Highlights

Measuring and Forecasting Arizona Business Activity

• Why is the Cyclical Approach Useful?
• The NBER’s Classical-Cycle Analysis
• Compiling a Coincident Indicator for the Arizona Business Cycle
• Developing and Using a Leading Indicator Composite
• Probability of an Arizona Business Downturn

Using the Cyclical Indicator System to Forecast State Revenue

• The Relationship of Business Activity and State Revenue
• Harnessing the Leading Indicator Information for State Planning
Why are Turning Points Important?

“By a *cyclical* movement we mean that as the system progresses in, *e.g.*, the upward direction, the forces propelling it upwards at first gather force and have a cumulative effect on one another but gradually lose their strength until at a certain point they tend to be replaced by forces operating in the opposite direction; which in turn gather force for a time and accentuate one another, until they too, having reached their maximum development, wane and give place to their opposite.

“The Trade Cycle ... explanation must cover, if it is to be adequate, ... the phenomenon of the *crisis* — the fact that the substitution of a downward for an upward tendency often takes place suddenly and violently, whereas there is, as a rule, no such sharp turning-point when an upward is substituted for a downward tendency.”

**ANSWER:** To understand a dynamic of the economy.
“Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.”

The Stylized Classical Business Cycle

Tracking the Business Cycle

Economic Activity

Time

Contraction

Expansion

Peak

Trough

Recovery

Prosperity

Return to Previous Peak
A Composite Index Compiles Various Types of Data into a “Market Basket” Measure Based on Some Common Objective and Data Criteria.

- Income growth
- Construction activity
- Job growth
- Retail Sales

Snapshot of the Economy
Why Develop Cyclical Indicators?

• They are easy to interpret.
• They are easy to communicate.
• They are relatively inexpensive to formulate, update, re-engineer.
• They provide perspective on drivers of international, national, and local business activity.
Existing examples provide insights about benefits & drawbacks
## Features of Philly Fed’s Approach

<table>
<thead>
<tr>
<th>Coincident Index Components</th>
<th>Leading Index Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonfarm Jobs</td>
<td>Housing permits</td>
</tr>
<tr>
<td>Average hours worked in manufacturing</td>
<td>Delivery times, survey of manufacturing</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>Unemployment insurance claims</td>
</tr>
<tr>
<td>Wage &amp; salary disbursements</td>
<td>Interest rate spread 10-year &amp; 3-month Treasury Bonds</td>
</tr>
</tbody>
</table>

**Benefits:** Covers all 50 states and the U.S. using the same variables, thereby allowing for state-to-state comparisons as well as comparing states to the nation. Leading index deftly blends state and national macroeconomic level data.

**Drawbacks:** “One size fits all” necessitates the use of “least common denominator” variables that may not be suitable for all states and omits more useful indicators that may only be available in one or more states. Coincident Index is an admixture of coincident, leading, and lagging indicators —it is more of a labor market indicator than a genuine business cycle indicator.
Federal Reserve Bank of Dallas produces coincident indexes for Texas’s 5 largest metros...

*Monthly, seasonally adjusted.
Last data entry August 2016.
...and the 4 largest border area metros.

Dallas Fed’s approach features fewer labor market variables and more localized indicators

<table>
<thead>
<tr>
<th>Coincident Index Components (9 Metros &amp; State)</th>
<th>Texas Leading Index Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonfarm Jobs</td>
<td>Real Oil Price</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>Unemployment insurance claims</td>
</tr>
<tr>
<td>Real wages</td>
<td>Average hours worked in manufacturing</td>
</tr>
<tr>
<td>Real retail sales</td>
<td>Oil Well Permits</td>
</tr>
<tr>
<td></td>
<td>Value of Texas Dollar</td>
</tr>
<tr>
<td></td>
<td>U.S. Leading Index</td>
</tr>
<tr>
<td></td>
<td>TX stock index</td>
</tr>
<tr>
<td></td>
<td>TX Help Wanted Index</td>
</tr>
</tbody>
</table>
Relevance to Arizona Governments & Businesses

• Arizona currently lacks a coincident and leading index that adequately captures the State’s economic base.

