Preliminary Presentation of the Iowa Leading Indicators Index
Tax Research and Program Analysis Section
Iowa Department of Revenue
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The Iowa Department of Revenue is creating a leading indicators index for the State of Iowa. This index will serve as another tool for forecasting revenue for the quarterly meetings of the Revenue Estimating Conference. Along with the national leading indicators index produced by The Conference Board, various States, regions, and cities have established leading indicator indexes. The Tax Research and Program Analysis Section, following the path taken by these other agencies, has built an index that should help indicate the direction of the Iowa economy.

Iowa Coincident Economic Series

Before it is possible to develop a leading indicators index for predicting economic activity for the State of Iowa on a monthly basis, it is necessary to establish a measure of that economic activity. Ideally the measure would capture total output or total personal income in the State; however, no comprehensive measure of gross state product (GSP) or personal income at the state level is available monthly, and even if one was, it would likely be subject to substantial revisions. Therefore it is necessary to choose an alternative data series or set of series that will best capture current economic activity for the State.

Many other States and regions have encountered this same problem. These agencies have developed coincident indexes of economic activity or identified a single economic series to use as the target for their leading indicators index. The economic series most often used is total non-farm employment.[1] That series was also determined to be the best data available for representing economic activity within

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[1] Other series include the unemployment rate, monthly home sales, manufacturing hours worked and retail sales. The Conference Board's National Coincident Indicators Index uses non-farm employment along with personal income less transfers, an index of industrial production, and manufacturing and trade sales; these are the four main series used by the NBER to date business cycles.

the State of Iowa on a timely basis. Although individual income tax withholding or retail sales tax payments are appealing series for signaling current economic activity, it was determined that recent changes in Iowa withholding tables made the former problematic and the ability of firms to base Iowa sales tax remittances on estimates of the previous year's liability rather than current sales made the latter unreliable.

Figure 1 presents the 12-month moving average of monthly Iowa non-farm employment data and Iowa annual gross state product (GSP).[2] The two series move together throughout history, indeed almost tracking exactly until the last four years. Beginning in 2002, GSP began to grow annually while employment continued the fall that began in 2001. Only in late 2003 did employment begin to rise and follow the continuing growth in GSP.

Figure 2 presents the same employment data and the 12-month moving average of total Iowa tax revenues (adjusted using the CPI-U to 2000 dollars) starting in July 1985. The two series track closely over the time period, although revenues grew more quickly than employment during the early years of the 1990's boom, reflecting, in part, the 1992 increase in the Iowa sales tax rate to 5 percent from 4 percent. The growth of revenues slowed starting in 1998 reflecting the cuts in individual income taxes that occurred in 1997 and 1998. Revenues fell dramatically in 2002 matching the drops in employment as the Iowa economy slowed. Unlike the quick turnaround seen above for GSP, revenues continued to fall along with employment throughout much of 2003. However, both series have been on an upward path since late 2003.

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[2] All moving averages considered are backward moving averages, calculated as the average of the past 12 months' observations.

Key Economic Sectors in the State of Iowa

Leading indicators for States and regions often include data series that are specific to the economic sectors that drive the area's economy: Texas focuses on crude oil, the Wichita Metro Area focuses on aerospace and wheat, and Southern Nevada focuses on tourism and gaming. What sectors drive the economy in the State of Iowa? The Iowa gross state product (GSP) makes up roughly one percent of the national gross domestic product (GDP) and Iowa total non-farm employment equals just over one percent of national non-farm employment. However, the distribution of output and workers in Iowa is more concentrated in the agriculture, manufacturing, and financial sectors.

- Agriculture - In 2004, Iowa agricultural output constituted 4.4 percent of the national agricultural output and 4.6 percent of the Iowa economy. These percentages have fluctuated over time, however. While Iowa agricultural output comprised 6.5 percent of GSP and 4.8 percent of national agricultural output in 1997, those shares fell to 2.5 and 2.3 percent in 1999 reflecting the volatility of agricultural markets and government subsidies. Although the share of the agricultural sector by itself seems to be a small part of the Iowa economy, recent analysis has estimated that farm, food, and agriculture-affiliated industries accounted for 16.4 percent of the State's value added in 1999.[3]

- Financial - Comprising 8.0 percent of Iowa output in 1997, by 2004 the financial sector had expanded to 10.7 percent of Iowa output, a growth of 34.3 percent. This explosion of finance and insurance output in Iowa has pushed the State share of national output for this sector to 1.2 percent. Banking, insurance, and mortgage lending are a large source of employment in the Des Moines area, which translated into a 6.7 percent employment share for the sector in the State, relative to 6.1 percent nationwide in December 2005.

- Manufacturing - In 2004, manufacturing comprised 20.5 percent of Iowa GSP, compared to just 13.3 percent of the national economy; the Iowa share of national manufacturing output was 1.5 percent. While the manufacturing sector has been on the wane across the nation, its importance in Iowa remains. In 1997, 15.5 percent of national output and 22.6 percent of Iowa output were

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[3] Swensen, David A. and Liesl Eathington, "Multiple Measures of the Role of Agriculture in Iowa's Economy," Office of Social and Economic Trend Analysis, Iowa State University, Technical Report 06-002, December 2002.

attributed to manufacturing. Over the next seven years, Iowa manufacturing output contracted by 9.0 percent, far less than the 17.6 percent contraction of national manufacturing output. Although in December 2005 just 10.6 percent of non-farm employment in the U.S. was concentrated in manufacturing, this industry captured over 15.5 percent of non-farm employment in Iowa.

