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Bill Adams
Pieter Bottelier
Ataman Ozyildirim
Jing Sima-Friedman

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Economics Program
845 Third Avenue
New York, NY 10022-6600
Tel. 212-339-0420
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Abstract

Leading indicators represent variables that tend to precede and predict coincident indicators of general economic activity, which as a multivariate concept, can be measured with the help of metrics on employment, production, total income and sales in real (inflation adjusted) terms. In many countries, composite indexes of leading economic indicators (LEI) are used to help predict short-term cyclical fluctuations of the economy in conjunction with composite indexes of coincident economic indicators (CEI). They also serve to analyze short-term macroeconomic dynamics of the business cycle. This paper reviews the available monthly and quarterly leading indicators for China, and develops a composite index following the indicators approach of The Conference Board, which publishes the U.S. LEI. Predicting turning points in the business cycle is extremely difficult, but the long history of research on leading indicators provides empirical evidence that LEIs can help in this task. This paper discusses our selection of leading indicators of the Chinese economy over 1986-2009. We evaluate our selection of leading indicators against the chronology of business and growth cycles.

 Corresponding author Ataman Ozyildirim: (212)339-0399, a.ozyildirim@conference-board.org. Economics Program of The Conference Board. 845 3rd Avenue, New York, NY 10022. An earlier version of this paper was presented at the CIRET Workshop on Sentiment Indicators and the Current Crisis in Budapest, November 2009. We are grateful for the comments of the workshop participants. The authors are indebted to Bart van Ark, Ken Dewoskin, Gail Fosler, David Hoffman, and Harry Wu for helpful comments and discussions. We would also like to thank Feng Guo and Hongyan Zhao who have provided valuable assistance in the early stages of the research. We benefited from the late Victor Zarnowitz' insights and discussions on an earlier version. Any remaining errors are the responsibility of the authors.

1. Introduction

Internationally comparable statistics for China will become more and more valuable as the country's role in the global economy continues to grow in importance and its economy develops and matures, becoming more like a genuine market economy. Given the importance of China to global output and growth, it is crucial to have a set of indicators that can help monitor and predict the short term or business cycle developments in the Chinese economy. Previous attempts at building business cycle indicators, such as those from NBS, SIC, and OECD, have concentrated on fluctuations in the growth of the economy (i.e. growth rate cycles or growth cycles, see Pan, 2009, Nilsson, 2006, Shi, 2005, and Zhang, 2005).[2] To the best of our knowledge there are no composite indexes that explicitly focus on signalling turning points in the business cycle (sometimes called the classical business cycle) as is done in The Conference Board indicators approach, for example.[3] A recent paper by Guo et al. (2009) has initiated research on the business cycle in China focusing on defining a suitable measure of coincident activity, and creating a chronology of business and growth cycles in China since 1986, before which limited data is available. This work served as a point of departure for the research described herein. But our findings and selections of indicators remain conditional. Given the challenges described below, the decisions made regarding the composite indexes may be reviewed and changed as data quality and availability improve and evolving nature of China's economy demands.

General economic activity ("how the economy is doing") can be viewed as a multivariate concept and measured as a composite index of selected coincident indicators.[4] Coincident indicators are comprehensive measures of employment and production, total income and sales in

[2] Other research on business cycles in China analyzes fluctuations in annual GDP growth rates (Liu et al. 2005).
[3] Since assuming the release of the US leading economic indicator from the Department of Commerce's Bureau of Economic Analysis in 1996, The Conference Board's Business Cycle Indicators program has developed leading and coincident economic indicators for nine additional economies: the United Kingdom, Germany, France, Spain, the Euro Area, Japan, Australia, Korea, and Mexico. According to The Conference Board, this long-term research program is building a portfolio of internationally comparable, methodologically consistent indicators to monitor the leading sectors of the economy and assist global forecasting and international comparison. For most of these economies, The Conference Board has constructed composite indexes of leading and coincident indicators (LEI and CEI) starting at 1970 or earlier, creating relatively long chronologies of each economy's business cycles and cyclical trends.
[4] Zarnowitz (1992)

real (inflation adjusted) terms. For best results, a set of long high-frequency (preferably monthly) time series on the required, or at least closely related variables, is needed to form the base of a good system of indicators. In market economies, sequences of activity lead downturns in coincident indicators. Cyclical movements develop and take place over the course of several months. High frequency data which show month to month changes in the levels of economic activity are needed to see these movements unfolding. Low frequency data are often compiled with a different purpose in mind such as measuring the size and trend growth of an economy; cyclical movements are obscured by the aggregated nature and relatively sparser detail on short-term dynamics of these quarterly or annual series. Some advanced Western countries, notably the United States and United Kingdom among others, have long produced and used rich data of this high frequency kind, but many developing countries, including China, have less complete and dependable statistical information. However, Guo et al. (2009) show that it is possible to select components for, and construct, an adequate contemporary index of Chinese coincident indicators (CEI) to help measure changes in China's total economic activity. Based on this research, we argue, in this paper, that it is possible to develop a composite index of leading indicators for the Chinese economy.

Leading indicators represent variables whose cyclical movements tend to precede and predict those of the CEI and related coincident indicators. For example, average hours of work lead employment: firms tend to lengthen (shorten) hours of work before they take the more drastic steps of hiring new (firing old) workers. Claims for unemployment benefits lead total (rate of) unemployment. New orders received by manufacturers lead output and shipments. Housing permits lead residential construction. Corporate profits lead fixed capital investment and formation of business enterprises. Early positive (negative) business activity signals often come also from the rises (declines) in stock prices, sensitive commodity prices, real money and credit supplies, and related interest rates.[5]

While leading indicators are generally more abundant than coincident indicators, it is less straightforward to select the best of them on the basis of their cyclical characteristics (i.e. conformity and consistency relative to the cycle, timeliness, economic and statistical importance

[5] The literature on the theory, history, and forecasting of business cycles devotes much space and effort to discussions of these and other important relationships among the indicators of recessions and recoveries. See, among others, Zarnowitz (1992), esp. part III, and references therein.

etc.), to form a composite index. For the case of China, it turns out, informational problems and measurement issues affecting leading series are especially challenging, but not overwhelming.

