HONORS THESIS PAPER

CENTRAL OREGON ECONOMIC ACTIVITY & BUSINESS CONDITION ANALYSIS

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Executive Summary

In a world without crystal balls, there is little economists and policymakers can foresee in an economy without the help of indexes of economic activity. By examining current economic trends, one can predict future developments in an economy based on expectations developed over the historical performance of a combination of relevant time-series data. In our project, we will be building an index of business activity for the Central Oregon region. This index is modeled after the same methodology used by the Department of Commerce for their highly regarded U.S. composite leading index. This methodology, the accuracy of which is verified by organizations such as the Conference Board, is the same methodology used by the majority of indexes in the U.S. The COBI, however, will be slightly different than the CLI in that it will be constructed using local data, so as to more accurately forecast local business activity.

Though there are many different statistical methods for forecasting national economic activity, the U.S. composite leading index (CLI) as established by NBER researchers Wesley Mitchell and Arthur Burns remains the paramount tool for predicting business cycle activity. Though criticized by some for its lack of methodology, the CLI is still favored by the majority of economists for its ease of use, reliability over time, and relative freedom from many of the statistical constraints that other forecasting methods are often plagued by.

It is every index's aim to simplify complex economic data into succinct and quantifiable changes in an economy. Yet, because economic conditions vary from area to area, and over time, the indicators chosen for an index and the weights associated with each indicator tend to vary depending on the subject area. According the Economist's glossary of economic terms, "the main challenges in compiling an index are what, exactly, to include in it and what weight to give the different things that are included." [1]

One of the many difficulties related to this project has been the scarcity of available data, and quite often, the lack of extensive time-series. Unlike the U.S. Index of Leading Indicators, which collects data going back from before World War II, most economic data for Central Oregon is available in most cases going back only until the 1990s, and therefore captures only one complete business cycle. This is primarily because before Central Oregon experienced a massive growth surge in the 1990s, and in many cases data series only started to be produced during that time. After a rather lengthy and sometimes challenging data collection process, we have narrowed down our index components to the following data series:

- New corporate filings for Deschutes County, seasonally adjusted
- Total enplanement and deplanement at Robert's Field, (Central Oregon regional airport), seasonally adjusted
- Estimated lodging revenue (estimated from room tax collections), seasonally adjusted, adjusted for inflation using CPI 1982=100
- New initial claims of unemployment, seasonally adjusted
- Median housing days on market, seasonally adjusted
- New permanent electrical connections, seasonally adjusted (proxy for housing permits)
- *Oregonian* help-wanted ad volume (proxy for *Bend Bulletin*)
- Total housing units sold

[1] http://www.economist.com/research/Economics/alphabetic.cfm?LETTER=I)

As mentioned, our index is then constructed according to the widely accepted methodology recommended by the Conference Board and used to calculate the CLI. We have also taken a look at some alternate methodologies, including that which was used to construct UNLV's Southern Nevada Index of Leading Indicators (SNILI). Their step-by-step methodology was especially helpful because of their attention to varying the weights on their component series, which is a potentially powerful tool used to increase the accuracy of the index.

In order to calculate specific weights for each component series, one may statistically estimate them, or simply score them according to the Department of Commerce scoring system, and then assign higher weights to those data series which perform best according to the scoring criteria.

Not only does our final index resemble a cyclical pattern, matching the U.S. national recession of 2001, it also appears to predict non-farm employment growth, as well as growth of median housing prices. In other words, we have successfully proven that one can establish a regional index of business activity using the most widely accepted methodology available, and show that the regional business cycle generally follows a similar pattern to national business cycles. Also, we have shown that index has the potential to predict future activity in certain areas such as housing prices and job growth.

These findings could help open up a potentially new area in time-series economics, and we hope that if the index proves to be a reliable indicator of business activity over time, that other regions will consider establishing a similar index. Perhaps more importantly, we think our index will be extremely helpful to those interested in the recent growth surge in Central Oregon. We think that our index could potentially help local leaders in business and government to make better informed choices regarding their own local economy, rather than basing their decisions on national economic measurements which may not directly reflect their own experience.

I. Introduction

> "Most forecasters regard the prediction of turning points as one of the significant challenges in their work." –Geoffrey H. Moore, former Director of Research at the National Bureau of Economic Research (NBER).

In a world without crystal balls, there are few reliable tools for economists to predict future economic activity. As a response to the desire of politicians, business leaders, and the general public to have information regarding the future business climate, economists have developed forecasting tools such as indexes of economic activity. These indexes, which track the combined activity of a series of indicators over time, have been developed with the goal of forecasting future activity. Former Vice President of the Conference Board, Edgar R. Fiedler approaches the subject of precision in forecasting within his paper *The Future Lies Ahead*[2]. He describes economic forecasting as a maddening occupation that is always fascinating, exciting and rewarding; a profession that is regularly exasperating, infuriating, and occasionally even deranging. In our own experience of building an index for Central Oregon, we have come largely to the same conclusion. Yet as Fiedler remarks, forecasting, no matter by what method it is done, is an intrinsic part within every community's decision process.

Philip Klein, Professor of Economics at Penn State University identifies the two most prominent current forecasting techniques to be the leading indicator method and the construction and interpretation of econometric models. These two camps of thought have at times battled with one another for higher ground in the economic literature. However, it now appears that a consensus has been reached that these two techniques can be complementary, as they can together assist in the complex task of monitoring business cycle developments. According to Klein, the public has the right to be skeptical over predictions of the future when no one has *certain knowledge* about the future, or even of the present. In fact, much of the knowledge of the recent past is incomplete at best. In light of this, the saying that "an imprecise forecast is better than none" has much value[3]. Indeed, in our review of the economic literature, it seems that all agree that the current system of forecasting economic activity using indexes of leading indicators, while flawed, is still the best available option.

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[2] Fiedler, E., (1995)"The Future Lies Ahead"
[3] Klein, P., (1989) "Geoffrey H. Moore and his Impact on Modern Business Cycle Research"

II. Background on Indexes of Economic Activity

During the time of the Great Depression, the U.S. government first identified a need to predict turning points in the national economy. NBER researcher Wesley Mitchell, considered by many to be the father of modern business cycle theory, was the first researcher to successfully tackle this problem when he established the U.S. composite leading index (CLI) along with fellow NBER researcher, Arthur F. Burns. This index was the first reliable national statistical database for the U.S., and at the time, surpassed that of any other country in the world[4].

As a direct result from CLI's assimilation of national data, research could soon be conducted to further describe this data in a manner that could be used to judge the economy as a whole. In 1938, Mitchell and Arthur F. Burns began researching economic indicators as a means to predict business cycles. In 1947, this groundbreaking research culminated in a publication entitled *Measuring Business Cycles*[5]. Concurrent with Burns and Mitchell's research, another business cycle economist in the NBER, Geoffrey Moore, also became interested in improving statistical measures, and later gravitated toward the development of business cycle indicators. The Department of Commerce then accepted the NBER as the official authority of business cycle turning points in the United States, and decided to publish a status report of the leading, coincident, and lagging indicators of the U.S. economy on a monthly basis. Since its inception, this set of indicators has been regarded as the paramount source of information about current and future economic activity in the U.S., and is highly regarded even within media circles as an accurate indicator of economic performance.

