry, governments connected to the Shawnee Hills AVA can influence each of the above determinants, either positively or negatively, through policies and the environment that is created, funding

support and the provision of public goods to support private operational capacity and social stability. The final section, section five, looked into *demand conditions* or the nature, changes and knowledge of the market demand for the industry's products. A section analyzing "chance" factors was omitted because unlike the South African wine industry the Shawnee Hills is not greatly affected by changes in currency values or external factors impacting costs, such as crime and HIV/Aids (Van Rooyen, Esterhuizen, and Stroebel, 2011). The participants were asked to rate the above factors impacting their competitive performance as: **(5)** mostly enhancing, (**4)** modestly enhancing, **(3)** neutral impact, **(2)** modestly constraining, and **(1)** or mostly constraining. All nineteen winery Owner/Operators within the Shawnee Hills American Viticultural Area received the survey and were instructed to rate each factor as it applied to their particular winery.

Seventeen out of the 19 wineries in the Shawnee Hills AVA completed and returned the survey. The data was then analyzed in clustered factor groups created using demographic information. The first cluster looked at the results as a whole, without any restrictions. The second cluster compared the results of wineries with a solo owner/operator (SOLO) and those that were owned and operated by multiple persons (MULTI). The third cluster separated the winery owner/operators who were themselves the primary labor source (WM) from those who employed outside winemakers (NWM). The fourth cluster was based on the number of years the winery had been open: one to five years (1-5), six to ten years (6-10), or more than ten years (10+). Survey questions were designed to discover the strengths and weaknesses of the current business environment in the Shawnee Hills AVA and to discover if the infrastructure was in place to sustain a regional wine quality program.

Survey factors of note included those related to government support both locally and statewide (Van Rooyen, Esterhuizen, and Stroebel 2011), belief or opinions on developmental innovation and research, collaborative relationships with research institutions, community cohesiveness especially between commercial grape growers and wineries, and the current state of grape supply. These factors were included in the survey instrument because all were common points of industry importance found in studies of other wine industry regions where quality assurance programs have been successful, such as the Lodi and Central Coast AVAs (Hillis, Hoffman, and Luebell 2010: Shaw, Luebell, and Ohmart 2011).

## 4. Results & Discussion

The factors in the tables (Appendix B) are the averaged results of the survey analysis and they are presented first as an overall average result of all 17 winery owner/operator survey respondents and their relevant clusters. They were grouped together using demographic information.

The three most enhancing factors overall in the Shawnee Hills AVA wine industry in 2013 in descending order were:

- regional tourism increase;
- growth in the United States wine market; continuous innovation; *
- unique services and processes; flow of information from customers; *
- (* = Factors tied)

The three most constraining factors overall in the Shawnee Hills AVA wine industry in 2013 in descending order were:

- confidence/trust in state political system
- tax system
- administrative/bureaucratic regulations

**Table 1: Averaged Overall Key Determinants Results of Winery Competiveness Survey of Winery Owner/Operators in the Shawnee Hills AVA**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Production Factors | 2.7 | 2.6 | 2.8 | 2.5 | 3.0 | 2.5 | 2.9 | 2.5 |
| Related & Supporting Industries | 3.1 | 3.0 | 3.3 | 3.1 | 3.2 | 3.0 | 3.2 | 3.2 |
| Firm Strategy, Structure, & Rivalry | 3.1 | 3.0 | 3.3 | 3.1 | 3.2 | 3.1 | 3.0 | 3.3 |
| Government Support & Policies | 2.3 | 2.3 | 2.3 | 2.2 | 2.5 | 2.3 | 2.4 | 2.1 |
| Demand Conditions | 3.1 | 2.9 | 3.5 | 3.1 | 3.3 | 3.3 | 2.9 | 3.3 |

*Ratings: 1= mostly constraining; 2 = mildly constraining; 3 = neutral; 4 = mildly enhancing; 5 = mostly enhancing

*Legend: All respondents = Overall; Solo owner = SOLO; Multiple Owners = MULTI; Owner performs winemaking tasks = WM; Owner hires labor to perform winemaking tasks = NWM; Number of years in business = 1-5, 6-10, 10+

*Sample size = 17 total respondents

Most of the production factor conditions in all clusters (Table 1) were constraining, which indicates that the production environment currently in the Shawnee Hills could be improved. The factors with the most constraining effect (Appendix B) on the competiveness of the Shawnee Hills AVA were the *cost of transport* and the *overall cost of doing business*. Similar results were reported by Van Rooyen, Esterhuizen, and Stroebel (2011) on the competiveness of the South African wine industry. The *overall cost of doing business* was found to be a constraining factor in all clusters in Table B1 (Appendix B). Although *availability of quality technology*, *quality of technology*, and *availability of water for*

*industrial purposes* were all neutral in the overall column, it is worth noting that in both the MULTI and NWM clusters these factors were even higher, bordering on modestly enhancing. It is also interesting to note that in the NWM cluster the *availability of skilled labor, the quality of skilled labor,* and *the availability of low-level skilled labor* were all either neutral or enhancing. This shows the importance non-winemaking owners put on the production process as it pertains to labor, and the appreciation they have for those employed. Skilled labor, especially as it applies to the grape growing and winemaking process, is essential to the development of any quality assurance program (Cliff Ohmart, Lodi Winegrape Commission mailing list message, January, 2005).

A final note on production factors should be discussed regarding the differences between those wineries that have been open for 1-5 years and those open 10 + years. The *availability of skilled labor* and the *cost of infrastructure* were found to be to be very constraining for wineries open 1-5 years. These variables could both be attributed to the costly process of establishing a business. However, wineries that had been in business 10 + years exhibited the signs of growth such as highly constraining factors of *cost of transport* and *overall cost of doing business*. These could show the difficulties associated with the process of business expansion. These older wineries could have greater levels of production, which might require employing a distributor, which would increase overall costs, especially transport costs. These constraining factors are not unique to the Shawnee Hills (Van Rooyen, Esterhuizen, and Stroebel 2011).

The factors within the related and supporting industries section were predominantly neutral. The *long-term outlook of local grape suppliers* in the overall cluster (Table B2, Appendix B) is the most constraining of all related & supporting industry factors. This signals concern that there could be a shortage of grapes in the future. Grape supply is important as many Midwest wine quality programs rely on the use of regional fruit as a source of differentiation (Edwards 2011). However it should be noted that in 10+ years in business column the *long-term outlook of local grape suppliers* was securely a neutral factor. This could mean that the longer a winery is in business the more established both its relationships with local suppliers and its own vineyard production becomes. Both of these outcomes would ease the fears associated with a shortage. In addition, the relationship between commercial grape growers and wineries must be secure and well defined if any wine quality program is to be sustainable (Shaw, Luebell, and Ohmart 2011), as a common requirement of many regional wine quality programs is the reliance on AVA produced fruit. Furthermore the sustainability of local suppliers was seen as an enhancing factor on the competiveness of a wine region (Van Rooyen, Esterhuizen, and Stroebel 2011).

Within the NWM cluster (Table B2) *collaboration with research institutions in Research & Development* was securely neutral, however this was a constraining factor within the WM cluster. This should be seen as an area of potential improvement. In order for wine quality to be improved, an environment of enhancing collaboration between research institutions such as Southern Illinois University and the winery owners, especially those who are the winemakers, must be established. The support of local research institutions such as universities can greatly aid both the funding and research development of wine quality programs (Hillis, Hoffman, and Luebell 2010). For example, the Lodi AVA wine quality program relied greatly on the collaborative efforts with the University of California-Davis in regulation formation and participant education, and the South African wine industry considers the status of their local research institutions to be an enhancing factor (Van Rooyen, Esterhuizen, and Stroebel 2011).