Guo et al. (2009) has developed business and growth cycle chronologies based on a Coincident Economic Index (CEI) using the indicator approach. In this paper, taking Guo et. al. (2009) as our point of departure, we first review their chronologies of business and growth cycles for China and propose a slightly modified alternative version of the CEI with a modified growth cycle chronology. Then, we discuss our proposed set of leading indicators to be combined into a composite index of leading economic indicators (LEI) for the Chinese economy over 1986-2009.

The primary question we seek to answer with the LEI is: how well it is likely to predict future economic activity and its major fluctuations for China as the Chinese economy becomes increasingly influenced by market-based economic activity. The usual indicator approach focuses on classical business cycles of alternating expansions and contractions in levels of economic activity. The approach relies on a business cycle chronology based on coincident indicators and indexes to evaluate the cyclical characteristics (such as conformity to cycle, consistency of lead times, smoothness, etc.) of leading indicators. However, when business cycle contractions (or turning points) are rare, usually as a result of high growth trends, the approach can be modified to look at growth cycles which are defined as cycles in deviations from a long term trend for evidence. Growth cycle analysis based on analysing cycles in deviations from trend in the cyclical variables is a natural extension of the business cycle approach. This modified approach was first used by Mintz (1969) and later by Klein and Moore (1985) to look at growth (or deviation) cycles in the post-World War II European economies which also exhibited strong growth trends and few business cycle recessions.[6] In our review of the empirical performance of the individual indicators we also consider evidence based on the chronology of growth cycles.

Unique challenges complicate the development of composite leading and coincident indicators for China. Foremost among these is limited historical data: monthly economic data for China are largely unavailable prior to 1986, and many important indicators have histories of only

[6] The work of Klein and Moore (1985) showed that the typical classification of measures of different types of economic activity into leading, coincident, and lagging with respect to business cycles also applied to growth cycles.

ten years or less. The very small size of our data set inevitably limits the effectiveness of traditional empirical techniques of business cycle analysis.

More importantly, the structure of the Chinese economy underwent tremendous changes and reforms during the period in question, with factors of production increasingly distributed by market forces rather than economic planning, and increasing proportions of firms, employment, and value added deriving from the private sector.

Idiosyncratic patterns of data reporting also affect data interpretation. For example, only the nominal year-over-year growth rate of value added of industrial production is reported, not the monthly quantity of value added. Base years for this series must be estimated – a feasible, but less desirable alternative to using original data.

Finally, China's statistical reporting system has undergone and continues to undergo major changes. Statistical series that originally covered only state-owned businesses have been modified or expanded to better measure private sector activity, or to measure it more accurately. While data released after these definitional revisions are arguably more comprehensive measures of the overall economy, the structural breaks they introduce to historical data complicate the identification and interpretation of trends (i.e. revisions of data coverage can coincide with and obscure periods of economic volatility).

This paper describes our application of the indicator approach to business cycle measurement and analysis for China, and explains how the challenges of Chinese data sources can be addressed to create a leading economic index for China. Section 2 describes the business cycle chronology and growth cycle chronology of China since 1986. Section 3 introduces potential leading indicators for China and describes their historical performance. Section 4 describes the selection and aggregation of leading indicators into a composite index, and measures the index's performance. Section 5 concludes and identifies future directions for research.

2. China's Economic Growth and Fluctuations Since 1986

While providing the broadest measure of output for an economy, annual or even quarterly GDP data (that are often subject to large revisions) are not particularly suited for cyclical analysis since business cycles occur on a monthly frequency. Moreover, the inadequacy of China's GDP data[7] makes it particularly important to complement them with series of monthly coincident indicators and the composite index based on these series. These indicators provide the main tool for determining the business cycle chronology and tracking the monthly fluctuations in China's macroeconomic activity. Guo et al. (2009) evaluated potential components of a coincident index for China and described the properties of that index. The Coincident Economic Index (CEI) Guo et al. (2009) developed, after comparing several alternatives, has five components: gross value of industrial output, retail sales of consumer goods, manufacturing employment, cash income of financial institutions, and volume of passenger traffic. In our research to create a leading index for China, we review Guo et. al. (2009) and make several incremental changes to the coincident index they proposed, as described below.

As discussed in Guo et al. (2009), the data on coincident indicators available for China provide valuable information as raw material for business cycle dating and analysis, but they have serious deficiencies and first require substantial selection and transformation. For business cycle analysis, indicator data have to be seasonally adjusted (in the case of China, with special attention paid to the Chinese New Year holiday) and deflated with appropriate prices indexes.[8] Moreover, some data published as year-over-year growth rates have to be converted to fixed base indexes. It is easy to find fault with these simple procedures designed to convert Chinese data to a form suitable for business cycle analysis, but they are the best option available given the lack of data to develop viable alternatives.

[7] See Wu (2000, 2002, and 2007), Holz (2006), and Maddison (2006) for reviews and discussions some of the sources of uncertainty surrounding the measurement of GDP in China.