III. Background on Business Cycles

As mentioned, indexes of economic indicators are most commonly used as a way to predict turning points in business cycles. In this paper, we will be concerned only with Classical Cycles as apposed to Growth Cycles. Classical cycles have been the main concern among aggregate economists since 1927. These cycles are defined as recurring expansions and

[4] Klein, P., (1989)"Geoffrey H. Moore and his Impact on Modern Business Cycle Research"
[5] Mitchell, W., Burns, A., (1948) *Measuring Business Cycles*.

contractions in absolute value[6]. Because the United States experienced no classical downturn in the years 1961 to 1969, a renewed interest in growth cycles occurred at that time. Growth cycles historically relate only to a "slowing" of an economic expansion, where absolute growth continues, with fluctuations between above and below long run increasing averages.

Unfortunately for economists, business cycles, despite their importance, are difficult if not impossible to perfectly predict in terms of the three "D's" common to economists: Depth, Duration, and Diffusion. Wesley Mitchell postulated that we could date business cycles, and find measures that precede the turning points as well as indicators that lagged the points that confirm them. He describes business cycles as "congeries of interrelated phenomena"[7]. Geoffrey Moore's challenge was how to treat the time series data in order to extract significant relationships that are hidden within the statistics.

Realizing the difficulty of synthesizing a perfectly accurate index, while at the same time giving the public important economic information that could be easily interpreted in an impartial manner, the NBER chose to simplify their methodology for indexes such as the CLI. While this makes the index easy to understand and the methodology simple to reproduce, it does to a certain extent compromise the absolute certainty of the indicators' forecasts.

IV. The Composite Index of Leading Indicators (CLI)

As we have learned, the U.S. Composite Index of Leading Indicators (CLI) has provided a useful and significant indicator of cyclical turning points and general business activity in the U.S. economy since World War II. Currently, the Commerce Department publishes the U.S. Composite Index of Leading Indicators (CLI) and as the only forecasting method endorsed by the federal government, it has proved a useful and significant predictor of cyclical turning points and general business activity. As Alan Auerbach of the NBER writes, "If the success of a specific approach to economic analysis can be measured by its longevity and continued use under a variety of environments, then the use of the [CLI] … must stand near the top (if not peak) of the list of such successes[8]."

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[6]Boehm, Ernst A., (1982) "Understanding Business Cycles Today: A Critical Review of Theory and Fact"

[7] Klein, P., (1989)"Geoffrey H. Moore and his Impact on Modern Business Cycle Research"

[8] Auerbach, A.J. (1982), "The Index of Leading Indicators: 'Measurement Without Theory,' Thirty-five Years Later"

The widely accepted belief is that the national economy falls into a recession after two consecutive quarters of real decline in GNP. Viewing the national economy through this lens, we find that a leading composite index can be a useful tool for providing early warning of cyclical turning points. The emphasis on how to read the index is to concentrate on the direction and duration of the index rather than the size of the change. A sustained change in direction of an index for 3 consecutive months is commonly perceived as an indication of a cyclical turning point.

Using the above method of turning point identification, the CLI has provided early warning of every recession of the U.S. economy since its inception, according to a study by Vaccara & Zarnowitz[9]. Only one-third of the index troughs, however, provided early warning forecasts. The mean lead was 7.4 months at peaks and 2.8 months at the troughs. With a 3-month signal requirement, the index thus gave a rough lead of 4 to 5 months going into a decline, and no lead going into an incline. In addition to the fact that it successfully identified all of the turns at a peak, it falsely identified half again as many peaks. However, in some of these "false" signals it coincided with a decline in economic growth, if not absolute decline.

Over the years, different techniques have been employed with the aim of sharpening the accuracy of the leading index. One method involves measuring the index over a 6-month period rather than a 1-month span, and then treats a single month's change in direction as providing a signal of a turning point. This resulted in a considerably "smoother" index, which reduced the number of false turning points.

V. Indicators

On the national level, there are well over 100 different economic indicators describing a wide array of sectors within an economy. These are data series compiled on a timely and continual basis by various organizations. The composite index is made of leading indicators; these are series that when followed actually predict the future activity in the economy. Residential housing construction permits are a classic example of a leading indicator. This data is gathered before a contractor actually pays for labor or building materials that go into the process of construction, which in turn then flows into the aggregate economy.

[9] Vaccara, Beatrice N. and Zarnowitz, Victor (1978), "Forecasting with the Index of Leading Indicators"

But why not view each indicator independently? The reasons for this are plentiful. First of all, because the power of the index lies very much in its ability to give much information on a visual basis, there is an inherent salience in having just a single statistic for the eye to follow. In this one statistic, is contained all the activity needed to explain the state of the economy. Otherwise, if we were to put the individual rate of change for each indicator on a single graph, you would end up with something a bit like what you see in Figure 1.

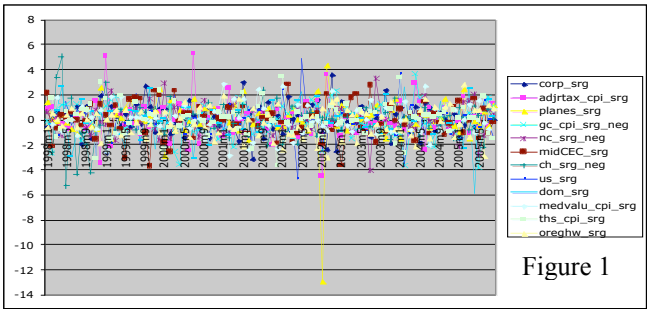


Figure 1

The power of a leading index to forecast changes business cycle is derived from the combined relevance of its component series. It is believed that wherever a turn in the business cycle first emerges, that turn will be signaled by at least one of the component indicators. The index should capture that turn as an economic chain of cause-and- effect courses its way through the component times-series. You will first see those time series with the longest lead start to pick up any changes in the economy. As the cause and effect spreads to other aspects of the economy, that turn will be picked up eventually by the entire system of economic response as well as possibly the previous variable that was affected. Soon, that surge makes its way through entire system, gaining in amplitude until enough of the series agree with that original pulse that they exhibit an upward-curving nature when graphed as a composite index.

VI. Concerns

In building our regional index of business activity for Central Oregon, there are a number of concerns that must be addressed. First, is it even possible to develop a regional index within the state of Oregon that could be updated in a timely manner? Once constructed, how much of a resemblance will it bear to regional business cycles? There are certainly more challenges and limitations involved in constructing a regional composite index than a national set of indicators. Once collected, how should we then aggregate that information into an index? Should we give each of the components an individual weight? These are all concerns for any researcher moving forward in the construction of an economic index. To aid us, we will be looking at a few other

regional indexes, and seeing what indicators they determined likely capture the overall economic climate.

VII. Hypothesis

We hypothesized that Central Oregon had indeed grown substantially in the recent past mainly due to an influx of comparatively wealthy individuals, and the area's thriving housing and tourism markets. If we were able to gather enough coherent and reliable data for the Central Oregon Region that spans the time period to include the previous national recession, by using the same basic methodology for index construction that is used in other successful indexes, then we would then be able to build a composite index that would graphically lead that most recent NBER business cycle. We also hope that our analysis will be able to lead employment growth and the housing market.