A final note of comparison with the related and supporting industries section between wineries that have been open for 1-5 years, 6-10 years and those with 10 + years in business regards the factor *supply of electricity*. Wineries with 1-5 years of operation found the *supply of electricity* to be an enhancing factor. However, those in business 6-10 or 10+ years found this factor to be of relatively neutral impact, which could be attributed to an increase in size and thus electricity use as the wineries grew older.

The factors in Table 1 of all Firm Strategy, Structure, and Rivalry factors were predominantly neutral. The most enhancing factors across all clusters in (Table B3, Appendix B) were *continuous innovation, unique services and processes,* and the *flow of information from customers.* This is an encouraging sign, as positive winery owner opinions in relation to both innovation and uniqueness are essential to the development of a differentiation strategy such as a wine quality assurance program (Love 1997). The most constraining factors were often associated with competition, such as the *entry of new competitors* and *neighboring wine region product entry in local market.* Intense competition in local markets has resulted in enhancing characteristics in other markets by raising expectations for quality (Van Rooyen, Esterhuizen, and Stroebel 2011).

Within the firm strategy, structure, and rivalry (Table B3) a noticeable difference exists between the WM and NWM clusters concerning expenditure on *research and development*. It appears that those owner/operators who also make the wine do not consider expenditures on R&D in both the winery and the vineyard to be as constraining as their counterparts who do not make the wine. It would be of greater value to the development of a wine quality program and thus the Shawnee Hills AVA if more positive *research and development* strategies could be established.

We also analyzed the differences between wineries that have been open

for 1-5 years, 6-10 years, and those with 10 + years in business (Table B3). In this section of the survey, wineries with 1-5 years of business found the factor *regional industry structure and rivalry* to be constraining whereas owners whose wineries had been open 6+ years reported experiencing a neutral effect. Community cohesiveness must be improved as participation in regional partnerships increases the adoption of beneficial practices (Shaw, Luebell, and Ohmart 2011).

Although either securely neutral or enhancing in all three age groups, it does appear that the factor *flow of information from customers* may become more enhancing as a winery is in business longer. These wineries may have developed more consistent lines of communication due to the length their relationships with regular customers. Similarly it appears that the wineries with 10+ years of business have a more favorable impression of substitute products such as micro-brews. This could be attributed to production of such products within these wineries themselves.

The factors in the government support and policies section were overwhelmingly constraining (Table B4, Appendix B). The most constraining factors across all clusters were *confidence/trust in state political systems, tax system,* and *administrative/bureaucratic regulations.* These are areas of concern as governments can provide a stable and consistent regulatory environment and tax policy (as well as funding through grants and tax breaks). This was also identified as the key area of strategic emphasis in the growth of the South African wine industry (Van Rooyen, Esterhuizen, and Stroebel 2011).

Some factors of note (in Table B4) include differences between the WM and NWM clusters especially as it applies to *confidence/trust in local political systems* and *competence of personnel in public sector*. Winemakers found the factor *confidence/trust in local political systems* to be constraining whereas non-winemaking owners did not. Also, those who are winemakers found the factor *Competence of Personnel in Public Sector* to be highly constraining whereas their non-winemaking counterparts did not. This may indicate that, for one thing, government regulations are currently much more restrictive regarding winemaking than grape growing.

A final note of comparison in the government support and policies section analyzed wineries that have been open for 1-5 years, 6-10 years and those with 10 + years in business. All three clusters in this section found nothing to be enhancing. It may appear that confidence and opinion on all factors related to the government is constraining and increases with number of years in business. Government factors are found to be constraining factors in many other regions of the wine world, particularly tax systems and the competence of public personnel (Van Rooyen, Esterhuizen, and Stroebel 2011).

The demand condition factors (Table 1) were varied yet showed a very high presence of neutrals and enhancing ratings. The factors with the most enhancing effects across all clusters include *regional tourism increase, growth in the United States wine market,* and *consumer knowledge of local products*. Some of the more constraining effects across all clusters include *growth in local market* and *competition in local market.* This is encouraging as enhancing demand conditions can often offset the constraining conditions within the previous sections. Furthermore the reputation of a wine region can be built locally through tourism efforts. Consumers are more willing to pay more for wines that use an AVA designation they are familiar with (Cross, Plantinga, and Stavins 2011). Additionally, consumers of Shawnee Hills wines are becoming more knowledgeable of regional offerings. This is important as consumer perceptions can be directly linked to the presence of regulatory features such as the presence of a regional wine quality program noted on a label (Chiodo, Casolani, and Fantini).

Wineries with solo owners found *consumer demand for Vinifera wines* and *demand for products in metropolitan Areas* to be constraining whereas those with multiple owners found these factors to be neutral (Table B5, Appendix B).

A final note of comparison regarding demand conditions on wineries that have been open for 1-5 years and those with 10+ years in business: wineries with 1-5 years of business found the factors *growth in local market* and *local market size* (Table B5) to be constraining whereas those with 10+ years of business did not. Furthermore wineries with 1-5 years in business found the factors *consumer demand for Vinifera wines* and *demand for products in metropolitan areas* to be neutral whereas those with 10+ years of business found these same factors to be constraining. This is interesting as it shows a conflicting view of consumer demand between younger and older wineries. The wineries with 1-5 years of business appear to be more concerned about consumer demand locally whereas those with 10+ years of business appear to be more concerned with consumer demand outside of the local market.

## 5. Conclusions & Recommendations

The Lodi and Central Coast AVA studies in California show that the presence and recognition of an area's possession of a distinct geography as referenced by an American Viticultural Area can have an effect on price, as does the implementation of regional quality winemaking and grape growing standards (e.g., the Lodi Rules Sustainable Winegrowing Program and SIP Certification Program). Other AVAs may conclude that they should develop regional wine quality programs, thus decreasing the uncertainty in consumer wine purchases. Additionally we know that regional reputation and knowledge regarding quality production are key drivers of consumer demand (Foti, Pilato, and Timpanaro 2011). What are

the key and potentially key drivers behind the demand for Shawnee Hills wines? This information would be of great value to the creation of a regional wine quality program. An expanded and regularly administered Shawnee Hills AVA Winery Competiveness Survey might answer some of the uncertainties.

The results of the wine competiveness survey indicate a need to differentiate Shawnee Hill's wines from both neighboring wine regions in the short run and global wines in the long run in order to penetrate the regional metropolitan markets such as Chicago, IL, St. Louis, MO, Nashville, TN and others. While a regional or AVA specific wine quality program has shown to help accomplish this task in other regions, the survey results also portrayed a current lack of essential financial support necessary to implement such a quality assurance program. As the most constraining element, government policies make an attractive target for improvement. Predictable and transparent laws, policies, and support structures would improve the business climate as would the removal of archaic restrictions.

Community partnerships are essential to the development of any regional quality program. If community cohesiveness can be improved then chances of government support should improve as well. In the Lodi AVA newsletters and grassroots coffee shop meetings were utilized to partly achieve this goal (Shaw, Luebell, and Ohmart). Whereas in South Africa, "lobby discussions" were conducted which brought government and industry leaders together (Van Rooyen, Esterhuizen, and Stroebel 2011). Finally, collaboration with research institutions must be improved. While both private enterprises and public research institutions may have similar goals, they may not be able to agree on the path to achievement of these goals simply because there is a lack of consistent lines of communication. Such collaborative efforts have shown to be successful in regulation formation and funding procurement in regions such as Lodi, CA, Iowa, Ohio, and others. A more united effort could only benefit the Shawnee Hills AVA.

There are, however, some positive factors already at work in the Shawnee Hills AVA as shown by the survey results. The Shawnee Hills AVA is filled with winery owner/operators who believe in the enhancing qualities of innovation and unique processes. Wine quality assurance programs could serve to encourage these things further. Furthermore it appears that the supply of local grapes is in no immediate danger of a shortage. This is important because most regional wine quality programs require the use of AVA grown fruit. Perhaps most intriguing, overall consumer demand in the United States for wine, specifically regionally identifiable wine with a sense of place is growing tremendously. With a united focus on product differentiation, the Shawnee Hills American Viticultural

Area has a chance to capture a portion of that growth.