• Arizona government agencies and businesses produce data that may be more useful leading indicators, but may not be comparable or available across all states.

• Approach taken to creating the Arizona Coincident and Leading Index is intended to be extended to other jurisdictions across Arizona including counties and metropolitan areas.
Steps to Formulate a Leading Economic Indicator System

- Determine the Reference Measure to Track
- Analyze that Reference Indicator
- Screen Data to Find Leading Indicators
- Compile Composite Indexes
- Develop an Interpretation System
## Summary of Steps to Form a Composite Index.

<table>
<thead>
<tr>
<th>For Levels</th>
<th>For Percentage Change and Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For Individual Components of Index</strong></td>
<td></td>
</tr>
<tr>
<td>Step 1 $C = 200 \frac{(X_t - X_{t-1})}{(X_t + X_{t-1})}$ or,</td>
<td>$X_t - X_{t-1}$</td>
</tr>
<tr>
<td>Step 2 $A = \text{Mean absolute change of } C$</td>
<td>Same</td>
</tr>
<tr>
<td>Step 3 $S = C/A$</td>
<td>Same</td>
</tr>
</tbody>
</table>

**For Sum of Components in Index**

Step 4 $R = \text{Average of all } S \text{ per period with weighting factors}$

Step 5 $r = R \text{ adjusted for coincident index standard change}$

Step 6 $I = \frac{(200 + r)}{(200 - r)} \text{ multiplied by lagged value of the composite index with the initial value set equal to 100}$

**For Sum of Components with Trend Adjustment**

Step 7 $T = \text{Composite index trend from initial cycle peak to terminal cycle peak}$

Step 8 $G = \text{Average of monthly trends of individual components of the composite, called the "target trend"}$

Step 9 $r' = r + (G - T)$, which yields the trend-adjusted change

Step 10 $I' = \frac{(200 + r')}{(200 - r')}$ multiplied by the lagged value of the composite index with the initial value set equal to 100

**For Base Year Changes**

Step 11 $B = \text{Calendar year mean of } I'$ for new base year

Step 12 $I^B = (I'/B) \times 100$, which yields the new base year composite
Applying These Concepts and Methods to the Arizona Business Activity Measures
How Should Arizona Business Activity Be Defined?

- Rely on Past Research and Practice
- What Makes Sense Conceptually for the State?
- Look to See that Turning Points are Roughly Coincident With Other Candidate Measures
- Select and Compile the Most Appropriate Indicators
Arizona Non-Farm Employment

Source: U.S. Bureau of Labor Statistics
# Turning Points in Arizona Nonfarm Employment, 1939-2016

<table>
<thead>
<tr>
<th>Peak</th>
<th>Trough</th>
<th>Recession—Peak-to-Trough Duration in Months</th>
<th>Expansion—Trough-to-Peak Duration in Months</th>
<th>Cumulative % Change from Peak to Trough</th>
<th>Cumulative % Change from Trough to Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>1943-Jul</td>
<td>1945-Oct</td>
<td>27</td>
<td>37</td>
<td>-11.9%</td>
<td>+22.8%</td>
</tr>
<tr>
<td>1948-Nov</td>
<td>1949-Aug</td>
<td>9</td>
<td>43</td>
<td>-4.1</td>
<td>+37.9</td>
</tr>
<tr>
<td>1953-Mar</td>
<td>1953-Dec</td>
<td>9</td>
<td>247</td>
<td>-1.7</td>
<td>+265.7</td>
</tr>
<tr>
<td>1974-Jul</td>
<td>1975-Jul</td>
<td>12</td>
<td>73</td>
<td>-4.7</td>
<td>+46.4</td>
</tr>
<tr>
<td>1981-Aug</td>
<td>1982-Aug</td>
<td>12</td>
<td>223</td>
<td>-2.5</td>
<td>+122.7</td>
</tr>
<tr>
<td>2001-Mar</td>
<td>2001-Dec</td>
<td>9</td>
<td>70</td>
<td>-1.4</td>
<td>+19.6</td>
</tr>
<tr>
<td>2007-Oct</td>
<td>2010-Sep</td>
<td>35</td>
<td></td>
<td>-11.7</td>
<td></td>
</tr>
<tr>
<td>Averages:</td>
<td></td>
<td>16.1</td>
<td>115.5</td>
<td>-5.4%</td>
<td>+85.8%</td>
</tr>
</tbody>
</table>
Real Personal Income for Arizona