VIII. Development

In beginning our research, we thought it best to start with understanding the demographics of the region. We wanted to gain an understanding of the economy, how it compared and differed from the nation and the state. We found a report prepared by the Washington State University Extension and the U.S. Department of Agriculture conducted in 2003 entitled *Analysis of Growth and Change among the Major Components within Deschutes County: 1969-2000.* In it, we learned that the overall wealth of the community had increased dramatically within the past quarter century. In real terms, earned income had tripled since 1979, increasing from $210 million to $2.1 billion. Property income was even more pronounced with a 1979 total of $233 million increasing to $748 million in 2003. The third major component of personal income was transfer payments, and again the increase was dramatic, $125 million rising to $537 million. What was even more interesting to find was that the share of personal income had also shifted. Earned income had shifted -11.6% of total personal income share, while transfer payments increased 6.0%, and property income increased 5.6%. The shift in property income at 5.6% was above the shift in share nationally (2.5%) and the state (3.7%). According to the report, a notable increase in property income's share is associated with a region that experienced an influx of relatively affluent retirees. This confirmed one of our original hypotheses that a migration of comparatively wealthy people had moved into the area.

In their study on the *Shift-Share Analysis* we found that Deschutes County employment growth over 2001-03 of 4.39% surpassed the 0.10% national growth by 4.29%. The synopsis of this study was that the difference was an industry mix inclined toward industry that experienced faster growth, coupled with the fact that a large share of local industries outperformed their national counterparts. Again, this confirmed our original assumption that people were moving there for the unique climate and recreational activities.

And finally, in a report completed by the City of Bend Residential Lands Study[10], 2005 we learned that the population forecast for the year 2025 was to increase by approximately 40%, with a need just within the city of Bend of an additional 23,288 new housing units. Looking further, we researched the Oregon Labor Market Information System (OLMIS) and learned that the number of new single family housing per capita permit data for Deschutes County in 2004 led Oregon with an amount of four times the state average, and that neighboring Clark County was second with 2.4 times the average. Their conclusions were that median housing values are increasing a faster rate than the median income, and that since earnings from work will continue to be the largest share of personal income, the community will need to recruit and retain industries with higher wages. Again, this confirmed our hypothesis that the housing market was a driving force in the region and would continue to be so into the future.

IX. Regional Indexes and Relevant Indicators

In our research, we have found few comparable regional indexes, primarily because this is a relatively new field in economics with much room for development. In an attempt to locate a community that is comparable to the Central Oregon region, we looked for an area which relies heavily on tourism and industries associated with rapid population growth, primarily housing. We found MSA regions with similar activity in Cheyenne, Wyoming, Grand County, Utah, and Las Vegas, Nevada. We did not, however, find an abundant development of regional composite indices. Rather, we found primarily individual economic indicators used to individually assess economic activity in a region. These types of indicators, which are distinct from composite indexes, show little discernible ability to assess the full range of economic activity.

[10] *Housing Needs Analysis*

By the end of our search, we had located only two composite indexes of economic activity in the Western U.S.: the Southern Nevada Index of Leading Indicators (SNILI) produced by the University of Nevada, Las Vegas, and the University Of Oregon Index Of Economic Indicators. These indexes were found to be valuable because they included data series that addressed the reasons for growth in their economies. This is valuable to us in so far as it gives us an overall account of which series are important to a regional community such as Central Oregon.

Using the above indexes for reference, and following Norman Frumkin's *Guide to Economic Indicators,* we identified a number of ideal component series for our index. Overall, there were dozens of possible data sets that we had been considering. However, as most economists involved with constructing indexes of economic activity will confess, one does not always have the pick of the litter when it comes to the final selection of data series. As you see in the table below, while we obtained a good number of data sets that we personally believed might hold some economic clout for the region, there were also several that had to be rejected due to either statistical or logistical difficulties.

Table 1: Comparable Index Components for UO-COBI

SNILI:

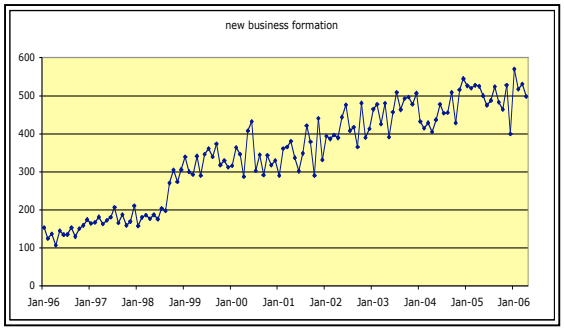
- Residential Building Permits
- Residential Permit Valuation
- Commercial Building Permits
- Commercial Permit Valuation
- Taxable Sales
- Airline Passengers
- Sales of Gasoline (gallons)
- Gross Gaming Revenue
- Visitor Volume
- Conventions Held Attendance
- Conventions Booked Attendance

Oregon Index of Leading Indicators:

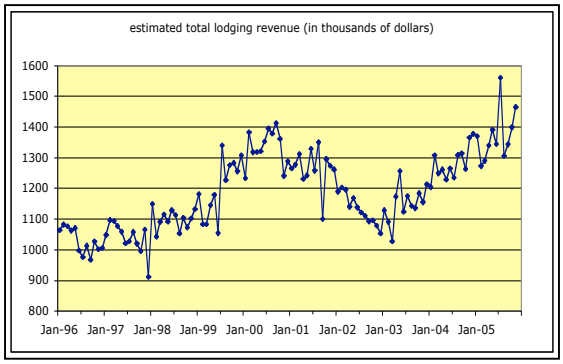
- Initial Unemployment Claims
- Residential Building Permits
- *Oregonian* Help-Wanted Ad Volume
- Oregon Weight-Mile Tax
- Non-Farm Total Payrolls
- Univ. Michigan Consumer Confidence Rating
- Real Manufacturer's new orders for non-defense, non-aircraft goods
- Interest Rate Spread

After careful consideration of each individual series, we set out exploring the community, the state, and national statistical databases in search for relevant, high frequency data. We chose not to incorporate any series that were older than 1990, because the dynamics of the region shifted at approximately that time. This way, we were ensuring a capable set of indicators that would capture the economy over the entire time period. We wanted to incorporate the latest business cycle, and we wanted to have no more than a total of ten series. The results of our efforts were eight individual data series beginning in 1997, reported on a monthly basis, and releases in a very timely manner following each month.

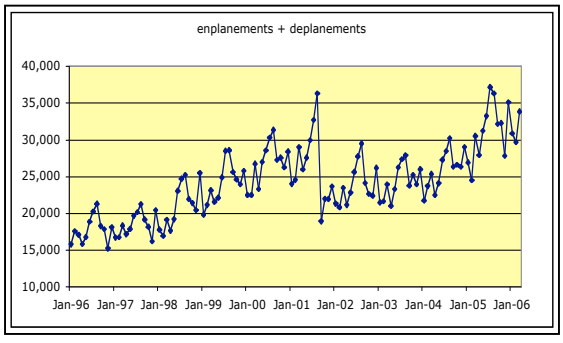
1. Corporate Filings data indicates the number of new business formations registered in Deschutes County with the corporations division at the Oregon Department of State. This data provides a robust account of both the business climate and the entrepreneurial engagement of the population in the region.