[8] Guo et al. (2009) had no suitable quarterly series on the level of real gross domestic product (GDP) in seasonally adjusted form. They derive the required estimates by (1) converting nominal GDP from quarterly to monthly by linear interpolation between center months of successive quarters; (2) converting nominal into real monthly GDP by deflating the former with the monthly consumer price index (CPI); and (3) applying the Census X-12 seasonal adjustment program with a special adjustment for the Chinese New Year to the resulting monthly real GDP series for China. This is the series referred to as "real GDP" in the subsequent discussion.

For evaluating leading indicator performance in this paper, we use a slightly modified version of the CEI developed by Guo et al. (2009). Our version of the CEI (the "modified CEI") includes gross value of industrial production as a component from January 1986 – December 1989, and substitutes the value added of industrial production for the gross value of industrial production series subsequently. The modified CEI also uses electricity production and omits the cash income of financial institutions component. As in Guo et. al. (2009) we use the index methodology followed by The Conference Board.[9]

Value added of industrial production improves on gross value of industrial production in that it is unaffected by changes in prices of raw material inputs. Since data for this series is not available prior to 1990, we use gross industrial production in its place to extend the chronology of the China CEI as early as possible.

Cash income of financial institutions was included in the CEI proposed by Guo et. al. (2009) for lack of a more adequate income series with broader coverage. However, as a coincident indicator, electricity production is superior to cash income of financial institutions in that the former reflects economic activity in a broader segment of the overall economy, since power-intensive manufacturing contributes to Chinese value added far more than the financial sector.

As shown in Charts 1 and 2 below, these modifications merely affect the business cycle chronology based on the CEI described above. However, the modified CEI shows slower growth before the cyclical peak in August 1988, and slightly faster growth following the December 1989 trough. Also, the modified CEI grows more slowly in 1992. After 2000, the short term fluctuations of the two indices are much closer.

[9] For details of the methodology see Business Cycle Indicator Handbook (2001). The monthly change in the index is calculated using the sum of the monthly changes in its components. Before aggregation, the components' monthly changes are adjusted by multiplying them with a standardization factor that adjusts them for their relative volatility. The adjustment equalizes the volatility of the contributions from each component. The standardization factors are based on the inverse of the standard deviation of the monthly changes in the series and these component standardization factors are made to sum to one. This summing to one of the standardization factors is done to assure that the cyclical part of the composite index is limited to a magnitude similar to the average deviation from the mean growth rate of the components of the index. This sum of the contributions is then cumulated and the resulting coincident index is rebased to equal 100 in 2000 (i.e. 2004=100).

Chart 1: CEI of Guo et al. (2009) and Modified CEI Compared

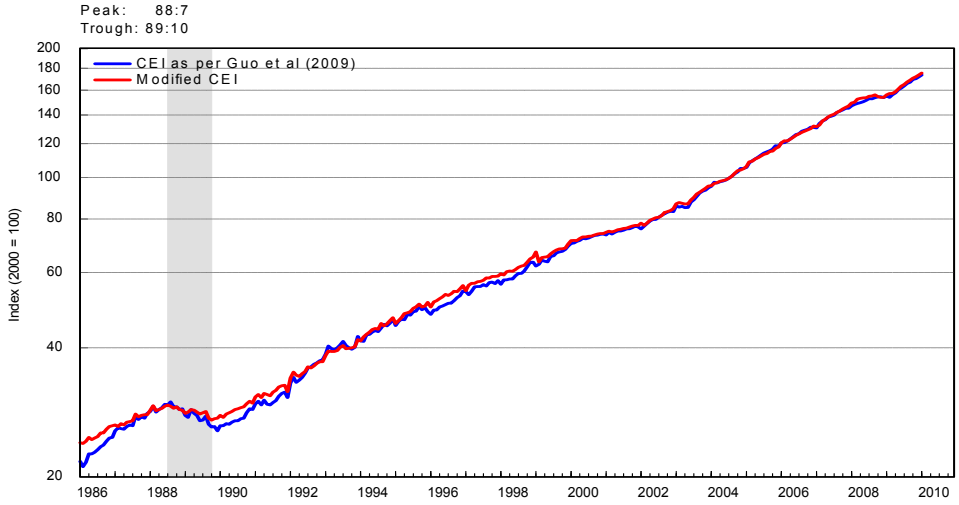
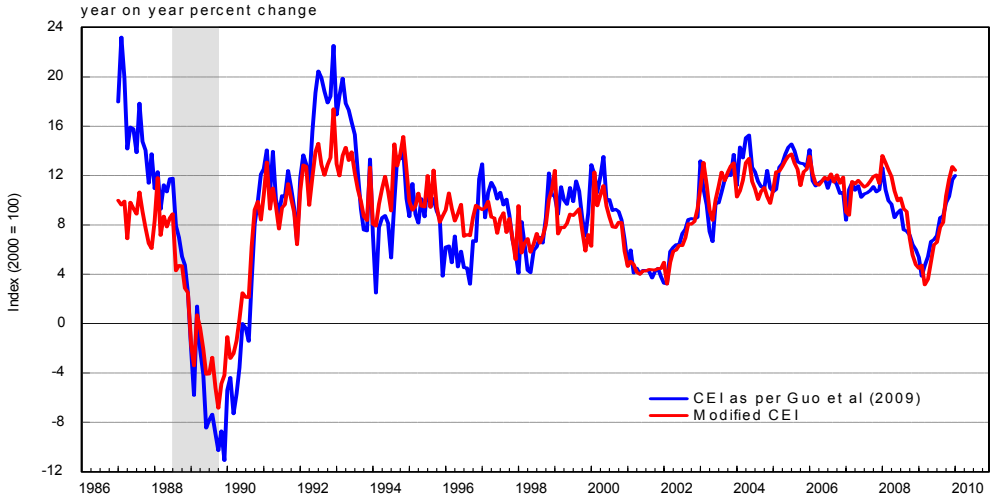