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APPENDICES

## Appendix A: Winery Competiveness Survey Instrument for Owner/Operators in the Shawnee Hills AVA Conducted January 2013-February 2013

| I. Production Factor Conditions | Mostly Constraining | Modestly Constraining | Neutral | Modestly Enhancing | Mostly Enhancing |
|---|---|---|---|---|---|
| Quality of low-level skilled labor | | | | | |
| Cost of Transport | | | | | |
| Cost of Financing | | | | | |
| Availability of skilled labor | | | | | |
| Overall Cost of doing business | | | | | |
| Labor Administrative Cost | | | | | |
| Cost of Quality Technology | | | | | |
| Quality of Skilled Labor | | | | | |
| Cost of Skilled Labor | | | | | |
| Cost of Infrastructure | | | | | |
| Credit Availability | | | | | |
| Availability of Quality Technology | | | | | |
| Quality of Technology | | | | | |
| Availability of Water for industrial purposes | | | | | |
| Availability of low level skilled labor | | | | | |

**Figure A1: Survey of Production Factor Conditions**

| II. **Related and Supporting Industries** | **Mostly Constraining** | **Modestly Constraining** | **Neutral** | **Modestly Enhancing** | **Mostly Enhancing** |
|---|---|---|---|---|---|
| Electricity Supply | | | | | |
| Collaboration with research institutions in R&D | | | | | |
| Telecommunication | | | | | |
| Suppliers of packaging material | | | | | |
| Financial Institutions | | | | | |
| Transportation Companies | | | | | |
| Internet Service Providers | | | | | |
| Social Media Services | | | | | |
| Long-term Outlook of local grape suppliers | | | | | |
| Reputation of research institutions | | | | | |
| Quality of local grape suppliers | | | | | |

**Figure A2: Survey of Related & Supporting Industries**

| III. Firm, Strategy, Structure, Rivalry | Mostly Constraining | Modestly Constraining | Neutral | Modestly Enhancing | Mostly Enhancing |
|---|---|---|---|---|---|
| Expenditure on R&D in winery | | | | | |
| Expenditure on R&D in vineyard | | | | | |
| Incentives for Management | | | | | |
| Flow of information from customers | | | | | |
| Information flow from primary suppliers to company | | | | | |
| Substitutes of company's products or services (i.e. microbrews) | | | | | |
| Continuous Innovation | | | | | |
| AVA Regulatory Standards | | | | | |
| Efficiency of Technology in production process | | | | | |
| Investment in Staff (training) | | | | | |
| Unique Services and Processes | | | | | |
| Entry of New Competitors | | | | | |
| Neighboring wine region product entry in local market | | | | | |
| Affordable high quality products | | | | | |
| Regional industry structure & rivalry | | | | | |

**Figure A3: Survey of Firm, Strategy, Structure, & Rivalry**

| IV. Government Support & Policies | Mostly Constraining | Modestly Constraining | Neutral | Modestly Enhancing | Mostly Enhancing |
|---|---|---|---|---|---|
| Confidence/Trust in local political systems | | | | | |
| Confidence/Trust in State political system | | | | | |
| Competence of Personnel in Public Sector | | | | | |
| Labor Policy & Regulation | | | | | |
| Administrative/ Bureaucratic Regulations in Industry | | | | | |
| Land use regulation policies | | | | | |
| Employee hiring/firing policies | | | | | |
| Tax System | | | | | |
| Political Changes | | | | | |
| Environmental Regulations | | | | | |
| Distribution policies | | | | | |
| Federal Government Wine/grape policy | | | | | |
| Complying with Environmental Standards | | | | | |

**Figure A4: Survey of Government Support & Policies**

| V. Demand Conditions | Mostly Constraining | Modestly Constraining | Neutral | Modestly Enhancing | Mostly Enhancing |
|---|---|---|---|---|---|
| Growth in Local Market | | | | | |
| Local Market Size | | | | | |
| Competition in Local Market | | | | | |
| Demand for Environmental Friendly Products | | | | | |
| Regional Tourism Increase | | | | | |
| Growth in United States Wine Market | | | | | |
| Consumer knowledge of local products | | | | | |
| Sophistication of local buyers | | | | | |
| Consumer Demand for Vinifera Wines | | | | | |
| Demand for products in metropolitan areas | | | | | |

**Figure A5: Survey of Demand Conditions**

## Appendix B: Shawnee Hills AVA Winery Competiveness Survey 2013

### Table B1: Shawnee Hills Winery Competiveness Survey 2013 Production Factor Results

| PRODUCTION FACTORS | Overall | SOLO | MULTI | WM | NWM | 1- 5 | 6 - 10 | 10 + |
|---|---|---|---|---|---|---|---|---|
| *Quality of low-level skilled labor* | 2.9 | 3.1 | 2.7 | 2.8 | 3.3 | 2.8 | 3.1 | 2.8 |
| *Cost of Transport* | 2.3 | 2.5 | 2.0 | 2.3 | 2.3 | 2.5 | 2.4 | 1.8 |
| *Cost of Financing* | 2.4 | 2.4 | 2.5 | 2.5 | 2.0 | 2.8 | 2.1 | 2.3 |
| *Availability of skilled labor* | 2.6 | 2.7 | 2.5 | 2.4 | 3.5 | 1.8 | 3.1 | 3.0 |
| *Overall Cost of doing business* | 1.9 | 2.1 | 1.7 | 1.9 | 2.0 | 1.8 | 2.3 | 1.5 |
| *Labor Administrative Cost* | 2.6 | 2.5 | 2.7 | 2.5 | 2.8 | 2.8 | 2.7 | 2.0 |
| *Cost of Quality Technology* | 2.5 | 2.5 | 2.5 | 2.4 | 2.8 | 2.5 | 2.3 | 3.0 |
| *Quality of Skilled Labor* | 2.8 | 2.8 | 2.8 | 2.5 | 4.0 | 2.5 | 3.4 | 2.3 |
| *Cost of Skilled Labor* | 2.5 | 2.4 | 2.8 | 2.3 | 3.0 | 2.3 | 2.7 | 2.5 |
| *Cost of Infrastructure* | 2.2 | 2.3 | 2.2 | 2.0 | 3.0 | 1.8 | 2.4 | 2.5 |
| *Credit Availability* | 2.6 | 2.5 | 3.0 | 2.6 | 2.8 | 2.5 | 2.9 | 2.5 |
| *Availability of Quality Technology* | 3.1 | 2.8 | 3.7 | 3.1 | 3.3 | 2.8 | 3.6 | 2.8 |
| *Quality of Technology* | 3.4 | 3.0 | 4.0 | 3.3 | 3.5 | 3.3 | 3.6 | 3.0 |
| *Availability of Water for industrial purposes* | 3.2 | 2.8 | 3.8 | 2.9 | 4.0 | 3.2 | 3.3 | 3.0 |
| *Availability of low level skilled labor* | 2.6 | 2.6 | 2.7 | 2.4 | 3.5 | 2.3 | 3.1 | 2.3 |

***Ratings:** 1= mostly constraining; 2 = mildly constraining; 3 = neutral; 4 = mildly enhancing; 5 = mostly enhancing

***Legend:** All respondents = Overall; Solo owner = SOLO; Multiple Owners = MULTI; Owner performs winemaking tasks = WM; Owner hires labor to perform winemaking tasks = NWM; Number of years in business = 1-5, 6-10, 10+