2. ***Room Tax*** data, provided by the Central Oregon Visitors Association, is an estimation of the total lodging revenue for the Bend hospitality industry. This was calculated by dividing the room tax statistic by the tax rate, which has grown from 7% to 9% over the past decade. The recalculated figures were then adjusted for inflation using the Consumer Price Index, where 1982=100, and then adjusted for seasonality.

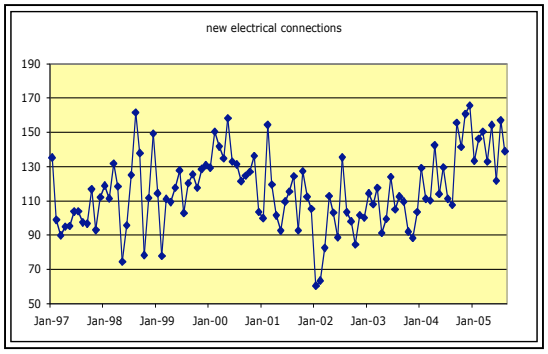


3. ***Airport Activity*** is a combination of both total enplanement and deplanement for Robert's Field in Redmond, which is the primary hub for air traffic in Central Oregon. Even after seasonal adjustment, one can see what a major shock September 11, 2001 caused in the airport

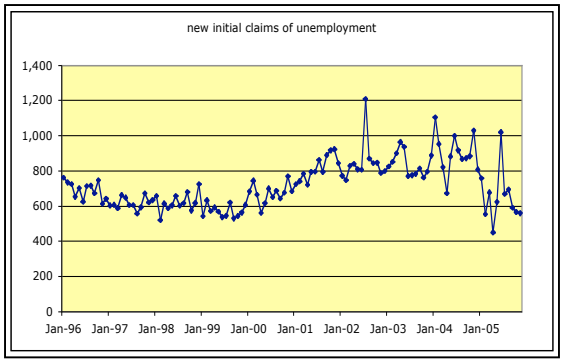


activity for the region. Combined, the *plane activity* and *room tax* data sets account for the tourism industry upon which Central Oregon heavily relies.

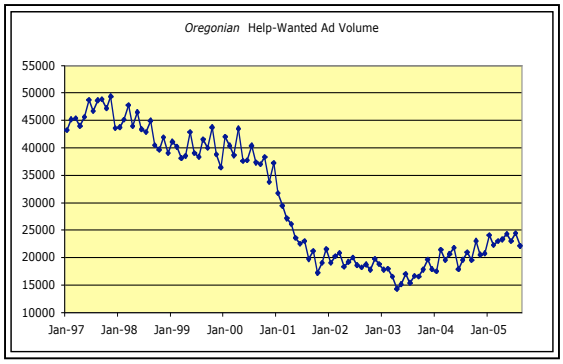
4. ***New Permanent Electrical Connections***, which has been gathered from 2 of the 3 primary electrical providers in Central Oregon, Central Electric Cooperative and Midstate Electric Cooperative, provides a proxy for building permits data. There were some difficulties with missing data in *Residential Housing Permits*, but because building permits are such an important economic indicator, we decided to continue to include electrical connections data. One pitfall with this data is that a permanent connection is not always made before construction begins on a new building, as builders occasionally use generators to supply power for the project. Also, new permanent connections are sometimes added to properties with existing electrical connections, such as with water wells, or otherwise.



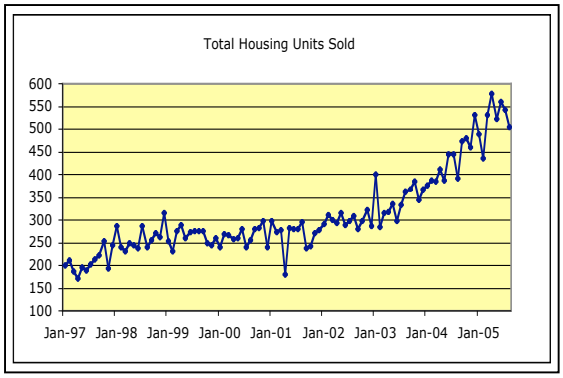
5. ***New Claims of Unemployment*** is an indicator of the job market. This data was gathered from the Oregon Employment Department, and gives a good indication of what the unemployment rate will be in future months. Initial claims rose at the onset of the most recent recession beginning in 2001, therefore in our index we have taken the negative values (inverse) of the observations in this data series, so that a rise in new claims of unemployment corresponds with a decrease in the composite index.



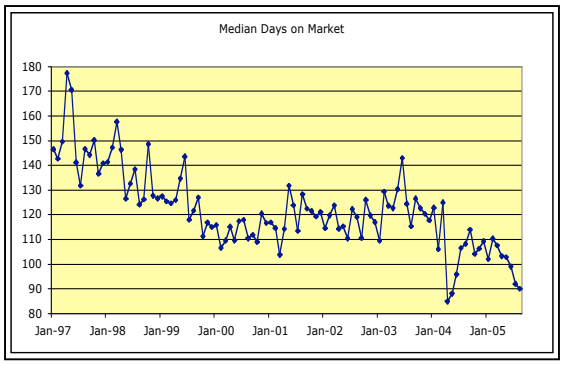
6. ***Oregonian Help-Wanted*** was included in order to further account for job market performance; this variable is currently being used as a proxy for Bend Bulletin help-wanted until that data is made available. We hypothesize that this is the most direct measure of demand for labor.



7. *Total Housing* ***Units Sold*** gives us an indication of large cash flow activity within the community. This is an important lead for our index in assessing near future cash influx. Data for our housing market indicators extends back until January 1997.



8. ***Median Residential Housing Days on Market***, provided by the Central Oregon Realtors Association, gives us direct insight into the nature of the housing market, which is a visibly important sector of the Central Oregon economy. This shows us the median length of time a property might sit on the realty market for a given month. Because a consistent trend of higher values in this indicator would imply a slowdown in the housing market, we have included the inverse of this data series in the composite index.



The combination of these data series gives a fair and robust representation of the overall Central Oregon economy. As we have seen with the University of Nevada business index, it is important to include indicators that capture the most important sectors of a region's economy. Because Bend is reliant primarily upon the housing and tourist industry, it makes sense to include two separate indicators for each of those two sectors. The other two areas captured by this index, labor market and business climate, can more generally be applied to all regions, and would therefore be wise in include in any index of economic activity. Like any other economy, a positive business climate in the region is important for facilitating future growth. We therefore predict that including new business formation in our composite index will prove to have been an excellent choice. If more data indicating the general business climate were made available in the future, we suggest that it be considered for this index.

A final data series that might possibly be a good indicator of business climate would be gallons of gas sold; we can calculate this data by dividing the gas tax revenue for the major fuel suppliers of Central Oregon by the tax rate, then adjusting for inflation and seasonal variation. We have already identified the 4 local fuel retailers of Central Oregon: Juniper Fuels, American Energy Co., Abbott Petroleum, and Bend Oil Company. The tax revenue department in the Oregon Department of Transportation has this data, but has so far been unwilling to release it for use in this index. We hope that if this index proves successful, one may be able to contact the above gas companies and suggest that authorize ODOT to disseminate that information for use in UO-COBI. In our efforts to obtain any fuels data available, we did have a look at average monthly gas prices. Unfortunately, this data did not result in a strong indicator, primarily because it is ambiguous as to whether higher gas prices indicate greater business activity because of greater market demand, or whether that means a worsened business climate because higher prices swallow a larger proportion of all economic transactions.