Chart 2: Year on Year Percent Changes of CEI as per Guo et al. (2009) and Modified CEI Compared

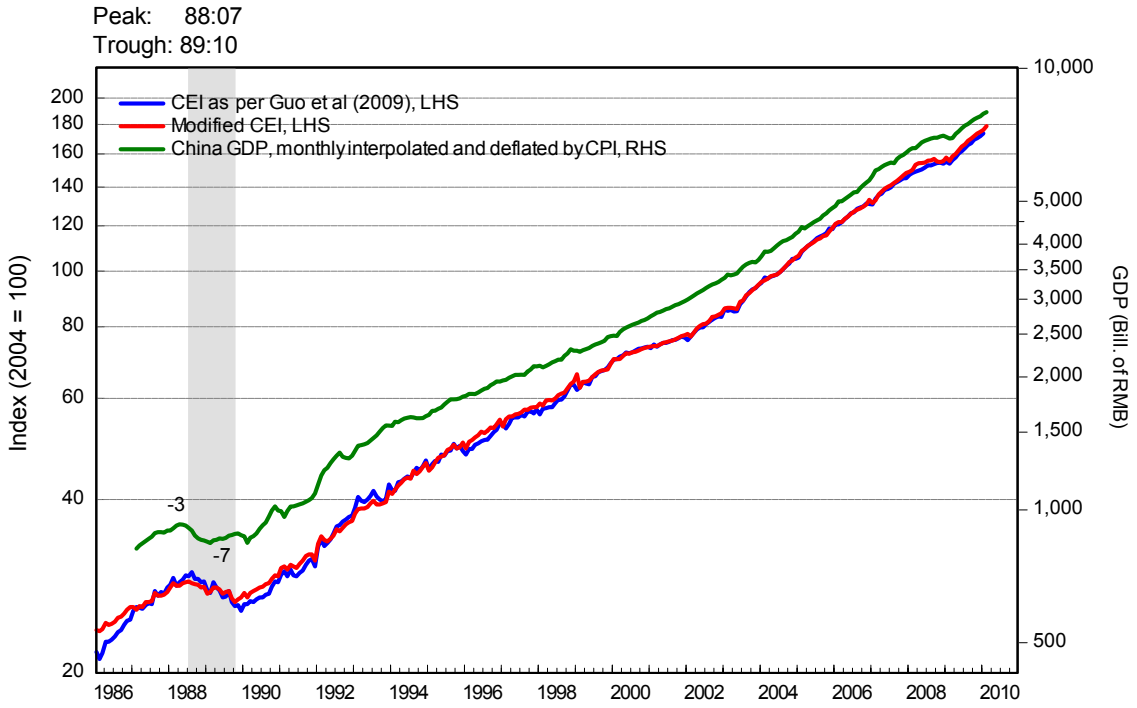


Note: Above shaded areas represent China's economic recession using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm.[10]

[10] The Bry-Boschan algorithm is a tool to identify cyclical peaks and troughs of data series, uniformly adjusting for outliers and other data issues that frequently affect economic data. It applies the NBER definition of business cycle fluctuations to time series to determine business cycle peaks and troughs. Using the Bry-Boschan algorithm to

Chart 3 below shows the China CEI and real GDP, 1986 – 2009. As dated according to CEI, in this 23-year period China's economy experienced one "business cycle contraction," which lasted from July 1988 to October 1989[11] (see the shaded area in the chart). Inflation-adjusted GDP declined in April 1988 – March 1989, a slightly earlier and shorter period. The two comprehensive measures of China's economic activity display a remarkable agreement in both their cyclicality and growth. Both CEI and real GDP had cyclical declines in 1988 -1989, and only in that period. Both show continuous and rapid (about tenfold) growth in 1990 -2008, and a very brief one-quarter slowing in growth in early 2009.

Chart 3 CEI and real GDP, 1986 – 2009



Note: Above shaded areas represent China's economic recession using CEI, and the turning points are determined by the Bry-Boschan algorithm.

identify turning points in economic data provides an objective, reproducible measure of turning point incidence and removes the subjective judgment of the individual analyst from the process of turning point identification.

[11] This contraction was largely due to political turmoil, not "purely economic" causes; however, it fits the definition of a business cycle contraction in that it is an extended period of economic contraction broadly effecting the economy, and visible in many different measures of economic activity.

Given the broadly independent derivation of these two series, we see their evident consensus as reassuring. Our previous caveats about the lapses from reliability in these measures of the evolution of China's aggregate economic activity still hold. Nevertheless, it would be difficult to argue against the general picture conveyed by CEI and GDP, namely the single recession in the late 1980s and strong growth since. The evidence of this contraction is also supported by Keidel (2001), and the modified CEI proposed in this paper.

Growth Cycles: Defined and Measured

According to the NBER definition of recessions and recoveries based on the seminal work of Burns and Mitchell (1946), business cycles are observed in seasonally adjusted level data rather than detrended data. In the traditional NBER approach, each monthly or quarterly time series can be viewed as being composed of three components: the seasonal (S), the irregular (I), and the trend-cycle (TC). Classical business cycle fluctuations in a time series are measured by looking at the trend-cycle component after removing the seasonality of the series. The trend-cycle component (after seasonal adjustment) can be further broken down into separate trend and cycle sub-component (i.e. detrending the series). However, trend estimation also creates the danger that excessive or inappropriate smoothing may lead to distortions in the identified fluctuations or even result in spurious fluctuations (Macaulay 1931; Burns and Mitchell 1946, ch. 8). Business cycles can be studied extensively without detrending, but the trend-cycle decomposition can be useful and helpful for analysis if done with special care and attention (Zarnowitz and Ozyildirim, 2006).