What series exist that might provide leading indicators to changes in these sectors? Commodities futures markets for agricultural products, stock market prices for Iowa-based financial and other companies, new orders for manufacturing companies in Iowa, and Iowa diesel fuel consumption are some possible series. In addition, labor market indicators such as initial unemployment claims and average weekly manufacturing hours are considered, along with financial indicators such as the yield spread and building permits.

Iowa Leading Economic Series

The series included in the Iowa Leading Indicators Index were chosen based on their economic significance in capturing the direction of the Iowa economy, and in particular the key sectors mentioned above. One constraint that limited the inclusion of many series was the need for the data to be available on a monthly basis. In addition to considering the economic significance and available frequency of the data, all of the series were evaluated against the complete Moore-Shiskin criteria, a system developed in 1967 by Geoffrey H. Moore and Julius Shiskin for scoring economic series as possible leading indicators.[4] The criteria include the following:

1. conformity – series must conform well to the business cycle
2. consistent timing – series must exhibit a consistent timing pattern over time as a leading indicator

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[4] The Conference Board, *Business Cycle Indicators Handbook*, December 2000, p.14.

3. currency – series must be published on a reasonably prompt schedule and not be subject to major revisions

4. economic significance – cyclical timing of the series must be economically logical

5. statistical adequacy – data must be collected and processed in a statistically reliable way

6. smoothness – month-to-month movements in the series must not be too erratic.

Unfortunately, the historical availability of several of the series limited the assessment of their conformity and consistent timing. It is difficult to draw a solid conclusion about the ability of a series to lead the business cycle when the historical sample includes only one or two cycles, especially considering the recent divergence of employment and GSP. Each series is briefly discussed below; Table 1 provides an overview of the Moore-Shiskin criteria analysis for all of the series formally considered.

The agricultural futures price index (AFPI) is a weighted index of changes in the prices for corn and soybeans futures contracts and in the estimated profitability for nearby hog and cattle future contracts. Daily settle prices for the current or next month futures contract are averaged over the month for hogs and cattle; "current crop" and "new crop" contract prices are considered for corn and soybeans. For hogs and cattle break-even estimates (reported monthly by Dr. John Lawrence at Iowa State University) are subtracted from the futures prices to provide an estimate of potential profits. To create the index, each commodity series is weighted by its share of annual Iowa agricultural production. Historical futures and break-even data are available for the past 15 years, limiting assessment of conformity and consistent timing.[5] However, the series captures the direction of the important agricultural sector in Iowa.

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[5] The Department would like to thank Dr. John Lawrence and Dr. Chad Hart of Iowa State University for sharing this data.

The Iowa Stock Market Index is a capitalization weighted index of 29 Iowa-based or Iowa-concentrated publicly-traded companies. Daily closing prices for each company are averaged over the month and weighted by shares outstanding. The series is indexed to a value of 10 during the 1984-1986 period. Historical data, purchased from Standard & Poor's, is available back to 1984, which again limits the assessment of conformity and consistent timing. This series serves to capture investor sentiment about the future prospects of many key employers in the State. In addition, over half of the value in the index is derived from financial companies, thus it should capture the direction of the important financial sector in Iowa.

The yield spread, the only national series included, measures the term structure of interest rates by taking the difference between a long rate, the 10-year Treasury Constant Maturity Rate, and a short rate, the 3-month Treasury Constant Maturity Rate. Although the choice of short-term rates varies among other leading indexes, the capacity of the yield spread to lead business cycles is well-established.

Building permits measure the number of permits issued for the construction of residential units in the State including single and multiple unit dwellings. Monthly permits data are reported by the U.S. Census Bureau, although State data is only available back to 1998 limiting the historical assessment of this series. This series is the most widely used in the identified leading indicators indexes.

Initial unemployment claims track the number of new claims for unemployment insurance in the State. Average weekly claim numbers, released within two weeks by the Bureau of Labor Statistics, signal changes in the availability of jobs. Changes in the series are inverted before inclusion in the index, thus a fall in unemployment claims contributes positively as a leading indicator. The series is very

volatile, mostly reflecting seasonal variation in layoffs and hiring, raising some concerns about smoothness.

Average weekly manufacturing hours also indicates the strength of the labor market, although more narrowly targeted to the manufacturing industry. State data, released by the Bureau of Labor Statistics (BLS), are available back to 1996, although the 2001 reclassification of industries raises minor concerns about compatibility of the series across the years. Based on the belief that manufacturing employers adjust hours before changing the number of employees, changes in weekly hours worked should provide a good signal to changes in the important manufacturing sector in Iowa.

The new orders index measures the share of purchasing managers in the State reporting increasing or steady orders received for their products. The index is one component of the regional Purchasing Managers Index (PMI) produced monthly by Dr. Ernest Goss at Creighton University. New orders lead the economy because they directly impact the production decisions of manufacturers in the State.

Diesel fuel consumption measures the amount of taxable gallons of diesel fuel purchased in the State, which is a good approximation of the fuel demand for commercial motor carrier transportation within and through Iowa. Data are reported by the Iowa Department of Revenue Compliance Division on a monthly basis, although the data reflect the sales from two months prior to the report. This lag raises a minor concern about the series' currency; all other series considered are available within one month. However, the leading properties of this series appear so strong that despite a one-month lag in the data, the series should still provide a good signal of changing economic activity. There is also a concern with the series smoothness. Despite these concerns, the series has been included, reflecting the importance of diesel fuel for transporting output for the key manufacturing and agricultural sectors.