The data series used in the composite index for capturing labor market trends could also use some work. As mentioned above, *new permanent electrical connections* are only a proxy for building permits data such as *housing units authorized.* Due to statistical inconsistencies in the data, we were unable to obtain a full set of building permits data. Our data for *initial claims of unemployment*, however, is solid, and provides an excellent forecaster of labor market trends.

X. Methodology

Before calculating for the final composite index, one first wants to ensure that each data series is seasonally adjusted, and if necessary, adjusted for inflation using a CPI deflator. The most commonly used deflator, and incidentally the one that we have chosen, is the CPI index where 1982 dollars=100. Seasonal adjustment programs are widely available as simple functions in different statistical software packages such as Stata and eViews.

Our first step is to equalize component volatility. This is done in order to prevent unstable data series from influencing the index in a way that is not consistent with the purpose of obtaining an index with any forecasting ability. Because the process of

equalizing component volatility can vary depending on the methodology chosen, care must be taken to choose a single methodology and stick with it consistently. In the following step-by-step description, we will show two of the more widely used ways of smoothing component volatility.

As previously mentioned, in this project we have constructed two alternate indexes for the sake of showing how differing methodologies can bring about differing results. These two methodologies take divergent paths in only a few of the steps, beginning with the first step of component volatility equalization.

The first of our two methodologies is the most widely accepted statistical procedure for constructing indexes, that of the Conference Board. The Conference Board, a non-profit organization that "creates and disseminates" knowledge about management and the marketplace, regularly produces several analyses and forecasts that assess economic conditions, including a number of highly regarded indexes such as the Consumer Confidence Index and the U.S. Leading Index[11]. Their methodology follows the most current procedures established by the U.S. Department of Commerce for index construction, and was last revised in 2001.

The Conference Board 5-step methodology begins with calculating month-to-month changes for each component[12]. Because all of our data sets are in integral form, we must take symmetrical monthly rates of growth. This is achieved as follows:

$$x_t = \frac{200 * (x_t - x_{t-1})}{(x_t + x_{t-1})}$$

-Month-to-month changes across all components must then be adjusted so that their volatility is equalized. This second step is to calculate the standard deviations, v_x, of the changes for each component, and then subsequently inverting those measures of volatility:

$$w_x = \left(\frac{1}{v_x}\right)$$

-The inverted volatility measures are then summed:

[11] http://www.conference-board.org/aboutus/about.cfm
[12] http://www.conference-board.org/economics/bci/4step_updating.cfm

$$k = \sum_{x=1} w_x$$

and expressed so as to equal one:

$$r_x = \left(\frac{1}{k}\right) * w_x$$

-The adjusted change for each component can then be understood as being its month-to-month change multiplied by its standardization factor:

$$m_t = r_x * x_t$$

-For the third step, all the standardized month-to-month changes are summed to obtain the growth rate for the current month *t*:

$$i_t = \sum_x m_{x,t}$$

-The fourth step, which is to compute the updated level of the index, multiply the trend-adjusted growth rate by the previous month's index level:

$$I_t = COBI_{t-1}\left(\frac{200 + i_t}{200 - i_t}\right)$$

-For the fifth and last step, we round the final index to one decimal point, and rebase it to equal 100 at the start of our components' time-series, which is in our case 1997. The history of the index is then multiplied by that number and divided by the average for the 12 months of the chosen year.[13]

Once the index is extended to include the most current set of data, we then must consider how we will update the index on a monthly basis. The Conference Board recommends that this is done using the latest and previous six months of data, and along with the standardized factors that were computed according to the above methodology, once again going through the five steps as outlined above. While revisions are thus made to the components within the six month moving window, the Conference Board recommends that one refrain from revising the rest of the time-series until the entire index is recomputed, which should be done at least once a year. In case the most current

[13] http://www.conference-board.org/economics/bci/ci_method.cfm

observation for a particular data series were not made available for one month, compute the remaining standardization factors so that they continue to sum to one.

While the Conference Board's methodology is still widely regarded as being the standard method for computing indexes, they do not stress in their online guide the importance of component selection. This is a factor that hopefully would have been considered before the computation of the index. However, in some methodologies we have seen, component selection is only one step in the index construction procedure. Therefore, taking inspiration from the researchers behind the University of Southern Nevada Index of Leading Indicators, Ricardo Gazel and Robert Potts, we will now investigate the importance of choosing relevant indicators, and how this can be done using a detailed scoring system.

Component Selection

The criteria for selecting index components may easily be the most functional index construction tools at an economists' disposal, since standardization procedures are, well, quite standardized across most methodologies (i.e. everyone is basically following the steps recommended by the U.S. Department of Commerce). By evaluating each data series against a set of criteria, an economist can determine not only which data sets are relevant indicators and which ones should be tossed, but also one can measure the explanatory value that a particular indicator may have in accounting for business cycle fluctuations. In the case of the U.S. composite index of leading indicators (CLI), a detailed scoring system is used to assess each indicator and produce a unique score on which to base that indicator's weight in the final index. Many indexes today are modeled using a similar scoring system, one of which is the UNLV's SNILI.

In 1995, UNLV researchers Ricardo Gazel and Robert Potts, under the auspices of the university's Center for Business and Economic Research, established the Southern Nevada Index of Leading Economic Indicators (SNILI), which tracks the Las Vegas regional economy using a composite index of 10 indicators. This regional index is the closest index we have found to which the UO-COBI can be compared, not only because they are both sub-state regional indicators, and because Bend's economy shares many of the same characteristics as that of Las Vegas- tourism, recreation, a large of percentage of retired people, and extremely high growth rates . SNILI, and the methodology that the

CBER generously provided to us, have been very helpful for us in understanding not only how an index works, but also how many of the difficulties we have faced in the construction of our regional index have been met in the same way by others.

In choosing their indicators, UNLV Index architects Gazel and Potts based their decisions on what is referred to as an "adjusted score system". This system is based on the Department of Commerce's own methodology for index construction contained in their *Handbook of Cyclical Indicators*. The first criterion each indicator is judged upon is that indicator's economic importance. How well do we understand the role of our index component as an indicator of business cycle activity? Does it make theoretical sense that we include a particular data series in our final index? Obviously, some data series would be better than others.

The second criterion used in the UNLV methodology is statistical adequacy. In what we will see later, the usefulness of an indicator can be measured by regression to see how well it explains some measurement of economic growth, like GDP growth for the subject region. In our case, we have looked at several regressions with various time lags to see how well each individual indicator explains the variation in non-farm employment growth, as well as median housing price

Gazel and Potts' third criteria judged potential indicators against real business cycle fluctuations, measuring whether the indicator lagged, coincided, or led real fluctuation in the economy. In other words, how does the data series perform? Does it forecast the business cycle, move with the business cycle, or follow the business cycle? Simple ocular analysis can easily determine the status of a data series as such.

The fourth criteria measured the indicators conformity to cyclical variation. Clearly, if there were no cyclical variation in the data series, then it would not be a befitting indicator of economic activity, which generally occurs in cycles. We have seen this occur with our *bankruptcy* data-set, which exhibited little if any cyclical pattern concurrent with the peaks and troughs and the most recent business cycle.