Coincident indicators and indexes normally exhibit long smooth trends while leading indicators tend to be much more volatile. This is because economic processes measured by leading indicators respond to and reflect fluctuations in economic growth rates with greater sensitivity. Hence, composite indexes of leading economic indicators can usually give signals of accelerations and decelerations in growth even when the subsequent growth rates of overall economic activity don't fall below zero. In other words, they sometimes signal a downturn, but a recession doesn't materialize. These so-called "false signals" are usually associated with growth

slowdowns.[12] Growth slowdowns are best measured as deviations from a long term trend for growth cycle analysis (for a discussion of trends and growth cycles see Zarnowitz and Ozyildirim, 2006). Given China's long term growth trajectory throughout the 1990s and 2000s and the scarcity of business cycle turning points, we complement our analysis of its leading indicators with growth cycle analysis. Growth cycle analysis can help in particular to evaluate indicators that don't have reliable long histories that cover business cycle turning points.

Guo et al. (2009) has also developed a chronology for the fluctuations in deviations from trend of the coincident index for China. But, since we have argued for a modified coincident index for China above, we derive a modified growth cycle chronology following the same procedures used by Guo et al. (2009). In our subsequent evaluation of the leading indicators we rely on this modified growth cycle chronology presented in Table 2 below.

Although the modifications we propose to the CEI only affect the business cycle chronology slightly, they do result in some differences in the growth cycle chronology based on the CEI. The growth cycle chronology is determined by applying the Bry-Boschan turning point algorithm to the estimates of detrended series derived from the alternate versions of the CEI.[13] These differences are documented in Table 1:

[12] Dramatic fluctuations in growth rates have been commonly seen in economies that have high growth trends sustained over long periods such as China now, Japan and Korea in the 1970s and 1980s, and Germany in the decades immediately following World War II.

[13] Series detrended by passing through a Hodrick-Prescott (1997) filter, a technique for estimating a macroeconomic time series as a combination of a short term cyclical component and long term trend component. We have applied the modification proposed by Ravn and Uhlig (2001) when estimating the Hodrick-Prescott trend. For a detailed description of the turning point algorithm see Bry and Boschan (1971).

Table 1: Comparison of Growth Cycle Chronologies for China: Guo et al. (2009) and Modified CEI

CEI, Guo et al. (2009)		Duration of Growth Slowdown	Modified CEI		Duration of Growth Slowdown (month)
Peaks	**Troughs**		Peaks*	Troughs*	
1988/08	**1989/12**	16	1988/02 (-6)	1990/02 (+2)	24
1993/02	**1993/10**	8	1993/02 (0)	1993/11 (+1)	9
1997/04	**1998/01**	9	1995/09 (-19)	1998/02 (+1)	29
2000/05	**2002/01**	20	2000/01 (-4)	2002/02 (+1)	25
n.a.	**n.a.**	n.a.	2003/12	2004/07	7
2008/02	**2009/01**	11	2008/03 (+1)	2008/12 (-1)	9

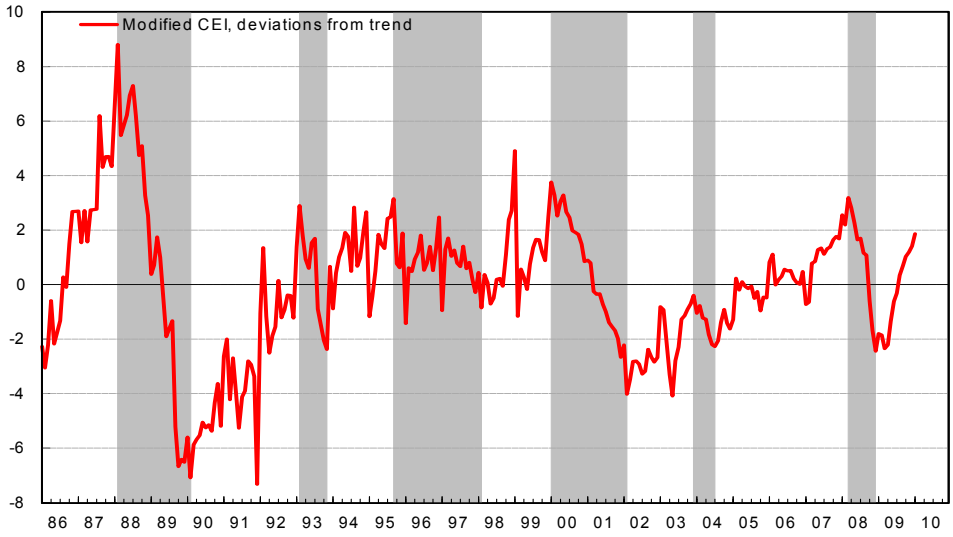
*The (-/+) numbers in parentheses denote leads(-)/lags(+) relative to CEI growth cycles in the first two columns.

While the growth cycle chronology (i.e., turning point chronology of the deviations from trend) of the CEI is somewhat sensitive to changes in the set of components used in the composite index, the business cycle chronology is not affected by these relatively minor adjustments in selection. Guo et al. (2009) find the Chinese economy went through 5 growth cycles in starting in 1988/8, 1993/2, 1997/4, 2000/5, and 2008/2. The growth cycle chronology implied by the modified CEI overlaps with the same 5 growth cycles; however, in the modified chronology the growth cycles tend to start earlier and end later. The growth cycle contractions we identify began on average 5 months earlier and lasted somewhat longer. We also find there was an additional growth cycle contraction which began in 2003/12 and lasted 7 months until 2004/07. The differences in the growth cycle peaks and troughs are to be expected because the two versions of the CEI have slightly different long terms trends, especially after 2001 where the modified CEI has a slightly lower trend growth rate. Unless expressly stated in the remainder of this paper, references to CEI will be to our modified CEI, rather than the Guo et al. (2009) composition.