***Sample size =** 17 total respondents

**Table B2: Shawnee Hills Winery Competiveness Survey 2013 Related & Supporting Industries Results**

| RELATED & SUPPORTING INDUSTRIES | OVERALL | SOLO | MULTI | WM | NWM | 1 - 5 | 6 - 10 | 10 + |
|---|---|---|---|---|---|---|---|---|
| *Electricity Supply* | 3.3 | 3.1 | 3.7 | 3.5 | 2.8 | 4.0 | 3.0 | 2.8 |
| *Collaboration with research institutions in R&D* | 3.1 | 3.0 | 3.2 | 2.9 | 3.5 | 2.8 | 3.3 | 3.0 |
| *Telecommunication* | 2.9 | 2.7 | 3.2 | 3.1 | 2.3 | 2.8 | 2.7 | 3.3 |
| *Suppliers of packaging material* | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.0 | 3.3 | 3.8 |
| *Financial Institutions* | 3.2 | 3.2 | 3.2 | 3.2 | 3.0 | 3.3 | 3.1 | 3.0 |
| *Transportation Companies* | 3.1 | 3.2 | 2.8 | 3.0 | 3.3 | 3.0 | 3.1 | 3.0 |
| *Internet Service Providers* | 3.1 | 2.6 | 3.8 | 3.1 | 3.0 | 3.0 | 3.1 | 3.0 |
| *Social Media Services* | 3.3 | 2.9 | 4.0 | 3.2 | 3.8 | 3.0 | 3.0 | 4.3 |
| *Long-term Outlook of local grape suppliers* | 2.8 | 2.5 | 3.5 | 2.7 | 3.3 | 2.5 | 2.9 | 3.3 |
| *Reputation of research institutions* | 3.0 | 3.3 | 2.5 | 2.8 | 3.5 | 2.3 | 3.3 | 3.5 |
| *Quality of local grape suppliers* | 3.4 | 3.5 | 3.0 | 3.3 | 3.5 | 3.0 | 4.0 | 2.8 |

***Ratings:** 1= mostly constraining; 2 = mildly constraining; 3 = neutral; 4 = mildly enhancing; 5 = mostly enhancing

***Legend:** All respondents = Overall; Solo owner = SOLO; Multiple Owners = MULTI; Owner performs winemaking tasks = WM; Owner hires labor to perform winemaking tasks = NWM; Number of years in business = 1-5, 6-10, 10+

***Sample size =** 17 total respondents

**Table B3: Shawnee Hills Winery Competiveness Survey 2013 Firm Strategy, Structure, & Rivalry Results**

| FIRM STRATEGY, STRUCTURE, & RIVALRY | OVERALL | SOLO | MULTI | WM | NWM | 1 - 5 | 6 - 10 | 10 + |
|---|---|---|---|---|---|---|---|---|
| *Expenditure on R&D in winery* | 2.7 | 2.7 | 2.7 | 2.8 | 2.3 | 2.5 | 2.7 | 3.0 |
| *Expenditure on R&D in vineyard* | 2.9 | 2.9 | 2.8 | 3.1 | 2.3 | 3.0 | 2.7 | 3.0 |
| *Incentives for Management* | 2.8 | 2.6 | 3.2 | 2.8 | 2.8 | 2.8 | 2.7 | 3.0 |
| *Flow of information from customers* | 3.6 | 3.5 | 3.8 | 3.5 | 3.8 | 3.5 | 3.3 | 4.3 |
| *Information flow from primary suppliers to company* | 3.4 | 3.5 | 3.2 | 3.4 | 3.5 | 3.3 | 3.3 | 3.8 |
| *Substitutes of company's products or services (i.e. microbrews)* | 3.4 | 3.4 | 3.3 | 3.3 | 3.5 | 3.2 | 3.1 | 4.0 |
| *Continuous Innovation* | 3.7 | 3.5 | 4.0 | 3.6 | 4.0 | 4.0 | 3.4 | 3.8 |
| *AVA Regulatory Standards* | 3.1 | 3.2 | 3.0 | 3.1 | 3.3 | 3.0 | 3.2 | 3.3 |
| *Efficiency of Technology in production process* | 2.9 | 2.8 | 3.2 | 3.0 | 2.8 | 2.7 | 3.1 | 3.0 |
| *Investment in Staff* | 3.4 | 3.2 | 3.8 | 3.5 | 3.3 | 3.3 | 3.4 | 3.5 |
| *Unique Services and Processes* | 3.6 | 3.5 | 3.8 | 3.5 | 4.0 | 3.5 | 3.4 | 4.3 |
| *Entry of New Competitors* | 2.6 | 2.8 | 2.3 | 2.7 | 2.3 | 3.0 | 2.5 | 2.3 |
| *Neighboring wine region product entry in local market* | 2.6 | 2.5 | 3.0 | 2.5 | 3.0 | 2.7 | 2.7 | 2.5 |
| *Affordable high quality products* | 2.9 | 2.5 | 3.7 | 2.7 | 3.8 | 3.0 | 2.9 | 3.0 |
| *Regional industry structure & rivalry* | 2.8 | 2.7 | 3.0 | 2.7 | 3.0 | 2.3 | 3.1 | 3.0 |

***Ratings:** 1= mostly constraining; 2 = mildly constraining; 3 = neutral; 4 = mildly enhancing; 5 = mostly enhancing

***Legend:** All respondents = Overall; Solo owner = SOLO; Multiple Owners = MULTI; Owner performs winemaking tasks = WM; Owner hires labor to perform winemaking tasks = NWM; Number of years in business = 1-5, 6-10, 10+

***Sample size =** 17 total respondents

**Table B4: Shawnee Hills Winery Competiveness Survey 2013 Government Support & Policies Results**

| GOVERNMENT SUPPORT & POLICIES | OVERALL | SOLO | MULTI | WM | NWM | 1 - 5 | 6 - 10 | 10 + |
|---|---|---|---|---|---|---|---|---|
| *Confidence/Trust in local political systems* | 2.6 | 2.5 | 2.8 | 2.3 | 3.5 | 2.7 | 2.9 | 2.0 |
| *Confidence/Trust in State political system* | 1.5 | 1.4 | 1.7 | 1.3 | 2.0 | 1.3 | 1.6 | 1.5 |
| *Competence of Personnel in Public Sector* | 1.9 | 1.9 | 1.8 | 1.5 | 3.0 | 1.7 | 2.0 | 2.0 |
| *Labor Policy & Regulation* | 2.3 | 2.4 | 2.2 | 2.2 | 2.5 | 2.3 | 2.6 | 1.8 |
| *Administrative/Bureaucratic Regulations* | 1.8 | 2.0 | 1.5 | 1.7 | 2.3 | 1.8 | 1.9 | 1.8 |
| *Land use regulation policies* | 2.9 | 2.9 | 2.8 | 2.8 | 3.0 | 3.0 | 3.1 | 2.3 |
| *Employee hiring/firing policies* | 3.2 | 3.3 | 3.2 | 3.2 | 3.3 | 3.2 | 3.1 | 3.5 |
| *Tax System* | 1.6 | 1.7 | 1.5 | 1.6 | 1.8 | 1.5 | 1.9 | 1.5 |
| *Political Changes* | 1.9 | 1.9 | 2.0 | 2.0 | 1.8 | 2.0 | 2.0 | 1.8 |
| *Environmental Regulations* | 2.5 | 2.7 | 2.2 | 2.5 | 2.5 | 2.7 | 2.4 | 2.5 |
| *Distribution policies* | 2.2 | 2.2 | 2.3 | 2.5 | 1.5 | 2.7 | 2.0 | 2.0 |
| *Federal Government Wine/grape policy* | 2.6 | 2.6 | 2.5 | 2.6 | 2.5 | 3.0 | 2.4 | 2.3 |
| *Complying with Environmental Standards* | 2.8 | 2.8 | 2.8 | 2.8 | 3.0 | 2.7 | 2.9 | 3.0 |

***Ratings:** 1= mostly constraining; 2 = mildly constraining; 3 = neutral; 4 = mildly enhancing; 5 = mostly enhancing

***Legend:** All respondents = Overall; Solo owner = SOLO; Multiple Owners = MULTI; Owner performs winemaking tasks = WM; Owner hires labor to perform winemaking tasks = NWM; Number of years in business = 1-5, 6-10, 10+