The fifth and final criteria used to base their judgment of how to weigh the indicators were "the conjugation of smoothness and the currency of the series." This last one, though not theoretically profound by any means, at least weeds out those potential indicators that do not provide accurate data in a consistent manner. For the index to be as

useful as possible, it should be released within two weeks or so of the month's end. Obviously, the purpose of a leading index would be defeated if it were produced *after* the length of its lead had already been surpassed by the amount of time it took to release it to the public. The point is to give some indication of how the economy will perform in the future.

One might add that it is also important for the data series to extend back as far as possible. An index can only begin at the start of the shortest data series. Many of the data series we collected have been eliminated due to this requirement, though it is still useful to collect only recently established data because one can hope that in the future the length of the series will be extended enough for us to say with confidence that the data would be a strong indicator of business fluctuations.

XI. An Alternate Methodology for Index Construction

Aside from the obvious distinction that the methodology used by UNLV makes from that of the Conference Board, i.e. component selection, it is still worth taking a look at the computational methodology provided by UNLV, since it involves a slightly different process for volatility equalization, as well as a stage where one can choose to assign weights to each component. Though this methodology did not come into use in computing our final index, it could be referenced in future revisions of the COBI, especially if one might consider giving the components varying weights.

-As before, first adjust your data sets for seasonality and inflation. This is an important step that must be repeated during any complete index revision. Such revisions are often made on a yearly basis.

-The next step is to calculate symmetric monthly rates of growth for each series. This is done following the same equation as we saw above:

$$x_t = \frac{200 * (x_t - x_{t-1})}{(x_t + x_{t-1})}$$

-The symmetrical rates of growth must then be standardized so as to prevent the more volatile data series from holding too great an influence over the index. But rather than use standard deviations, which is prescribed the Conference Board, UNLV chose to use average absolute changes in the component series as a means of smoothing volatility. This is done as follows:

$$\text{where } A_i = \frac{\sum_{t=2}^{n} |c_{i,t}|}{(N-1)}$$

-Next, calculate the weighted average of the standardized rates of growth $s_{i,t}$:

$$R_t = \frac{(\sum_{i=1}^{k} s_{i,t} W_i)}{(\sum_{i=1}^{k} W_i)}$$

where W_i is the weight assigned to the component series i and k is the number of series in the index.

-Finally, the weighted average is transformed into a raw index I, where the initial I observation is 100.

$$I_t = \frac{I_{t-1}(200 + R_t)}{(200 - R_t)}$$

Clearly, there are advantages and disadvantages to each of the two methodologies outlined above. In the Conference Board methodology, each component of the index has roughly the same weight, meaning that a change in any of the indicators, holding all others constant, will have the same effect across all indicators. With the UNLV methodology, each indicator is weighted according to its ability to explain economic fluctuation and activity. This can be judged through more advanced statistical analysis, or through application of the 5 component criteria that we saw above. The idea of weights is that the effect of one indicator, holding all others constant, may be greater or larger depending on the weight given to that indicator. This could have a powerful effect on an index's final results.

Because the SNILI only uses weights of either 1.0 or 1.1, it appears that they did not apply the detailed scoring system into the calculation of their weights, but instead perhaps simply made an educated guess about on which data series to place their weights.

There are, however, much more elaborate methodologies for using either the scoring system, or even regression analysis, to calculate the weights used for each component. Unfortunately, such a detailed investigation is beyond the scope of this paper. Also, it is doubtful that any regression would amount to a very helpful weighting system, since our data has only been collected from the last 10 years. This may not be a problem though, since as we saw above, most weighting schemes used for indexes, especially the U.S. CLI, are essentially arbitrary and have no significant effect on the resulting index[14].

XII. Results

Figure 2 shows a seasonally adjusted, 6-month moving average of the UO-COBI, calculated according the Conference Board recommended methodology. Clearly, it appears to have a peak and a trough. The official NBER recession was from March 2001 to November 2001, and it falls within the downturn of the index. Table 1 in the Appendix shows the monthly percentage changes of the index, and using the method of Vaccara & Zarnowitz with the 6-month "smoothing" technique, we can look for cyclical turning points in the data.

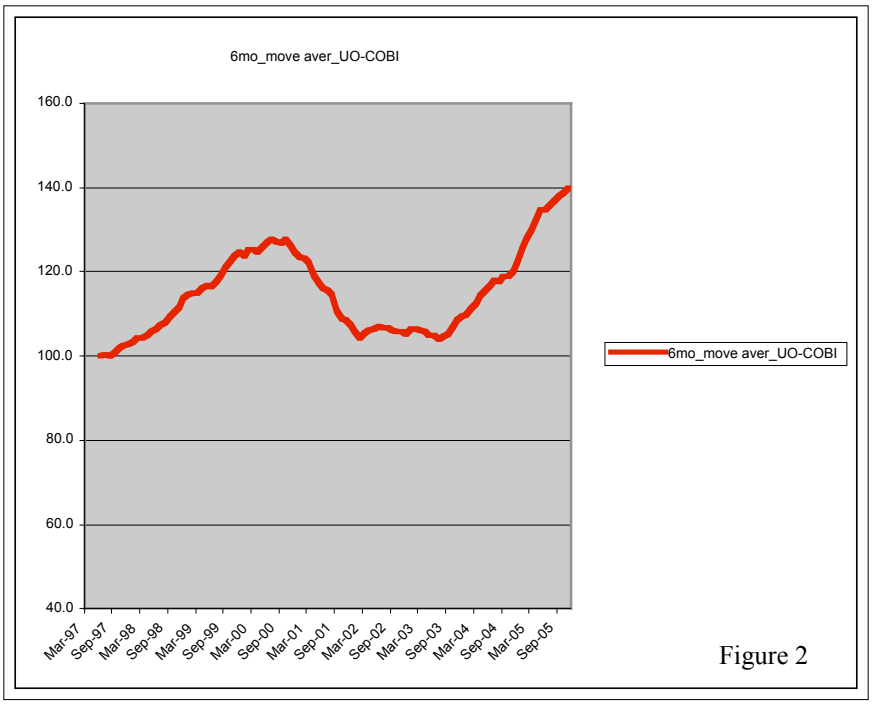


Figure 2

[14] Hymans, S. (1973), "On the Use of Leading Indicators to Predict Cyclical Turning Points"

By looking for percentage changes two consecutive months in the same direction, we see that the index signals turning points four different times: two peaks and troughs. Considering the "job-less" recovery that occurred after the official recession ended, it may be worthy to note that this index experienced a period of a short duration decline before it again climbed steadily out of the slump.

Comparing the non-farm employment growth graphically to the UO-COBI, we notice a slowdown between the peak and the trough. This fits our hypothesis that the index could signal a change in the employment growth.