In addition to the above eight series that have been chosen to serve as leading indicators, three additional series were formally considered. Revenues from real estate transfer taxes were found to lack conformity and consistent timing, although the analysis was limited by the short history available. The series is also very volatile, and thus smoothness was an additional problem. Second, the delivery lead time index, another component of the PMI mentioned above was ruled out because it had weak consistent timing and the fact the series reflects the economic activity of suppliers to Iowa manufacturers and thus not necessarily reflecting economic activity within Iowa. Third, the managers' confidence index, a third component of the PMI, was considered. While the rest of the PMI components reported in the regional analysis paralleled the components in the national PMI produced by the Institute of Supply Management, this component is unique to Creighton University. Reported to represent the response of purchasing managers to the question whether the economy will be up, down or the same in 6 months, there remained a concern about the statistical adequacy of the series. In addition, the series was highly correlated with two other components, the new orders index and average weekly manufacturing hours, and was therefore dropped.

Iowa Leading Indicators Index

The Iowa Leading Indicators Index (ILII) provides a monthly signal about the direction of the economy by combining the monthly changes in each of the eight components (see Appendix A for a detailed discussion of the steps that follow those used by The Conference Board). Figure 3 presents the ILII and the coincident index of Iowa non-farm employment, both computed with a base value of 100 in 1999. Both indexes rose throughout 1999. The ILII peaked in July 2000 then fell for the rest of the year and through 2001. Employment peaked six months later in January 2001 and dropped steadily over the next 33 months. Employment bottomed out in September 2003, 21 months after the ILII

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reached its trough in January 2002. The ILII remained relatively flat through 2002 and into early 2003 before beginning a sharp rise from July 2003 through August 2004. The fast growth in the ILII during 2003 and 2004 lead the growth in employment, which began in December 2004, by 17 months. The ILII lost value between July 2004 and August 2005, then rose through the rest of 2005. During 2006, the ILII began another fall. The index dropped 0.2 percent in March and 0.3 percent in April, only to hold steady in May and rise 0.3 percent in June. Despite the apparent slowing signals throughout the last two years, employment has continued to grow at a steady pace of 0.1 percent per month.

The Conference Board considers a contraction signal in the national leading indicators index reliable when two conditions are met: 1. the index declines by at least two percent over a six month period (using an annual rate); and, 2. a majority of the individual components also decline over those six months.[6] Applying the first rule to the ILII reveals one reliable contraction signal for Iowa since January 1999. The six month decline in the index exceeded two percent in July and August 2001. In those same months five of the eight components declined, indicated by a diffusion index measure of 37.5 (see Appendix B for a discussion how the diffusion index is computed). Thus, the ILII successfully identified the contraction in employment that occurred over the 33 month period in 2001 through 2003. Unfortunately, historical data limitations on various components of the ILII prevent analysis before January 1999 to determine whether the index would equally well for previous recessions in Iowa.

This rule of thumb for contraction signals also helps explain the recent drop seen in the ILII without a commensurate drop in employment. At no time over the last two years has the ILII dropped more than an annualized two percent during a six-month period. The largest measured drop was 1.7 percent in

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[6] Ibid, p.19.

May 2005. The six-month diffusion index has only fallen below 50 during a short period of August through November 2005.

Conversely, the ILII reached two percent growth over an annualized six-month period in January 2000 and throughout the entire October 2003 through October 2004 period. The earlier point occurred at the tail end of a boom. The later period provided a 14 month lead to the upswing in employment.

ILII Sensitivity

As part of the development of the ILII, sensitivity to the inclusion of each of the components was considered. The ILII was recomputed using just seven components, dropping each component one at a time. The eight panels of Figure 4 show three lines including the employment index and the ILII, as in Figure 3, and an additional dotted line that represents the ILII excluding the particular component.

The agricultural futures price index has the biggest effect on raising the magnitude of the recent peak in the ILII (see panel A). With all components, the ILII peaked at a value of 106.0 in October 2004, without the AFPI, it peaks at only 104.9. This suggests that commodity prices were bolstering the agricultural sector and the entire economy during the 2004 and 2005 period.

Excluding the Iowa stock market index causes three noticeable changes in the ILII (see panel B). The dip in 2001 becomes more pronounced, the rise in 2003 accelerates as does the fall in late 2004 and early 2005. Clearly the stock market index has a significant impact on the value of the index.

Excluding the yield spread delays the peak in 2000, deepens the trough in 2002, and raises the peak in 2004 (see panel C). These reflect the impact on short-term yields of the Federal Reserve Board interest

rate actions. In the first eight months of 2000, the Board raised the Federal Funds rate after holding it down in anticipation of the Y2K worries. Starting in 2001, the Board reversed course and began a steady drop in the short-term rate through 2002, bolstering the economy. More recently, the inclusion of the yield spread pulls down the ILII as the short-term rate rises along with the Federal Funds rate which the Federal Reserve Board has been raising steadily since June 2004.

Excluding building permits makes the downturn in 2000 and 2001 even more shallow, but the series has little impact on the rest of the index (see panel D).

Excluding unemployment initial claims has a big impact on the level of the ILII from May 2001 to March 2004 (see panel E). Unemployment was rising during this time, thus excluding that negative signal of economic activity boosts the ILII values. This reveals the key role that labor markets play in driving economic activity as measured by the employment-based coincident index.