Turning Points in Quarterly Real Personal Income for Arizona

<table>
<thead>
<tr>
<th>Peak</th>
<th>Trough</th>
<th>Recession—Peak-to-Trough Duration in Quarters</th>
<th>Expansion—Trough-to-Peak Duration in Quarters</th>
<th>Cumulative % Change from Peak to Trough</th>
<th>Cumulative % Change from Trough to Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973-Q4</td>
<td>1975-Q1</td>
<td>5</td>
<td>27</td>
<td>-3.6%</td>
<td>+39.5%</td>
</tr>
<tr>
<td>1981-Q4</td>
<td>1982-Q3</td>
<td>3</td>
<td>29</td>
<td>-2.8</td>
<td>+50.3</td>
</tr>
<tr>
<td>1989-Q4</td>
<td>1990-Q4</td>
<td>4</td>
<td>70</td>
<td>-2.0</td>
<td>+123.9</td>
</tr>
<tr>
<td>2008-Q2</td>
<td>2010-Q1</td>
<td>7</td>
<td></td>
<td>-7.9</td>
<td></td>
</tr>
<tr>
<td>Averages</td>
<td></td>
<td>4.8</td>
<td>42.0</td>
<td>-4.1%</td>
<td>+71.2%</td>
</tr>
</tbody>
</table>

Source: U.S. Bureau of Economic Analysis
Real Taxable Retail Sales for Arizona

Turning Points in Arizona Real Taxable Retail Sales, 1981-2016

<table>
<thead>
<tr>
<th>Peak</th>
<th>Trough</th>
<th>Recession Peak-to-Trough Duration in Months</th>
<th>Expansion Trough-to-Peak Duration in Months</th>
<th>Cumulative % Change from Peak to Trough</th>
<th>Cumulative % Change from Trough to Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-Aug</td>
<td>1982-Sep</td>
<td>13</td>
<td>49</td>
<td>-10.5%</td>
<td>+43.2%</td>
</tr>
<tr>
<td>1986-Oct</td>
<td>1988-Sep</td>
<td>23</td>
<td>6</td>
<td>-1.7</td>
<td>+4.2</td>
</tr>
<tr>
<td>1989-Mar</td>
<td>1991-Mar</td>
<td>24</td>
<td>114</td>
<td>-7.0</td>
<td>+69.1</td>
</tr>
<tr>
<td>2000-Sep</td>
<td>2002-May</td>
<td>20</td>
<td>56</td>
<td>-2.9</td>
<td>+26.6</td>
</tr>
<tr>
<td>2007-Jan</td>
<td>2010-Mar</td>
<td>38</td>
<td>60</td>
<td>-30.4</td>
<td>+38.2</td>
</tr>
</tbody>
</table>

Averages: 23.6, 57.0, -10.5%, +35.8%

Source: Arizona Department of Revenue
Inflation-Adjusted AZ Hotel Revenue

Turning Points in Arizona Gross Sales for Hotels and Motels, 1993-2016

<table>
<thead>
<tr>
<th>Peak</th>
<th>Trough</th>
<th>Recession—Peak-to-Trough Duration in Months</th>
<th>Expansion—Trough-to-Peak Duration in Months</th>
<th>Cumulative % Change from Peak to Trough</th>
<th>Cumulative % Change from Trough to Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-Sep</td>
<td>2001-Nov</td>
<td>14</td>
<td>50</td>
<td>-19.2</td>
<td>+35.2</td>
</tr>
<tr>
<td>2007-Jan</td>
<td>2009-Dec</td>
<td>35</td>
<td></td>
<td>-27.5</td>
<td></td>
</tr>
</tbody>
</table>
Defining the Arizona Business Cycle based on Experimental Coincident Index

Composite index of four Arizona coincident indicators: (1) Real Hotel Receipts; (2) Real Retail Sales; (3) Real Personal Income; and (4) Payroll Employment.