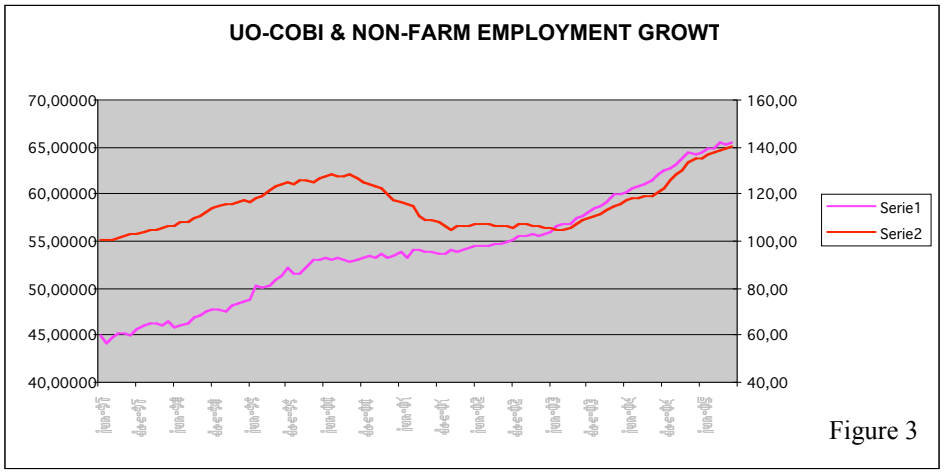


Figure 3

Now, looking at the median housing value year over year, and smoothed with a 12-month moving average, compared to the index, we see that again it signals the turns in the housing market. Compared with Table 1, the index signals all of the housing turning points.

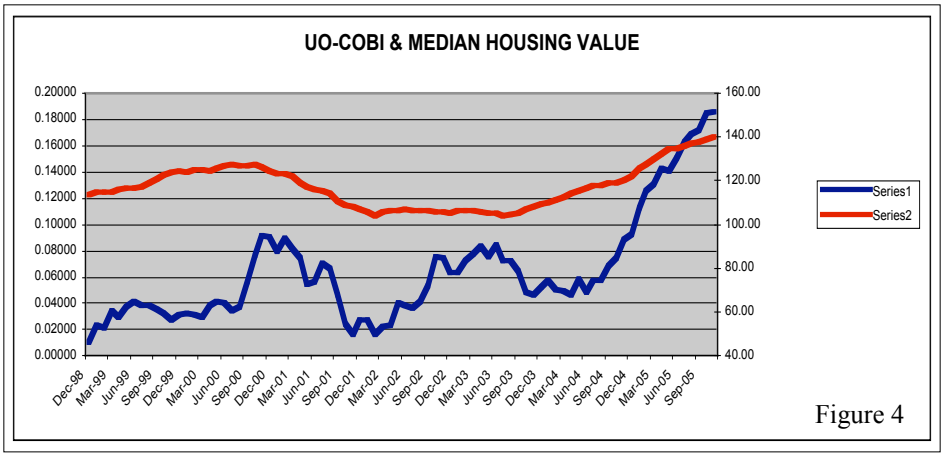


Figure 4

Estimating the relationship between COBI and non-farm employment

While we have seen that the COBI lines up well with job growth and median housing prices, it may still be worth investigating whether those relationships can be

statistically measured. In the following section, we will use basic OLS techniques to examine whether we can statistically show that our locally produced monthly data can predict the performance of the Central Oregon economy. Many similar studies have been done using the U.S. leading index, though in most cases, the choice of regression variables is the CLI as an explanatory variable, and the composite coincident index as the explained[15]. Because of our limited data and resources, we have not had the occasion to make such a statistical estimation. In some cases, however, the individual component series of the U.S. leading index is regressed to explain employment growth[16]. In the following exercise, we will run a similarly styled regression analysis to see how well our component series explain the variation in non-farm employment growth. As our explanatory variables, we will be using both our original integral figures, adjusted for seasonality and inflation, as well as calculated monthly growth rates. At the end, we will run a second series of regression that will simply regress those housing prices and employment growth on the COBI.

-Using our raw integral data for each component series, after adjustment for seasonality and inflation, we estimate the following equation:

$$nonfarm\_emp_t=\alpha+\beta_1 corp\_filings_t+\beta_2 room_t+\beta_3 airport_t+\beta_4 ui\_claims_t+\beta_5 oreghw_t+\beta_6 electric_t+\beta_7 units\_sold_t+\beta_8 median\_dom_t+u_i$$

Table 3: Non-farm regression estimates - integral data series

Source	SS	df	MS	Number of obs =	104
				F(8, 95) =	264.15
Model	3208.05188	8	401.006485	Prob > F =	0.0000
Residual	144.217828	95	1.5180824	R-squared =	0.9570
				Adj R-squared =	0.9534
Total	3352.26971	103	32.5463078	Root MSE =	1.2321
Nonfarm_emp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
Corp_filings	.0086609	.0029443	2.94	0.004	.0028156 .0145061
Room	6.49e-06	1.89e-06	3.43	0.001	2.74e-06 .0000102
Airport	.0001152	.0000778	1.48	0.142	-.0000391 .0002696
ui_claims	.0005891	.0014422	0.41	0.684	-.0022741 .0034522
Oreghw	-.0001429	.0000302	-4.72	0.000	-.0002029 -.0000828
Electric	.0022021	.0072241	0.30	0.761	-.0121394 .0165437
units_sold	.0249083	.0022728	10.96	0.000	.0203963 .0294203
median_dom	-.0324053	.0128103	-2.53	0.013	-.057837 -.0069737
Cons	39.26833	3.763585	10.43	0.000	31.79667 46.73999

[15] See Hymans and Vaccara for typical examples

[16] see Auerbach

It appears that our component series, when all set at month t, do a relatively fine job explaining non-farm employment. However, because we have not regressed using growth rates, we are capturing a certain amount of multicollinearity.

Table 4: Pairwise correlation coefficients (non-farm) – integral data series

	corp_f~s	room	airport	ui_cla~s	Electric	unitss~a	median~m	oreghw
corp_filings	1.0000							
Room	0.5024	1.0000						
Airport	0.7129	0.8077	1.0000					
ui_claims	0.5283	0.1427	0.2391	1.0000				
Electric	0.2190	0.4796	0.4448	-0.0236	1.0000			
Unitssold_sa	0.7663	0.5111	0.6602	0.3537	0.4115	1.0000		
median_dom	-0.6967	-0.6800	-0.7547	-0.3382	-0.3660	-0.6440	1.0000	
Oreghw	-0.8410	-0.2849	-0.5025	-0.7616	0.0291	-0.6000	0.5319	1.0000

According to our pair-wise table, there appears to be multicollinearity between the regressors *airport* & *room* as well as *oreghw* & *corp_filings_SA*.

However, we suspect that this multicollinearity is related to the fact that growth rates had not been calculated for the component series. Though further regression analysis is not within the scope of the paper, we would suggest that in order to obtain more realistic statistical results, one would want to standardize the rates of growth, and then run another regression, using logged variables for both sides. The main thrust of the regression above, however, is clear – there are several ways regression can be used to improve the structure of an index. One way would be to run a similar regression to the one just recommended, and using the regression results, determine the extent to which the leading composite index predicts changes in a variable that captures the overall current economic activity, such as non-farm employment. These regression results can also be used to then help determine the extent to which each component series might be weighted so as to produce a more powerful and predictive index.