Excluding average weekly manufacturing hours has an even more dramatic impact on the ILII, raising its value in nearly every month after July 1999, in particular since 2005 (see panel F). This suggests that the current downturn in the ILII is being driven in large part by a reduction in manufacturing weekly hours. This also reflects the large weight placed on this series in the standardization process because of its low variability over time (see the appendix for a discussion of the standardization process and Table A1 for the standardization weights).

Excluding the new orders index has a limited effect on the ILII, slightly pushing up the index during its peak in 2004. This reflects strong reports from manufacturers during this time (see panel G).

Excluding diesel fuel consumption shows up in lower values of the ILII throughout 2002 and 2003 and in a dramatic drop since August 2004 (see panel H). Indeed, the index would drop from 104.9 in June 2006 to just 102.2 without this component. This suggests that diesel fuel consumption has been strong in recent months and is signaling continued strength in the economy despite the negative signals from many of the other indicators.

Conclusions and Remaining Issues

The Iowa Leading Indicators Index is a work in progress. The limited historical period over which the index can be calculated restricts the analysis of its effectiveness at predicting changes in economic activity. The initial results suggest that the ILII can provide some guidance in predicting the direction of Iowa non-farm employment. Additional indicators may improve the ability of the ILII to predict movements in the economy and the Department continues to study data series with this in mind. At this time, the Department plans to release the ILII as currently formulated to begin to provide policy makers across the State of Iowa with as much information as possible about the future direction of the State economy.

With this in mind, the current signals from the ILII are unclear. Although the general direction over the last 24 months points toward a slowing economy, the low magnitude of the ILII downward trend does not suggest the economy will move into negative territory. However, a few poor results for a handful of the components could easily push the ILII into indicating a recession is looming. Economics is part art and part science, and the Department hopes the ILII, using tools based in science, is able to paint a picture in which viewers will find some value.

Table 1. Moore-Shiskin Criteria and Iowa Leading Indicators Index Components

	Moore-Shiskin Criteria					
	Conformity	Consistent Timing	Economic Significance	Currency	Statistical Adequacy	Smoothness
ILII Series						
Agricultural Futures Price Index	LH	LH	X	X	X	X
Iowa Stock Market Index	LH	LH	X	X	X	X
Yield Spread	X	X	X	X	X	X
Building Permits	LH	LH	X	X	X	X
Initial Unemployment Claims	X	X	X	X	X	C
Average Work Hours	LH	LH	X	X	X	X
New Orders Index	LH	LH	X	X	X	X
Diesel Fuel Consumption	LH	LH	X	C	X	C
Additional Series						
Delivery Lead Times	LH	LH, C	C	X	X	X
Managers Confidence Index	LH	LH	X	X	C	X
Real Estate Transfer Taxes	LH, C	LH, C	X	X	X	C

Legend: X=meets adequately, LH=difficult to determine with limited history, C=concern about the series meeting the criterion

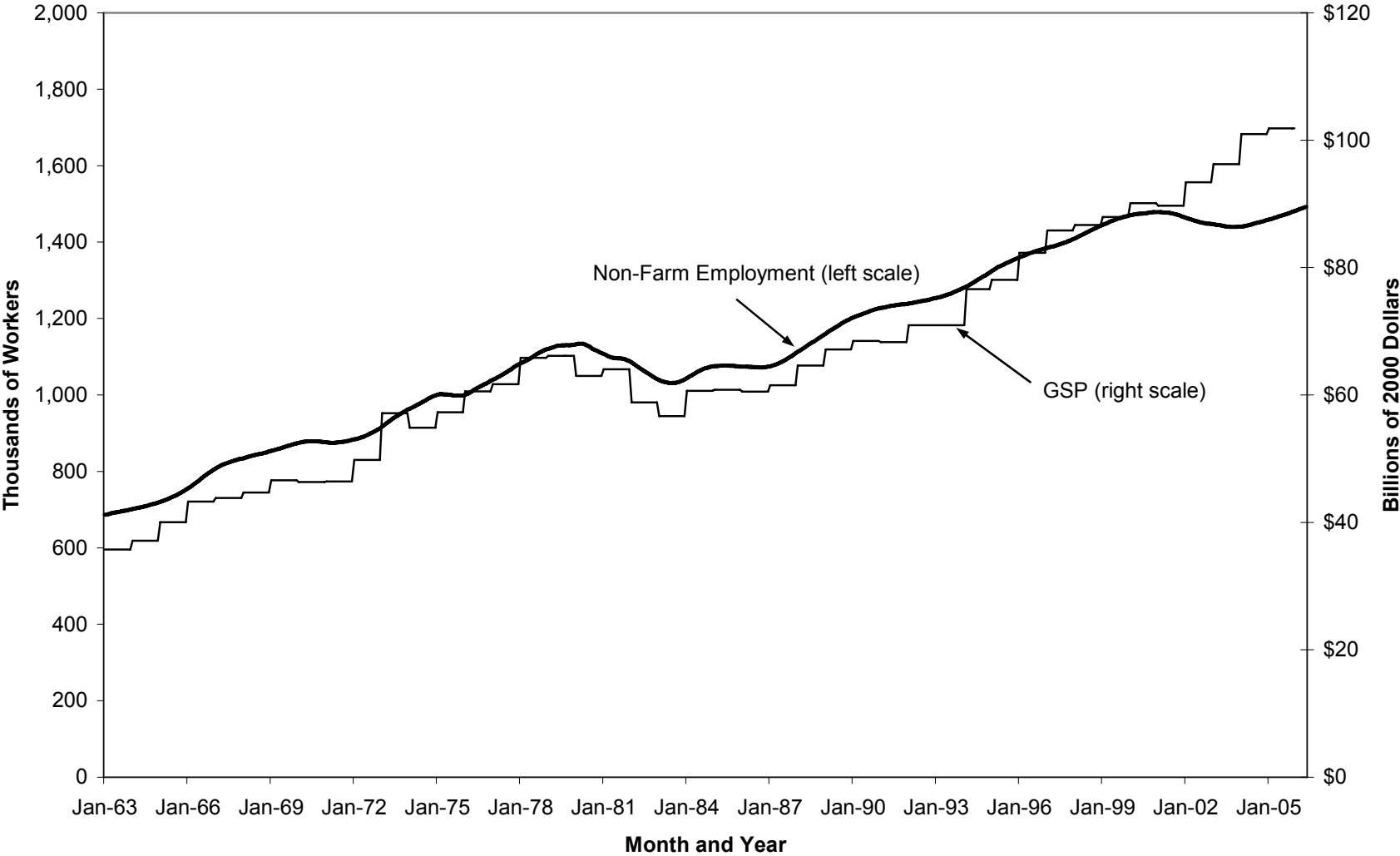## Figure 1. Iowa Non-Farm Employment and Annual Gross State Product