Same indicator as above, but expressed as a six-month smoothed annualized growth rate.
## Turning Points in Arizona Experimental Coincident Index, 1947-2016

<table>
<thead>
<tr>
<th>Peak</th>
<th>Trough</th>
<th>Recession—Peak-to-Trough Duration in Months</th>
<th>Expansion—Trough-to-Peak Duration in Months</th>
<th>Cumulative % Change from Peak to Trough</th>
<th>Cumulative % Change from Trough to Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948-Nov</td>
<td>1949-Aug</td>
<td>9</td>
<td>43</td>
<td>-7.1%</td>
<td>+140.6%</td>
</tr>
<tr>
<td>1953-Mar</td>
<td>1953-Oct</td>
<td>7</td>
<td>249</td>
<td>-4.3</td>
<td>+2856.8</td>
</tr>
<tr>
<td>1974-Jul</td>
<td>1975-Apr</td>
<td>9</td>
<td>76</td>
<td>-10.8</td>
<td>+152.5</td>
</tr>
<tr>
<td>1990-May</td>
<td>1990-Dec</td>
<td>7</td>
<td>123</td>
<td>-1.2</td>
<td>+215.8</td>
</tr>
<tr>
<td>2001-Mar</td>
<td>2001-Dec</td>
<td>9</td>
<td>64</td>
<td>-1.7</td>
<td>+67.1</td>
</tr>
<tr>
<td>2007-Mar</td>
<td>2010-Mar</td>
<td>36</td>
<td></td>
<td>-30.4</td>
<td></td>
</tr>
<tr>
<td>Averages:</td>
<td></td>
<td>13.3</td>
<td>107.8</td>
<td>-9.2%</td>
<td>+598.4%</td>
</tr>
</tbody>
</table>
In Search of Leading Indicators

• Numerous series scanned for their cyclical characteristics

• Eleven measures found to be acceptable leading indicators covering the following concepts:
  • Labor
  • Housing
  • Consumer Confidence
  • Motor Vehicles
  • Passenger Air Traffic
  • Financial
  • Trade
  • Copper Industry
  • Neighboring States’ Business
1. LABOR INPUT

Initial Claims for State Unemployment Insurance
Seasonally Adjusted, Average Weekly Rate

Sources: Arizona Office of Employment and Population Statistics & Arizona Department of Economic Security
2. HOUSING INPUT

Arizona Building Permits

Shaded Areas Represent AZ Recessions

Number of Units Started

Source: U.S. Census Bureau
3. CONSUMER CONFIDENCE INPUT

Arizona Consumer Confidence Index

Source: Behavior Research Center, Rocky Mountain Poll - Arizona
AZ New Motor Vehicle Registrations

Source: Motor Vehicle Division, Arizona Department of Transportation
5. AIR-TRAVEL PASSENGERS INPUT (SKY HARBOR ONLY)

Arizona Airports
Passengers Arriving and Departing

Seasonally Adjusted and Smoothed

Number of Passengers

Sky Harbor Airport Passenger Data (left scale)
Tucson International Airport Passenger Data (right scale)

Sources: Sky Harbor International Airport, City of Phoenix & Tucson International Airport
6. FINANCIAL INPUT

Arizona Stock Price Index

Sources: Arizona Department of Revenue & Federal Reserve Bank of Dallas
6. FINANCIAL INPUT

Blackrock's Arizona Municipal Bond Fund
(Ticker MZA)

Source: BlackRock
7. AIR-FREIGHT CARGO INPUT

Phoenix Sky Harbor and Tucson International Air-Freight Cargo

Smoothed and Seasonally Adjusted

Sources: Sky Harbor International Airport, City of Phoenix & Tucson International Airport
8. COPPER INDUSTRY INPUT

USGS Leading Indicator of Copper Industry

Source: U.S. Geological Survey
Leading Indicator of California Economy

Percentage Points

Source: Philadelphia Federal Reserve

Leading Indicator of Texas Economy

Source: Philadelphia Federal Reserve

Source: Federal Reserve Bank of Philadelphia
Experimental Coincident and Leading Indexes of Arizona Business Activity

Shaded Areas Represent Arizona State Business Cycle

- **Red Line**: Experimental Coincident Index for Arizona (Left Scale)
- **Green Line**: Experimental Leading Index for Arizona (Right Scale)
Leading indicator quantifies likelihood of AZ Recession

Probability of an Arizona Recession

- Probability of a Downturn
- 90% Threshold
For leading indicators what was not used, what remains to be examined?