XIII. Conclusion

With our business index for Central Oregon resulting in a very strong indication of cyclical business activity, there is reason to believe that our project has been a success. Naturally, as more data sets become available, and as we are able to model the index against additional business cycles, the predictive power of the COBI will only increase. Until we can determine with certainty that this index does indeed predict cyclical activity in more than just one full business cycle, then our index will have to be considered preliminary.

Yet even as an economic information supplement, this index could prove immensely useful to future researchers in regional business forecasting, and the business leaders and policymakers in the Central Oregon region. Because so much of the knowledge about the economic activity in the Bend area is simply anecdotal, it is difficult for anyone in the Bend region to say much of anything about the local economy. With the establishment of this index, there will be an easily digestible measure of economic activity, that could at the very least, provide considerable food for thought.

In such a capacity, we hope that this index will help shape the Central Oregonian population's own understanding of the growth in the region, and give them some perspective on the scale of that growth. Currently there is very little quantified data available to residents there, and most economic journalism focuses more on anecdotal evidence rather than hard numbers. Because of its sub-state focus, this index is somewhat of an experiment. In future revision and analysis of the index, we hope that this experiment will have proven to be a substantial success in the field of regional economic forecasting.

As mentioned, this index is entirely preliminary, and therefore will require extensive revision and adjustment in the future if it is to become a more powerful indicator of business activity. Future revisions may include the addition of useful data series such as gallons of gas sold, or another variable that captures tourism, such as visitor volume. We also hope to see the replacement of our proxy variables, new electrical hookups and Oregonian help-wanted volume, with the actual variables.

Additionally, if more time and resources could be allocated to this project, we may be able to construct a data series that captures the regional business confidence. Such indicators can be derived from a regular confidence survey[17].

[17] see: http://www.conference-board.org/economics/indicatorsExpectations.cfm

Appendix

Table 1: Monthly % change in the index

Jan-98	0.4
Feb-98	0.2
Mar-98	0.4
Apr-98	0.9
May-98	0.7
Jun-98	0.5
Jul-98	0.7
Aug-98	0.8
Sep-98	0.8
Oct-98	0.7
Nov-98	1.1
Dec-98	1.3
Jan-99	0.9
Feb-99	0.5
Mar-99	0.8
Apr-99	1.0
May-99	0.9
Jun-99	0.8
Jul-99	1.0
Aug-99	0.8
Sep-99	1.0
Oct-99	1.4
Nov-99	0.8
Dec-99	0.2
Jan-00	0.3
Feb-00	1.3
Mar-00	1.0
Apr-00	0.6
May-00	1.1
Jun-00	1.0
Jul-00	-0.1
Aug-00	0.3
Sep-00	0.0
Oct-00	0.2
Nov-00	-0.2
Dec-00	-0.1
Jan-01	-0.3
Feb-01	-0.6
Mar-01	-0.5
Apr-01	-1.2
May-01	-1.7
Jun-01	-1.3
Jul-01	-0.9
Aug-01	-0.7
Sep-01	-2.4
Oct-01	-2.3
Nov-01	-1.1
Dec-01	-1.2
Feb-02	-1.3
Mar-02	-1.2
Apr-02	-0.6
May-02	-0.2
Jun-02	-0.2
Jul-02	-0.9
Aug-02	-0.8
Sep-02	0.5
Oct-02	0.1
Nov-02	0.0
Dec-02	0.0
Jan-03	0.6
Feb-03	-0.1
Mar-03	-0.3
Apr-03	-0.4
May-03	-0.5
Jun-03	-0.3
Jul-03	0.2
Aug-03	0.2
Sep-03	0.2
Oct-03	0.7
Nov-03	0.4
Dec-03	0.5
Jan-04	-0.3
Feb-04	1.0
Mar-04	0.8
Apr-04	1.8
May-04	1.4
Jun-04	1.0
Jul-04	0.7
Aug-04	0.7
Sep-04	1.2
Oct-04	1.0
Nov-04	1.2
Dec-04	1.5
Jan-05	2.2
Feb-05	0.9
Mar-05	1.7
Apr-05	1.3
May-05	1.6
Jun-05	1.0
Jul-05	2.3
Aug-05	1.5
Sep-05	1.6
Oct-05	1.8
Nov-05	1.7

References

Auerbach, A.J. (1982), "The Index of Leading Indicators: 'Measurement without Theory,, Thirty-five Years Later," Review of Economics and Statistics, 64 (4), 589-95.

Boehm, Ernst A. (1990), "Understanding Business Cycles Today: A Critical Review of Theory and Fact", Analyzing modern business cycles: Essays honoring Geoffrey Moore: 25-56, Armonk, N.Y

Duy, Tim. (2005), "University of Oregon Index of Economic Indicators", Oregon Economic Forum, http://econforum.uoregon.edu/EconIndex.htm. Retrieved 9 June, 2006.

Fiedler, Edgar R. (1990), "The Future Lies Ahead". Analyzing modern business cycles: Essays honoring Geoffrey Moore: 128-42. Armonk N.Y

Frumkin, Norman, (1994), "Economic Indicators", 2ed. Armonk, N.Y

Gazel, Ricardo C. and Potts, Robert D. and Schwer, Keith R., (1997), "Using a Regional Index of Leading Economic Indicators to Revise Employment Data" Center for Business and Economic Research, University of Nevada, Las Vegas

Hymans, S. (1973), "On the Use of Leading Indicators to Predict Cyclical Turning Points," Brookings Papers on Economic Activity, 2, 339-84.

Klein, Phillip A. (1990), "Geoffrey H. Moore and his Impact on Modern Business Cycle Research" Analyzing modern business cycles: Essays honoring Geoffrey Moore: 3-6. Armonk, N.Y

Koopmans, T.C. (1947), "Measurement without Theory", Review of Economics and Statistics 29 (August)

Lahiri, K. & Moore, G. (1991), "New Economic Indicators - New approaches and forecasting records" Cambridge University Press, N.Y

McGuckin, R. & Ozyildirim, A. & Zarnowitz, V. (2003), "A More Timely and Useful Index of Leading Indicators" Economics Program Working Paper Series #03-01. The Conference Board, N.Y.

O'Gara, R.T. (2005), "Economic Indicators for Greater Cheyenne", Wyoming Center for Business & Economic Analysis

Popkin, Joel. (1990) "Why Some of the Leading Indicators Lead" Analyzing modern business cycles: Essays honouring Geoffrey Moore: 59-68. Armonk, N.Y.

Smith, Gary W. (2003), "Shift-Share Analysis of Deschutes County Employment Growth" Washington State University Extension

Stekler, H. O. and M. Schepsman (1973). "Forecasting with an Index of Leading Series," Journal of the American Statistical Association 68, No. 342, 291-6

Stock, James H. and Watson, Mark W. (1992), "A procedure for Predicting Recessions with Leading Indicators: Econometric Issues and Recent Experience" NBER Working Paper Series #4014

Strigel, Werner H. (1990) "Business Cycle Surveys: A New Quality in Economic Statistics,. Essay" Analyzing modern business cycles: Essays honouring Geoffrey Moore: 69-84. Armonk, N.Y

Syrnyk, Damian (2005), "Housing Needs Analysis: City of Bend Residential lands Study" City of Bend Community Development Department (June)

Vaccara, Beatrice N. and Zarnowitz, Victor. (1978), "Forecasting with the Index of Leading Indicators" NBER Working Paper Series #244