Chart 4 shows the deviations from trend in the modified CEI and the growth cycle expansions and contractions based on this series. The shaded areas represent the growth cycle

contractions (peak to trough) listed in Table 1 columns 3 and 4. In the following sections, we will review the selection of the leading indicators for China and evaluate them against the coincident index as the main measure of the business cycle.[14]

Chart 4: Deviations from Trend of the Modified CEI and Growth Cycles Based on the Series



Note: Above shaded areas represent China's growth cycles of CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

3. Evaluating the Leading Indicators for the Chinese Economy

This section describes selected leading indicators that can be viewed as candidates for a composite leading index. It describes their historical performance and discusses some of the theory behind why they are expected to perform as leading indicators. It also discusses some of the data quality problems. One of the advantages of the composite index approach is that measurement errors and biases in different indicators can offset each other (they are unlikely to be highly correlated with each other) resulting in a more reliable index, but an evaluation of the potential biases that may result from data problems is left for future research.

[14] Recall that the chronology of business cycle and growth cycle turning points serve as the benchmark to compare the turning points of the leading indicators when evaluating their cyclical characteristics.

Table 2 lists the results of our intensive search for acceptable leading indicators. The available data have serious limitations. Only a few of the items approximate the well-known leading variables long used in United States and Europe – notably the M2 money supply adjusted for inflation and the stock price index. Most represent types of investment and related data for fixed assets, real estate, and construction starts; these will at least sound familiar and not be entirely surprising. But, data on investment commitments (new orders, contracts) are missing; the series on total floor space and residential floor space under construction, which may be analogous to building starts or permits, may not be reliably leading. Also lacking are labor market indicators such as the average workweek and unemployment insurance claims. So our choices are inevitably limited and tentative. As the structure of the Chinese economy changes and new and better statistics become available, the selection of the leading indicators will likely change to benefit from these new developments.

Five of the twenty two series require adjustment to rising price levels, and are deflated using producer prices. Six series go back to 1986; the others start only in the 1990s, hence are as yet regrettably short and cover no recession.

Table 2

Short List of Leading Indicators for China

No.	Indicators[15]	Deflated by[16]	Beginning Year
	(1)	(2)	(3)
1	Total Loans Issued by Financial Institutions	PPI	1986
2	Money Supply	PPI	1986
3	Stock Price Index Shanghai Stock Exchange	n.a.	1991
4	Hang Seng China Enterprise – Share Price	n.a.	1993
5	5000 Industry Enterprises Diffusion Index	n.a.	1992

[15] See charts of the individual indicators in Appendix A, Charts 2-14.
[16] CPI denotes consumer price index; PPI denotes producer price index; n.a. not applicable (not deflated).

6	5000 Industry Enterprises Diffusion Index: Profitability Index	n.a.	1992
7	5000 Industry Enterprises Diffusion Index: Raw Materials Supply Index	n.a.	1992
8	5000 Industry Enterprises Diffusion Index: Domestic Orders Index	n.a.	1992
9	NBS Manufacturing PMI	n.a.	2005
10	NBS Manufacturing PMI Sub-Indices: PMI Orders	n.a.	2005
11	NBS Manufacturing PMI Sub-Indices: PMI Supplier Deliveries	n.a.	2005
12	NBS Manufacturing PMI Sub-Indices: PMI Imports Sub-Index	n.a.	2005
13	Consumer Expectations Index	n.a.	1991
14	Freight Carried: freight-ton-kilometers	n.a.	1986
15	NBS Manufacturing PMI Sub-Indices: PMI Export Orders	n.a.	2005
16	Exports in billion of US$	PPI	1986
17	Total Floor Space Started	n.a.	1996
18	Residential Floor Space Under Construction	n.a.	1996
19	Real Estate Investment	PPI	1996
20	Freight Carried: freight-tons	n.a.	1998
21	Fixed Assets Investment	PPI	1986
22	Cargo Handled at Principle Seaports	n.a.	1986

The twenty two individual leading indicators listed in Table 2 are depicted in the same order in the charts in the appendix, each separately, in monthly, seasonally adjusted form, to

appropriate logarithmic vertical scales. The specific-cycle peaks and troughs (i.e. business cycle turning points) in these series are identified using the Bry-Boschan computer algorithm.

Potential LEI components:

Three of the series with the longest available history in Table 1, total loans issued by financial institutions, money supply M2, and exports in US$ (Appendix Chart 2, 3, and 4) show leads at the recession peak of July 1988 and trough of October 1989. As such, they provide a starting point in the evaluation of composite indexes comprised of subsets of the twenty two indicators listed in Table 1. As discussed above, the recession is identified and determined according to the composite index of coincident indicators for China we propose in this paper based on previous research done (Guo et. al, 2009). The recession is denoted by a shaded area in each chart. The leads are listed in months, marked with a minus (-) sign.

Three other indicators in Table 1, cargo at principal seaports, fixed assets investment, and freight carried in ton-kilometers (see discussion below and Appendix Charts 5, 6, and 7) cover the period during which the recession occurred, but the first two have no clear leads and the last has no turning points during that period at all. Other series discussed below– stock price indexes, floor space started, and real estate investment (Appendix Charts 8, 12, and 13) start in the 1990s, and hence miss the recession.