***Sample size =** 17 total respondents

**Table B5: Shawnee Hills Winery Competiveness Survey 2013 Demand Conditions Results**

| DEMAND CONDITIONS | OVERALL | SOLO | MULTI | WM | NWM | 1 - 5 | 6 - 10 | 10 + |
|---|---|---|---|---|---|---|---|---|
| *Growth in Local Market* | 2.8 | 2.6 | 3.2 | 2.8 | 2.8 | 2.8 | 2.6 | 3.3 |
| *Local Market Size* | 2.9 | 2.6 | 3.3 | 2.8 | 3.0 | 2.7 | 2.7 | 3.5 |
| *Competition in Local Market* | 2.8 | 2.6 | 3.0 | 2.7 | 3.0 | 3.0 | 2.6 | 2.8 |
| *Demand for Environmental Friendly Products* | 3.1 | 3.3 | 2.8 | 3.1 | 3.3 | 2.8 | 3.1 | 3.5 |
| *Regional Tourism Increase* | 4.0 | 3.7 | 4.5 | 3.8 | 4.8 | 4.3 | 3.9 | 3.8 |
| *Growth in United States Wine Market* | 3.7 | 3.5 | 4.0 | 3.7 | 3.8 | 3.7 | 3.4 | 4.3 |
| *Consumer knowledge of local products* | 3.4 | 3.0 | 4.0 | 3.3 | 3.5 | 3.7 | 2.9 | 3.8 |
| *Sophistication of local buyers* | 3.0 | 2.9 | 3.2 | 2.9 | 3.3 | 3.2 | 2.9 | 3.0 |
| *Consumer Demand for Vinifera Wines* | 2.9 | 2.5 | 3.5 | 2.8 | 3.0 | 3.3 | 2.6 | 2.8 |
| *Demand for products in metropolitan areas* | 2.9 | 2.5 | 3.7 | 3.0 | 2.8 | 3.5 | 2.6 | 2.5 |

***Ratings:** 1= mostly constraining; 2 = mildly constraining; 3 = neutral; 4 = mildly enhancing; 5 = mostly enhancing

***Legend:** All respondents = Overall; Solo owner = SOLO; Multiple Owners = MULTI; Owner performs winemaking tasks = WM; Owner hires labor to perform winemaking tasks = NWM; Number of years in business = 1-5, 6-10, 10+

***Sample size =** 17 total respondents

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# How Low Can You Go? Assessing the Viability of Small Samples for a Local Business Index

**David J. Sorenson**
*Augustana University - USA*

**Abstract:** Previous research indicated great variability among respondents in the predictive value of respondent data for the "Sioux Falls Business Index," a set of diffusion indices based on survey question responses which has been gathered monthly since 2005. In this paper the analysis is extended to evaluate combinations of firms that might provide satisfactory "small" samples for the purpose of predicting future economic conditions in the Sioux Falls, South Dakota, MSA by comparing group responses to monthly economic data for the MSA. The investigation is motivated by the declining number of participants providing data for the Index. Results indicate promising potential for prediction using a smaller sample, but much of the increase in predictive power appears to be a result of the reduction of sample sizes.

## 1. Introduction

In a prior paper (Sorenson, 2013), the author analyzed the extent to which a local business indicator survey captured changes in the Sioux Falls, SD, economy. While the paper primarily focusses on demonstrating that the survey does indeed provide useful information about changes in the local economy, the last section of the paper provides initial results about individual firms. In the current paper, the predictive power of individual firms and combinations of firms is further investigated. After summarizing the nature of the business survey and previous findings, the smaller samples will be evaluated in terms of correlation with business conditions and predictive power. The paper will be limited to a single measure from the survey, the six-month ahead forecast for the local economy, and a single measure of the local economy, change in employment across a six-month period.

## 2.0 The Index and Prior Evaluation

*The Sioux Falls Business Index*

The Sioux Falls Business Index (SFBI) is "a monthly measurement that

summarizes various indicators reflecting the local business environment . . . . based on a survey of local businesses that captures their assessment of trends in business conditions" (Sioux Falls Argus Leader, 2015). Modelled after surveys done by the Institute of Supply Managers (ISM) and the Federal Reserve Banks of Philadelphia, Richmond, and Dallas, the index asks a number of questions about monthly firm activity and forecasts for the firm and the local economy. The survey was begun in February of 2005 and continues to be administered monthly by Augustana College (see Appendix for the full text of the questions). The Argus Leader staff typically chooses a couple of the computed diffusion indices to publish monthly in the *Vital Signs* section of their *Business Journal*.

Participation in the survey is completely voluntary and varies from month to month. From 48 respondents in the initial month the number of participants quickly rose to 75, but numbers have been dwindling in recent years, often resulting in fewer than twenty respondents. While plans to increase participation are under discussion, the changing participation rate is a primary motivation for investigating the possibility of continuing to work with smaller samples.

*Prior Evaluation of the SFBI*

In keeping with earlier evaluations of other surveys (see Trebing, 1998, Schiller and Trebing, 2003, Keaton and Verba, 2004, Lacy, 1999, and Berger, 2010), fairly simple measures and models were used to initially evaluate the diffusion indices of the SFBI (Sorenson, 2013). Using only firms which had responded at least twenty times, simple correlation coefficients, adjusted $R^2$, and marginal additions to adjusted $R^2$ were the primary means of discerning the association between survey measures and local economic indicators on sales, employment, and unemployment.

The association between SFBI measures and monthly economic data was found to be quite weak. However, substantial association was found for six-month ahead forecasts, both in correlation and marginal added explanation in autoregressive regression models. Using the index related to the question concerning future general conditions in the Sioux Falls economy, absolute values of correlations with various economic indicators ranged from 0.5 to 0.75 and marginal additions to adjusted $R^2$ ranged from 0.22 to 0.24.

## 3. Extension to Individual Firms and Small Groups

The initial evaluation of survey responses revealed sizable correlations between selected individual firms' responses and economic indicators, suggesting the potential viability of using individual firms or combinations of firms to forecast economic activity. To simplify the additional analysis here, only the six-month change in employment will be used as an economic

indicator. The firm's survey response of general conditions being up, same, or down is coded as 1, 0, or -1. This means that single-firm responses will be rather crude variables, with the number of potential values increasing as the number of firms being averaged increases. The ten firms which responded most frequently to the survey are used in the analysis here.

*Summary of Individual Firms*

A summary of characteristics of employment change and the firm indices is shown in Table 1. On average, six-month employment growth in Sioux Falls was 791 jobs. The firms had a wide variety of 'average' responses. Firms 2, 3, and 4 appear to be quite optimistic, with averages of 0.5 or higher, while firms 1, 8, and 10 had slightly negative averages. The other four firms had slightly positive responses on average. Three of the firms participated more than 90 months, with the other firms varying between 75 and 87 months.

**Table 1. Descriptive Statistics of Employment Change and Firm Predictions of Local Economy Condition in Six Months (1 = up; 0 = same; -1 = down).**

| Variable | Mean | Std. Deviation | Observations |
|---|---|---|---|
| Δ Employment | 790.95 | 1450.3 | 93 |
| Firm 1 | -0.086 | 0.503 | 93 |
| Firm 2 | 0.635 | 0.595 | 85 |
| Firm 3 | 0.500 | 0.565 | 92 |
| Firm 4 | 0.517 | 0.603 | 91 |
| Firm 5 | 0.000 | 0.647 | 87 |
| Firm 6 | 0.058 | 0.581 | 86 |
| Firm 7 | 0.000 | 0.788 | 75 |
| Firm 8 | -0.167 | 0.692 | 78 |
| Firm 9 | 0.152 | 0.662 | 79 |
| Firm 10 | -0.039 | 0.613 | 78 |

The degree of association between individual firms and employment change is presented in Table 2. Three firms actually have negative correlations with employment change, appearing to be poor predictors on average, but they are kept in the dataset as potential diversifying group partners. The strongest correlation is the rather impressive 0.56 for Firm 10. The correlations among the firms are also shown in order to illustrate the potential for 'unique' information provided by firms. Given the generally low correlations among firms, there is hope

that combinations might generate results superior to individual firms.