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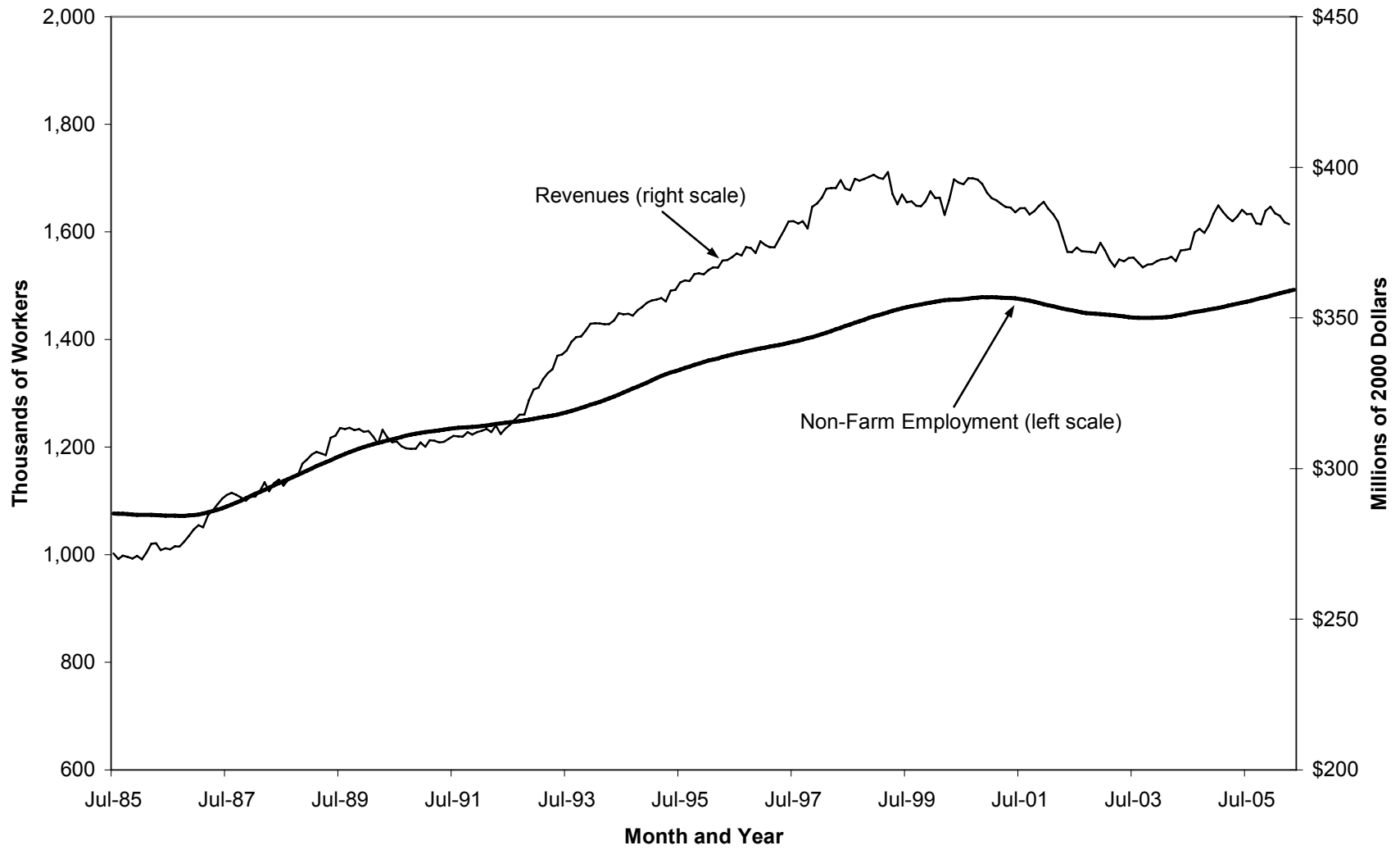**Figure 2. Iowa Non-Farm Employment and Total Tax Revenues**