In the remainder of the paper we will focus on the growth cycle chronology based on the modified CEI. As with the business cycle chronology, in our charts, the growth cycle contractions (or growth cycle recessions) are denoted by shaded areas. The leads are listed in months, marked with a minus (-) sign. Charts which graph the indicators in levels use the business cycle chronology and charts which show the deviations from trend of the indicators use growth cycle chronology. The only exception to this are the charts of some diffusion indexes which already relate the indicator to changes in growth of economic activity (a growth cycle concept) rather than the level of economic activity (the business cycle concept).

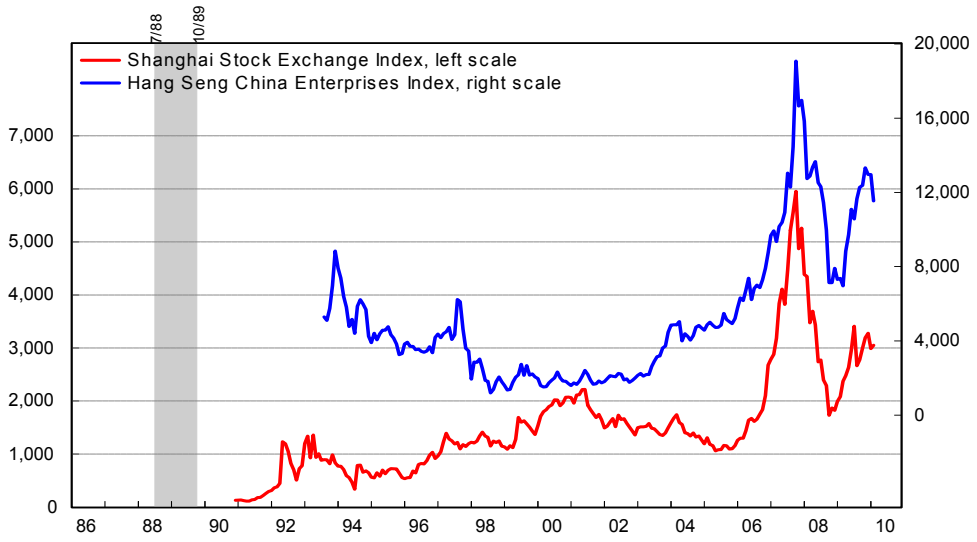
Monetary and Financial Indicators:

Stock Price Indexes

Chart 5 compares China's two stock price indexes, the Shanghai Stock Exchange available since 1991 and the Hang Seng China Enterprises Index available since 1993. The former had a mild rising trend through 2000 and a mild declining trend in 2001 – 2005, while the latter had similarly gradual trends in opposite directions. Both indexes display sharp up-and-down spikes in 2006 – 2008.

The Shanghai Stock Exchange Index is the primary stock exchange in mainland China in terms of number of listed companies, number of shares listed, total market value, tradable market value, securities turnover in value, stock turnover in value and the T-bond turnover in value. The index starts in December 1990 and covers both A shares (traded and denominated in RMB) and B shares (in US$). The Hang Seng China Enterprises Index ("H-Share Index") was launched in August 1994 as a benchmark for the stock price performance of the China incorporated companies listed in Hong Kong. Shares of these companies are called H shares. The Shanghai Stock Exchange Index covers mainly large State Owned Enterprises (SOEs). Although its coverage may be broader than that of the H-Share Index, often the listings on this stock market are of the best part of a company, which is separated from the parent for the listing. The funds raised in this way are used to subsidize the parent company. The large proportion of state-owned non-tradable shares in the total market capitalization, which make the tradable part sensitive to rumors about market-moving activities by state-owned investors, has been responsible for the high volatility of the market. The Shanghai Stock Exchange Index's coverage of private firms is also very limited.

Chart 5 Shanghai Stock Exchange Index vs. Hang Seng China Enterprises Index



Note: Above shaded areas represent China's economic recession using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm.

Stock price indexes usually measure and summarize expectations of investors, and thus, provide a measure of the direction of investors' expectations on earnings, profits, and economic conditions. Moreover, this class of indicator has proved empirically useful as a component of the leading indexes in U.S. and other countries. However, in the case of China, the development of equity markets in terms of capital flows, market liquidity, trading volume, and efficient processing of market information is not as sophisticated as in more advanced economies. Moreover, the empirical relationship between China's stock indexes and cyclical economic movements is erratic. The two series show opposite trends in 1994-2000 and 2001-2005 periods, pointing to a lack of consistency in the stock market performance relative to each other and the Chinese economy. The deviations from trend graphed in Chart 5 show that these series do not conform well to the growth cycle expansions and contractions. The growth cycle turning points of the two series show a high degree of variability and inconsistent leads (also see Table 3, cols. 4 and 5). We have not been able to identify a stock market price index that is more directly affected by China's economic growth and outlook rather than being reactive to government

policies or to the influences of global developments and sentiment. These factors and the recent behavior of the equity markets in China argue against including a stock price index as a component of the LEI for China.

Total Loans Issued by Financial Institutions:

Total loans series is a sum of short, medium, and long-term loans, loans to the industrial sector, to the commercial sector, to the construction sector, to the agricultural sector, and all other loans. The series is monthly and is deflated by PPI. It starts in 1986, and shows a 7-month lead on the peak and a 5-month lead on the trough of the recession (July 1988 – October 1989). It has a month on month jump of more than 20 percent in January 1994, which may be due to a monetary policy change (after Deng Xiaoping's 1992 Southern Tour speech encouraging investments, policies on loans started loosening in 1994) or may be due to redefinition of the series. Otherwise it is a fairly smooth series which shows promising leads. The deviations from trend of this series are graphed in Chart 6 against the growth cycle chronology. Although its leads with respect to growth cycle turning points appear to vary considerably, its mean and median leads at peaks is 8 and 5 months, respectively (Table 3, col. 3), quite desirable for a leading indicator. For troughs, the mean and median leads are 6 and 7 months, respectively. This series missed the peak of the most recent growth cycle from March to December 2008 (see Chart 6).