**Table 2. Correlations Among Employment Change and Firms' Six-Month Predictions.**

| Variable | Δ Empl. | Firm 1 | Firm 2 | Firm 3 | Firm 4 | Firm 5 | Firm 6 | Firm 7 | Firm 8 | Firm 9 | Firm 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Δ Empl. | 1.00 | -0.01 | -0.14 | 0.03 | 0.18 | 0.16 | 0.05 | -0.23 | 0.42 | 0.12 | 0.56 |
| Firm 1 | -0.01 | 1.00 | -0.14 | -0.06 | 0.06 | 0.04 | 0.06 | -0.02 | 0.22 | 0.15 | 0.08 |
| Firm 2 | -0.14 | -0.14 | 1.00 | 0.09 | 0.12 | 0.07 | 0.31 | 0.24 | 0.05 | 0.13 | -0.16 |
| Firm 3 | 0.03 | -0.06 | 0.09 | 1.00 | -0.11 | 0.00 | 0.08 | -0.12 | 0.05 | 0.07 | -0.12 |
| Firm 4 | 0.18 | 0.06 | 0.12 | -0.11 | 1.00 | 0.25 | 0.15 | 0.44 | 0.26 | 0.45 | 0.38 |
| Firm 5 | 0.16 | 0.04 | 0.07 | 0.00 | 0.25 | 1.00 | 0.37 | 0.18 | 0.26 | 0.11 | 0.23 |
| Firm 6 | 0.05 | 0.06 | 0.31 | 0.08 | 0.15 | 0.37 | 1.00 | -0.03 | 0.08 | 0.04 | -0.11 |
| Firm 7 | -0.23 | -0.02 | 0.24 | -0.12 | 0.44 | 0.18 | -0.03 | 1.00 | 0.04 | 0.35 | 0.17 |
| Firm 8 | 0.42 | 0.22 | 0.05 | 0.05 | 0.26 | 0.26 | 0.08 | 0.04 | 1.00 | 0.19 | 0.41 |
| Firm 9 | 0.12 | 0.15 | 0.13 | 0.07 | 0.45 | 0.11 | 0.04 | 0.35 | 0.19 | 1.00 | 0.30 |
| Firm 10 | 0.56 | 0.08 | -0.16 | -0.12 | 0.38 | 0.23 | -0.11 | 0.17 | 0.41 | 0.30 | 1.00 |

While some firms' predictions exhibit sizable correlations with employment change, they may not provide significant prediction beyond a simple autoregressive model. To assess the marginal contribution, simple models with a single lag of the 6-month employment change were estimated. The first row of Table 3 summarizes the lag-only model, which has an adjusted $R^2$ of about 0.2. Given the loss of degrees of freedom, two of the models with a firm added lead to a decrease in adjusted $R^2$. On average, adding a firm's prediction to the lag term only provides a marginal increase of 0.06, but the largest increase is 0.146, or about a 70% improvement.

**Table 3. Adjusted-R² for Single-Firm Models.**

| Model | Intercept | Lag Slope | Firm Slope | Obs | R² | Adj. R² | Marginal Adj. R² |
|---|---|---|---|---|---|---|---|
| Δ Empl.(-1) Only | 377.4 | 0.452 | . | 87 | 0.212 | 0.203 | . |
| Firm 1 | 396.3 | 0.441 | -50.2 | 82 | 0.209 | 0.189 | -0.014 |
| Firm 2 | 312.5 | 0.521 | 181.4 | 76 | 0.290 | 0.270 | 0.068 |
| Firm 3 | 419.8 | 0.479 | -246.9 | 81 | 0.257 | 0.238 | 0.035 |
| Firm 4 | 48.7 | 0.414 | 857.0 | 80 | 0.347 | 0.330 | 0.127 |
| Firm 5 | 348.9 | 0.458 | 135.1 | 76 | 0.249 | 0.228 | 0.026 |
| Firm 6 | 303.7 | 0.456 | 530.6 | 76 | 0.250 | 0.229 | 0.026 |
| Firm 7 | 300.9 | 0.498 | 642.5 | 69 | 0.290 | 0.269 | 0.066 |
| Firm 8 | 522.7 | 0.280 | 524.2 | 70 | 0.214 | 0.190 | -0.012 |
| Firm 9 | 219.6 | 0.410 | 803.6 | 74 | 0.339 | 0.320 | 0.118 |
| Firm 10 | 502.3 | 0.303 | 864.2 | 68 | 0.368 | 0.348 | 0.146 |
| Average | | | | | 0.275 | 0.256 | 0.059 |

*Combinations of Firms*

Combining firms into pairs provides a means of potentially tempering significant errors in prediction and allows for a wider range of values of the index. The results of all 45 possible pairs are shown in Table 4, switching now to *total* adjusted R² rather than marginal adjusted R². The average correlation coefficient with employment change is 0.32, with a maximum of 0.65, and the average adjusted R² is 0.3, with a maximum of nearly 0.5. However, these gains come at the cost of losing a significant number of observations, as paired observations were only computed if both firms participated for a given month.

**Table 4. Correlations and Adjusted R² for Two-firm Groupings.**

| | n | Mean | Std. dev. | Median | Min | Max | Q1 | Q3 |
|---|---|---|---|---|---|---|---|---|
| Correlations | 45 | 0.317 | 0.176 | 0.33 | -0.06 | 0.65 | 0.21 | 0.44 |
| Adjusted R² | 45 | 0.297 | 0.064 | 0.30 | 0.15 | 0.47 | 0.26 | 0.33 |
| Observations | 45 | 64.91 | 5.62 | 64 | 52 | 77 | 61 | 69 |

Comparable figures for three-firm groupings are shown in Table 5. The mean correlation and adjusted R² increase to 0.38 and 0.33, respectively, but the average number of observations drops an additional ten to 55. The variability among groups in providing additional explanatory power leads to another small increase in the standard deviation.

**Table 5. Correlations and Adjusted-$R^2$ for Three-firm Groupings.**

| | n | Mean | Std. dev. | Median | Min | Max | Q1 | Q3 |
|---|---|---|---|---|---|---|---|---|
| Correlations | 120 | 0.381 | 0.150 | 0.39 | -0.02 | 0.67 | 0.27 | 0.49 |
| Adjusted $R^2$ | 120 | 0.333 | 0.066 | 0.33 | 0.17 | 0.49 | 0.28 | 0.38 |
| Observations | 120 | 55.94 | 5.68 | 55.5 | 42 | 72 | 52 | 59.5 |

The same method of testing was extended to groupings of four firms up to groupings of nine firms. The results from one firm through all ten firms are shown in Tables 6 and 7. The trends of gains in both strength of average correlation and increased explanatory power continue through the increase in group size, although the incremental improvements are clearly declining. The standard deviation of the correlations declines as one increases the number of firms, not surprising given the increasing inclusion of each firm in multiple groupings, and the standard deviation of adjusted $R^2$ declines consistently after a peak among three-firm groupings.