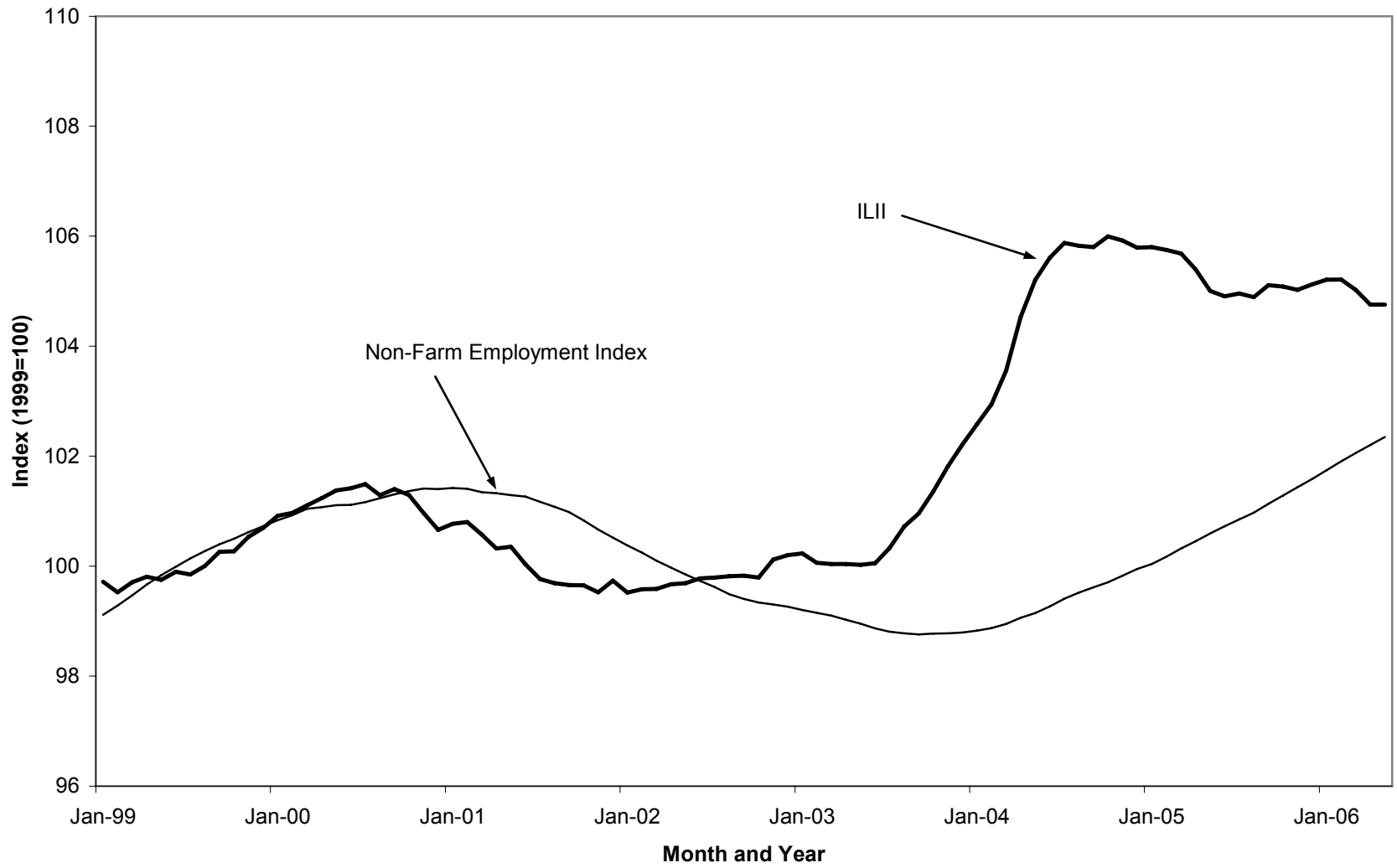# Figure 3. Iowa Leading Indicators Index and Iowa Non-Farm Employment Coincident Index