- **Examined, not used**
  - New Corporation Filings (Corporation Commission)
  - Private Sector Hours Worked (U.S. Bureau of Labor Stats)
  - Vehicle Border Crossings (U.S. Customs)
  - Value of Arizona Dollar (Dallas Fed)
  - New Contractor Licenses (Registrar of Contractors)

- **Remains to be examined**
  - New Transaction Privilege Tax Licenses (Dept. of Revenue)
  - Truck Traffic, AZ Ports of Entry (ADOT)
  - Tourism Indicators (AZ Tourism Office)
  - Interest Rate Spreads – Risk Spread, Term Spread
  - Utilization of “Temp” employees (Survey of Temp Agencies)
Leading Index aids in forecasting State revenues

Source: Arizona Department of Revenue
Withholding Tax collections tend to lag onset of recession longer than TPT.
Changes in Corporate Income Tax collections tend to mirror business cycle

Source: Arizona Department of Revenue
Final Thoughts

• This research is very promising as a tool to track and anticipate changes in state economic activity and state tax revenues

• Peer review and further experimentation with candidate series will finalize indexes

• Need to develop a Purchasing Managers Survey as a lead indicator to add to lead index

• Incorporate measures directly into revenue forecasting efforts

• Future research will drill down and expand the methods to AZ counties and/or major AZ cities
Thank You

The analysis, views, and conclusions set forth in this presentation do not necessarily indicate concurrence by other members of the staff or management of the Arizona Department of Revenue. This presentation is based on information the authors believe is reliable. However, the authors cannot guarantee its accuracy and is not liable for any damages arising out of its use. All proprietary materials and analysis are copyrighted. ©2016.
Comparison of the Arizona and U.S. Business Cycles
(Timing Measured Relative to the Arizona Cycle;
Minus Indicates AZ Cycle Leads U.S. cycle, Plus Indicates AZ Cycle Lags)

<table>
<thead>
<tr>
<th>AZ COINCIDENT INDEX</th>
<th>U.S. BUSINESS CYCLE DATES</th>
<th>Timing Relationship (in Months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>Trough</td>
<td>Peak</td>
</tr>
<tr>
<td>1948-Nov</td>
<td>1949-Aug</td>
<td>0</td>
</tr>
<tr>
<td>1953-Mar</td>
<td>1953-Jul</td>
<td>-4</td>
</tr>
<tr>
<td>1953-Nov</td>
<td>1954-May</td>
<td>-6</td>
</tr>
<tr>
<td>1974-Jul</td>
<td>1973-Nov</td>
<td>+8</td>
</tr>
<tr>
<td>1981-Aug</td>
<td>1981-Jul</td>
<td>+1</td>
</tr>
<tr>
<td>1982-Aug</td>
<td>1982-Nov</td>
<td>-3</td>
</tr>
<tr>
<td>1990-May</td>
<td>1990-Jul</td>
<td>-2</td>
</tr>
<tr>
<td>1990-Dec</td>
<td>1991-Mar</td>
<td>+3</td>
</tr>
<tr>
<td>2001-Apr</td>
<td>2001-Mar</td>
<td>+1</td>
</tr>
<tr>
<td>2001-Dec</td>
<td>2001-Nov</td>
<td>+1</td>
</tr>
<tr>
<td>2007-Mar</td>
<td>2007-Dec</td>
<td>-8</td>
</tr>
<tr>
<td>2010-Mar</td>
<td>2009-Jun</td>
<td>+9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-0.6</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Withholding Tax collections tend to lag onset of recession longer than TPT.