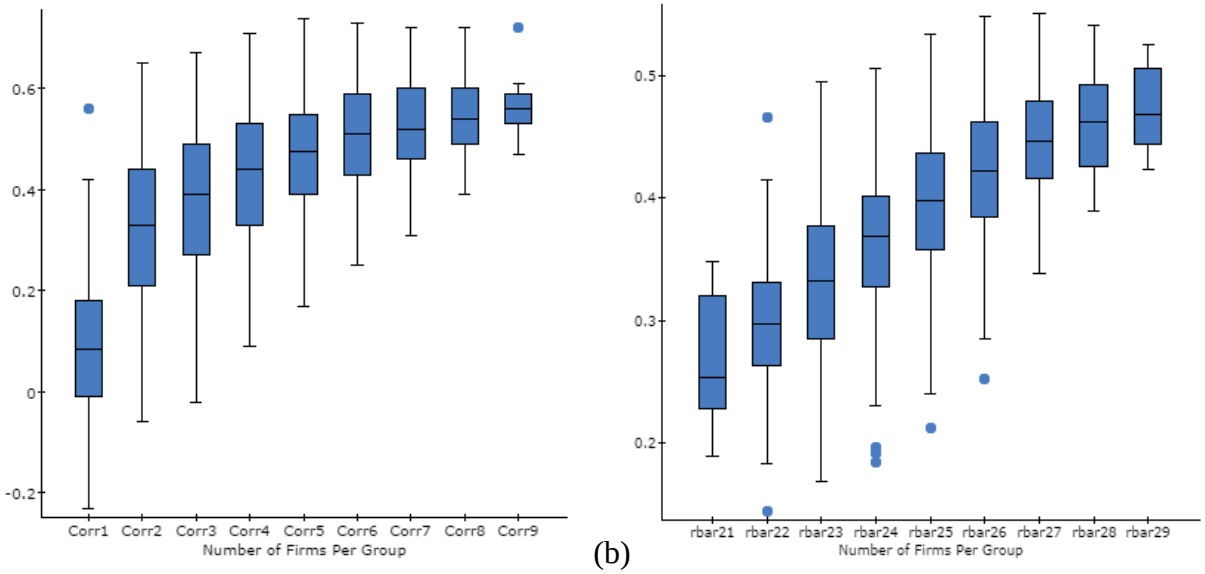
**Table 6. Correlations for Four- through Nine-Firm Groupings.**

| No. of Firms | n | Mean | Std. dev. | Median | Min | Max | Q1 | Q3 |
|---|---|---|---|---|---|---|---|---|
| One Firm | 10 | 0.114 | 0.238 | 0.085 | -0.23 | 0.56 | -0.01 | 0.18 |
| Two Firms | 45 | 0.317 | 0.176 | 0.33 | -0.06 | 0.65 | 0.21 | 0.44 |
| Three Firms | 120 | 0.381 | 0.150 | 0.39 | -0.02 | 0.67 | 0.27 | 0.49 |
| Four Firms | 210 | 0.431 | 0.131 | 0.44 | 0.09 | 0.71 | 0.33 | 0.53 |
| Five Firms | 252 | 0.472 | 0.119 | 0.475 | 0.17 | 0.74 | 0.39 | 0.55 |
| Six Firms | 210 | 0.504 | 0.109 | 0.51 | 0.25 | 0.73 | 0.43 | 0.59 |
| Seven Firms | 120 | 0.530 | 0.098 | 0.52 | 0.31 | 0.72 | 0.46 | 0.6 |
| Eight Firms | 45 | 0.550 | 0.086 | 0.54 | 0.39 | 0.72 | 0.49 | 0.6 |
| Nine Firms | 10 | 0.566 | 0.068 | 0.56 | 0.47 | 0.72 | 0.53 | 0.59 |
| All 10 Firms | 1 | 0.580 | | | | | | |

**Table 7. Adjusted-$R^2$ for Four- through Nine-Firm Groupings.**

| No. of Firms | n | Mean | Std. dev. | Median | Min | Max | Q1 | Q3 |
|---|---|---|---|---|---|---|---|---|
| One Firm | 10 | 0.261 | 0.057 | 0.254 | 0.189 | 0.348 | 0.228 | 0.320 |
| Two Firms | 45 | 0.297 | 0.064 | 0.297 | 0.145 | 0.466 | 0.263 | 0.332 |
| Three Firms | 120 | 0.333 | 0.066 | 0.332 | 0.168 | 0.495 | 0.285 | 0.377 |
| Four Firms | 210 | 0.366 | 0.064 | 0.368 | 0.184 | 0.506 | 0.327 | 0.402 |
| Five Firms | 252 | 0.397 | 0.059 | 0.397 | 0.212 | 0.533 | 0.358 | 0.437 |
| Six Firms | 210 | 0.423 | 0.054 | 0.422 | 0.252 | 0.548 | 0.385 | 0.462 |
| Seven Firms | 120 | 0.445 | 0.048 | 0.446 | 0.338 | 0.551 | 0.415 | 0.480 |
| Eight Firms | 45 | 0.462 | 0.042 | 0.462 | 0.389 | 0.541 | 0.426 | 0.492 |
| Nine Firms | 10 | 0.474 | 0.035 | 0.468 | 0.424 | 0.525 | 0.444 | 0.505 |
| All 10 Firms | 1 | 0.480 | | | | | | |

Graphical display better captures the changes occurring with the larger grouping sizes. Figure 1 illustrates the trends in correlation and adjusted $R^2$ using box plots that show not only the trends in medians, which are generally quite close to the means, but also the spread and outliers. The most notable jump in median correlation occurs between the single firms and the pairings, with much smaller increments and a levelling off as one approaches the nine-firm groupings. The progression is steadier among the adjusted-$R^2$ values. The outliers are somewhat intriguing, especially the single firm with a much higher correlation than others and the single nine-firm grouping which is much higher than others.




(a) (b)

**Figure 1. Box Plots of (a) Correlation and (b) Adjusted-$R^2$ by Grouping Size.**

The summaries of the groupings suggest that combinations of small numbers of firms may, indeed, provide a feasible alternative to a larger sample size. However, the gains from selective grouping become questionable when the reduction in sample sizes is scrutinized. While some loss of observations was expected when using a method that only computes and includes cases when each member of a grouping participated in a month, the decline in sample sizes was much larger than anticipated. The decline noted for the two- and three-firm cases summarized in Tables 2 and 3 are extended in Figure 3, which provides the average number of observations per group (divided by 100 for scaling purposes) for each grouping size along with the average correlations and adjusted-$R^2$ values. The upward trending of both measures of association is clearly matched by a downward trend in sample sizes.

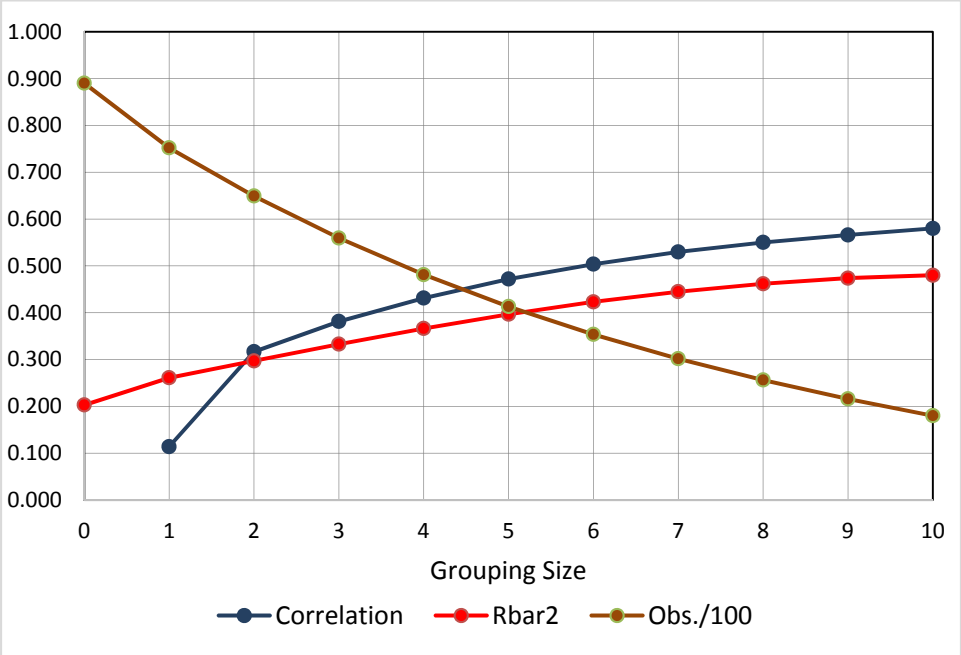



**Figure 2. Average Correlation, Adjusted $R^2$, and Sample Size for Groupings.**

The relationship between sample size and explanatory power was further investigated by examining differences within the various grouping sizes. For every grouping size examined, explanatory power declined as the sample size increased, by as much as adjusted $R^2$ declining 0.0046 for each additional observation included. The problem was less severe at the largest groupings.