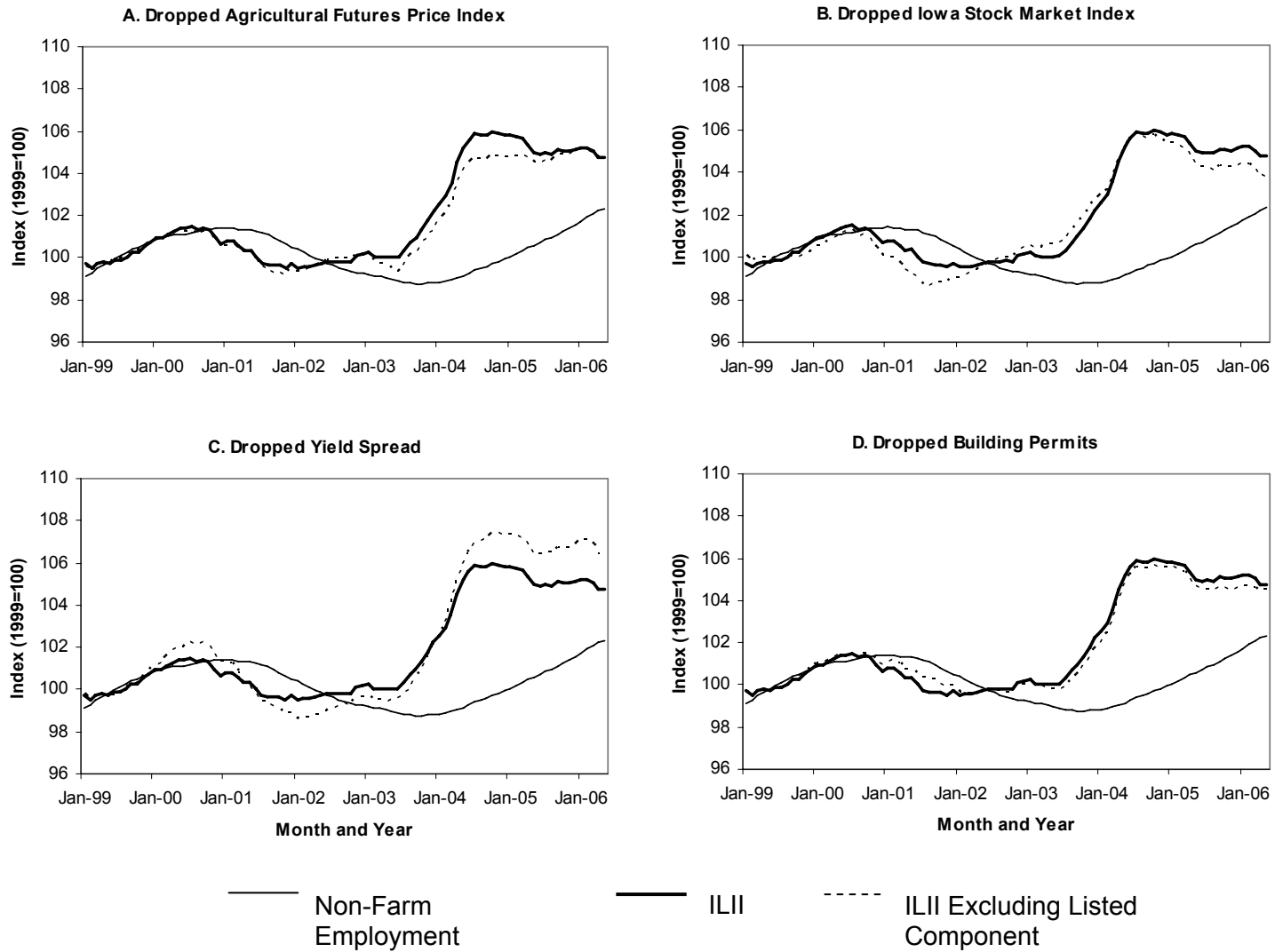## Figure 4. Iowa Leading Indicators Index: Sensitivity to Excluding Leading Indicator Components
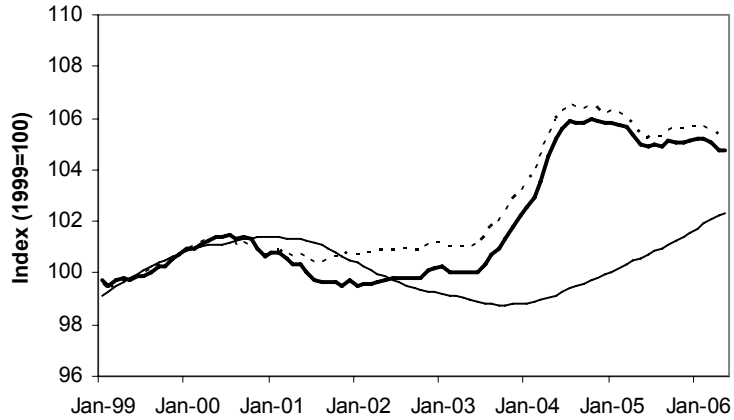

A. Dropped Agricultural Futures Price Index

B. Dropped Iowa Stock Market Index

C. Dropped Yield Spread

D. Dropped Building Permits

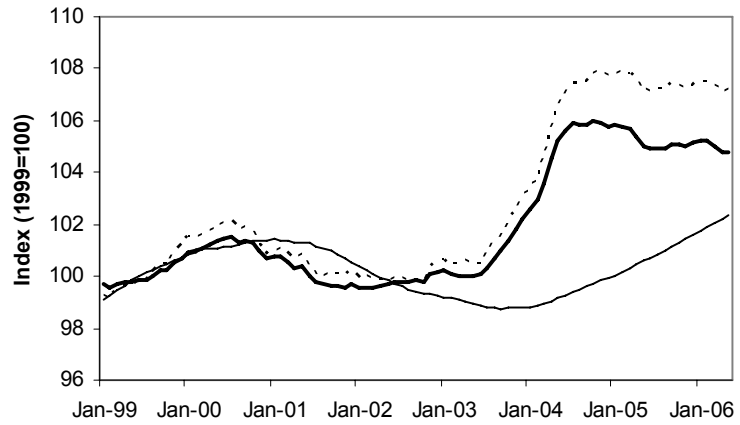Legend: Non-Farm Employment, ILII, ILII Excluding Listed Component