## 4. Expanded Sample Sizes

In order to better assess the feasibility of providing sufficient explanatory power with smaller numbers of responding firms, group indices were re-calculated using the average of those firms that responded in a particular month. Even if multiple firms did not respond, the observation was still used in the analysis of correlation and adjusted-$R^2$. Rather than examine all grouping sizes, which would have included numerous cases of very few values being included at the mean for small grouping sizes, only groupings of 7 to 9 firms were examined. The results are shown in Table 8 and Figure 3.

**Table 8. Correlations and Adjusted-$R^2$ for Full-sample Groupings.**

| Group Size | n | Mean | Std. dev. | Median | Min | Max | Q1 | Q3 |
|---|---|---|---|---|---|---|---|---|
| *Correlations:* | | | | | | | | |
| Single Firm | 10 | 0.114 | 0.238 | 0.085 | -0.23 | 0.56 | -0.01 | 0.18 |
| Seven Firms | 120 | 0.431 | 0.065 | 0.44 | 0.26 | 0.56 | 0.39 | 0.48 |
| Eight Firms | 45 | 0.448 | 0.051 | 0.45 | 0.33 | 0.54 | 0.42 | 0.49 |
| Nine Firms | 10 | 0.463 | 0.035 | 0.465 | 0.4 | 0.52 | 0.44 | 0.49 |
| All Ten Firms | 1 | 0.480 | | | | | | |
| | | | | | | | | |
| *Adjusted $R^2$:* | | | | | | | | |
| Single Firm | 10 | 0.261 | 0.057 | 0.254 | 0.189 | 0.348 | 0.228 | 0.32 |
| Seven Firms | 120 | 0.322 | 0.039 | 0.320 | 0.238 | 0.429 | 0.294 | 0.348 |
| Eight Firms | 45 | 0.331 | 0.032 | 0.330 | 0.276 | 0.400 | 0.306 | 0.352 |
| Nine Firms | 10 | 0.338 | 0.023 | 0.335 | 0.311 | 0.375 | 0.318 | 0.364 |
| All Ten Firms | 1 | 0.345 | | | | | | |

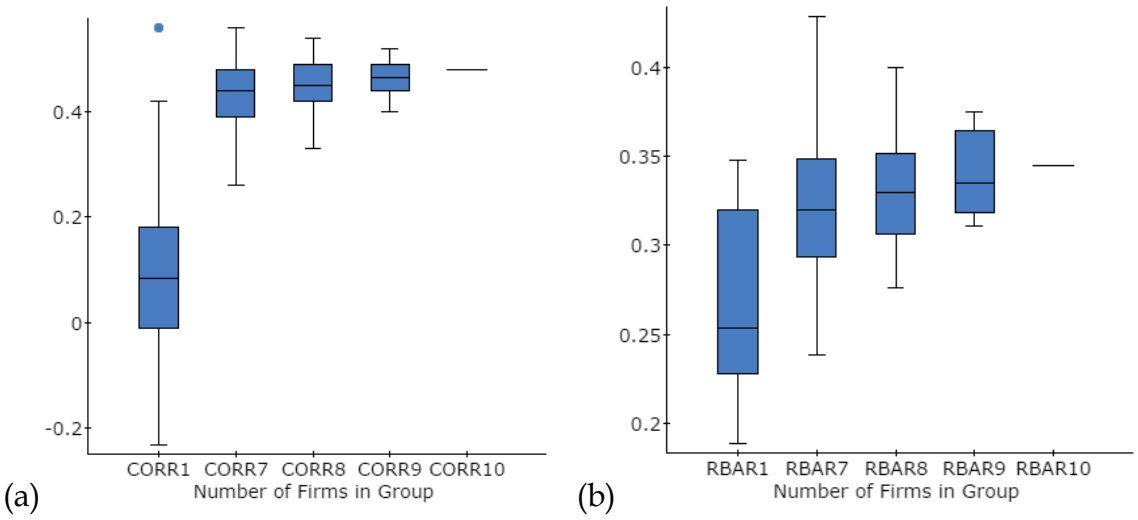



**Figure 3. Full-sample Box Plots of (a) Correlation and (b) Adjusted-$R^2$ by Grouping Size.**

Note: The scales differ from those in Fig. 1 and there is a jump from single firms to groups of 7, so results are not directly visually comparable.

The full-sample results provide an interesting contrast to the reduced-sample findings. Both correlation and adjusted $R^2$ for the groups are far lower in the full sample. Among seven-firm groupings, for example, the average correlation is now 0.43 rather than 0.53, and the average adjusted $R^2$ is now 0.322 rather than 0.445. For the seven-, eight-, and nine-firm groupings, the minimum correlations are slightly lower for the full-sample groups, but the maximum values are much lower, dropping closer to 0.5 than the 0.7 found in the earlier groupings. The adjusted $R^2$ minimum and maximum value reductions are not as different, but the maximum values are reduced more than the minimum values. Interestingly, the best seven-firm grouping still performs better than the best eight- or nine-firm grouping. Furthermore, the best seven-firm grouping is able to achieve an adjusted $R^2$ almost equal to that of the entire set of firms responding to the survey.

## 5. Conclusion

The examination of groupings of firms provides promising results for the use of smaller samples. Although the average adjusted $R^2$ for the seven- to ten-firm combinations is below the 0.436 reported for the entire sample (Sorenson, 2013, p. 62), there is still some gain over a simple autoregressive model. In addition, the best seven-firm grouping value rivals the value of the entire sample. There is reason to hope that carefully selected small samples may provide a reasonable substitute for a larger sample.

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# Appendix. Sioux Falls Business Index Survey

*Confidentiality Assurance: Data will only be released after aggregating into categories or over all firms. We will not release any information that we believe would reveal characteristics of individual firms or opinions of their representatives.*

**A. First, we would like some information about your firm to aid in the analysis of the data by sector and size of firm.**

In which sector of the economy does your firm earn the largest share of its revenues?

What is the approximate number of employees at your firm working in the Sioux Falls area? ☐

**B. Next, we would like your assessment of business conditions as you expect them SIX MONTHS FROM NOW.**

| | Up | Same | Down | N/A |
|---|---|---|---|---|
| General economic conditions in the Sioux Falls metro area | ☐ | ☐ | ☐ | ☐ |
| General conditions at your firm | ☐ | ☐ | ☐ | ☐ |
| Prices that you charge for your products and/or services | ☐ | ☐ | ☐ | ☐ |

**C. Now, please give us your assessment of the following conditions in your business COMPARED TO LAST MONTH:**

| | Up | Same | Down | N/A |
|---|---|---|---|---|
| Revenues (Sales) | ☐ | ☐ | ☐ | ☐ |
| Number of Employees | ☐ | ☐ | ☐ | ☐ |
| Average hours worked per employee | ☐ | ☐ | ☐ | ☐ |
| Average wage (employee compensation) | ☐ | ☐ | ☐ | ☐ |
| Price paid for purchased materials and/or products | ☐ | ☐ | ☐ | ☐ |
| Price(s) received for your product(s) | ☐ | ☐ | ☐ | ☐ |
| Inventory of finished goods and/or products for sale | ☐ | ☐ | ☐ | ☐ |
| Customer traffic | ☐ | ☐ | ☐ | ☐ |

*Please click on the submit button to send us your information. Thank you for participating in the survey.*