Figure 4. Iowa Leading Indicators Index: Sensitivity to Excluding Leading Indicator Components (continued)
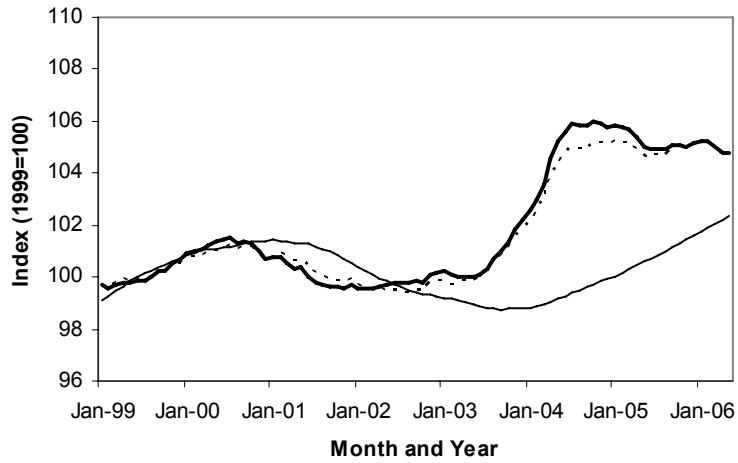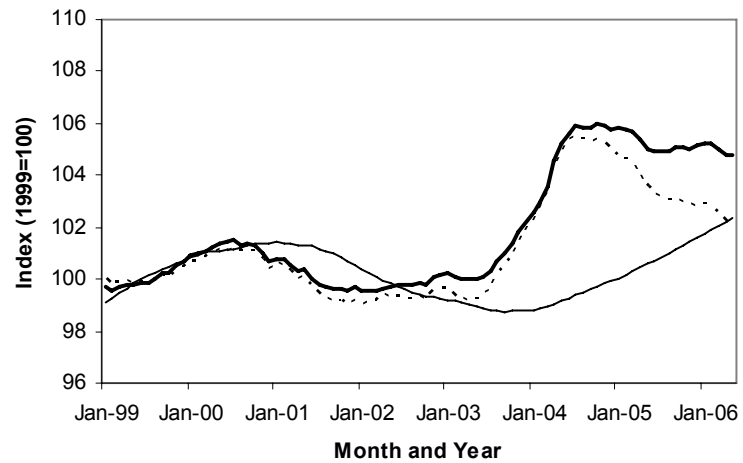

E. Dropped Unemployment Initial Claims

F. Dropped Average Weekly Manufacturing Hours

G. Dropped New Orders Index

H. Dropped Diesel Fuel Consumption

Non-Farm Employment | ILII | ILII Excluding Listed Component

Appendix A: Computation of the Iowa Leading Indicators Index

The ILII was computed following the five step process presented in the *Business Cycle Indicators Handbook* by The Conference Board.

1. Calculate month-to-month changes for each component. For the components already in percent form (including the yield spread and the new orders index) simple arithmetic differences are calculated. For the other components, a symmetric percent change formula is used because this formula will return the original value if equal positive and negative changes occur in consecutive months.

   = 200*(current month value – last month value)/(current month value + last month value)

2. Multiply each component's month-to-month changes by the standardization factor. Standardization factors, the inverse of the standard deviation of the changes in the series normalized across all series to sum to one, equalize the volatility of each component in the index (see Table A1 for the standardization weights currently being used).

3. Add the standardized month-to-month changes across all eight indicators to compute each monthly ILII change.

4. Compute preliminary values of the index using a cumulative symmetric percent change formula. The initial month's value is set to 100, then to compute the cumulative change of the index, each the index's value is multiplied by the following monthly change:

   $ILII_0 = 100$

   $ILII_1 = ILII_0 * (200 + \text{month 1 ILII change})/(200 - \text{month 1 ILII change})$

5. Rebase the index to average 100 in the base year (1999). The preliminary levels are multiplied by 100 and divided by the average preliminary value over the 12 months in 1999.

Because many of the series are subject to a lot of variation, before calculating month-to-month changes all series except the yield spread, the only national series, are smoothed by taking 12-month moving averages.

The standardization factors will be recalculated annually and any revisions to historical data (beyond the previous two months) will be incorporated annually during the summer.

The Non-Farm Employment Coincident Index is computed following this same method; however, with only one component, steps 2 and 3 are unnecessary.

Table A1. ILII Standardization Factors

Iowa Leading Indicator Components	Standard Deviation	Inverted Standard Deviation	Standardization Factor
Agricultural Futures Price Index	0.486	2.059	0.130
Iowa Stock Market Index	1.124	0.890	0.056
Yield Spread	0.269	3.717	0.236
Building Permits	2.123	0.471	0.030
Unemployment Claims	1.982	0.504	0.032
Average Weekly Hours	0.202	4.771	0.302
New Orders Index	1.206	0.829	0.053
Diesel Fuel Consumption	0.394	2.538	0.161

The standardization factors are the inverse of the standard deviation of the month-to-month changes
in each component over the January 1999 to June 2006 period. These factors equalize the volatility
of the contribution from each component and are normalized to 1. The month-to-month changes are
based on 12-month moving averages for all components except the yield spread, which is the
only national series. The yield spread and new orders index changes are simple arithmetic changes;
month-to-month changes for the rest of the components are computed as symmetric percentage changes.

Appendix B: Computation of the Diffusion Index

A diffusion index measures the proportion of components rising in a given time period. Components experiencing an increase of more than 0.05 percent are assigned a value of 1.0; components experiencing a change in absolute value of 0.05 percent or less are assigned a value of 0.5; components experiencing a decrease of more than 0.05 percent are assigned a value of 0.0. These assigned values are then summed over all of the components. The sum is multiplied by 100 and divided by the number of components. Thus a value below 50 indicates more than half of the components declined in value during the period of interest.

The diffusion index is based on the actual changes in the components, not standardized contributions used to compute the ILII. A diffusion index is computed for one-month and six-month symmetric percent changes in the components (see Figure B1).

Figure B1. ILII One-Month and Six-Month Diffusion Indexes