Economic commentary on Chinese monetary policy often focuses on monthly new increased loans as a measure of changes in credit conditions. The changes in new increased loans and the changes in total loans tend to follow similar trends over time; one possible advantage of new increased loans is that its behavior is not affected by write-offs of non-performing loans, which causes a decrease in total loans. However, the new increased loan series has a much shorter history and higher volatility, in addition to its many gaps in coverage,[17] making it less suitable for business cycle analysis.

[17] Data released by PBoC show unexplained gaps in June 2003, February, March, and June 2004, and March 2005.

Money Supply M2:

Money supply M2 includes M1 + quasi-money (time deposits + savings deposits + other deposits). There are three indicators of the money stock in China, and M2 is the broadest aggregation. From June 2001, the coverage of monetary aggregate M2 has been expanded to include margin accounts maintained with securities companies (also part of other deposits). The series starts in 1986, and experienced a large decline in 1987, perhaps due to high inflation in the mid-1980s. Real money supply M2 is a monthly series and is deflated by PPI. Real M2 shows inconsistent leads at growth cycle peaks and troughs (Table 3, col. 2). The mean and median leads at peaks are both about 8 to 9 months, but the series misses the peaks at both February 1993 and September 1995 (see Chart 6). It also lags the November 1993 trough by 14 months and the July 2004 trough by 9 months. Missed turning points and the inconsistency of leads argue against using this series as a leading indicator.

The total loans and money supply M2 series present interpretive challenges. Firstly, money supply and total loans somewhat overlap, in that increased loans will tend to increase the money supply and vice versa. The overlap between money supply and loans may be a serious problem if overall indicator selection results in an unbalanced representation of different sectors of the economy.

Secondly, the standard reasoning for using loans as a leading indicator may not apply in China. In market economies, loan growth can be a signal that borrowers and lenders perceive improving conditions for investment and general business activities. In China, changes in the loan stock are largely driven by regulatory guidance, not market conditions; therefore, total loans may not be a good leading indicator of overall economic conditions.

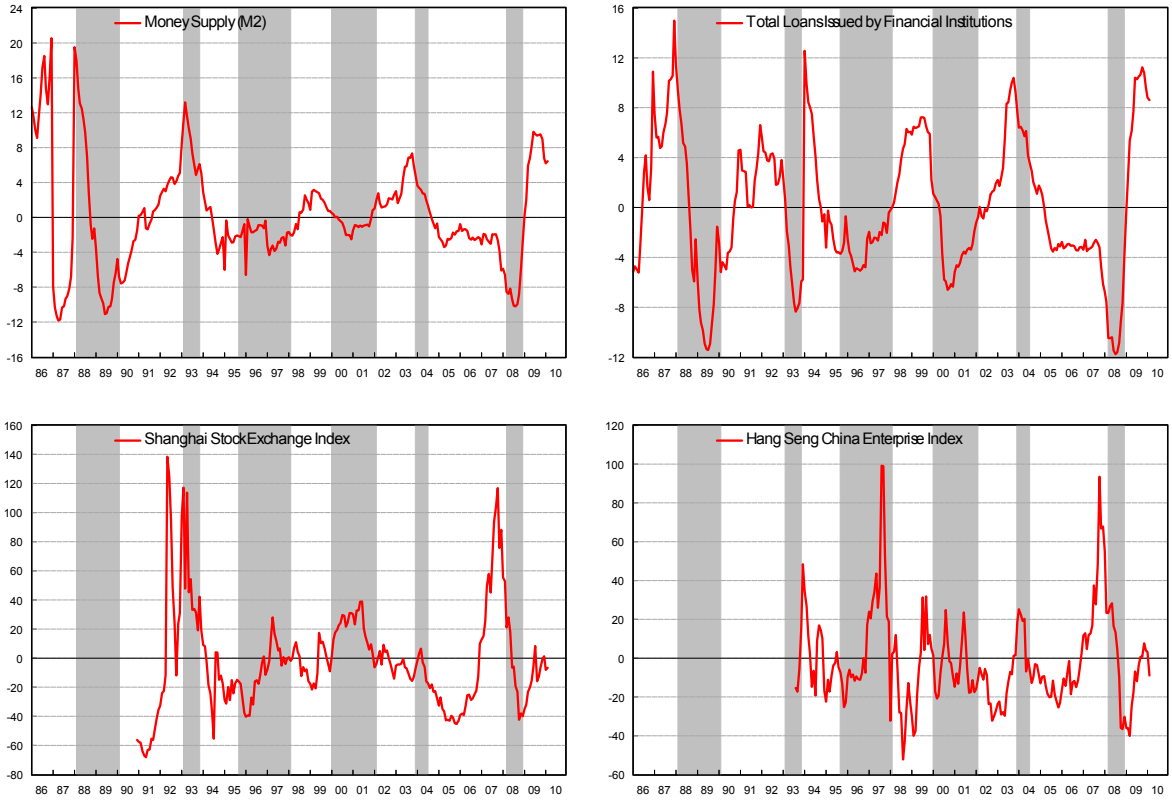
However, in addition to possibly reflecting perceptions of business conditions, the loans component captures expansion and availability of credit in the economy through the banking system, a cause of increased economic activity as well as a signal of it. Hence, total loans could still be a useful leading indicator, especially as government regulations are eventually replaced by banks' risk management in determining loan growth.

Table 3 Leads and Lags of Selected Monetary and Financial Indicators (de-trended) at Growth Cycle Peaks and Troughs

Turning Points for China Growth Cycles	Money Supply	Total Loans Issued by Financial Institutions	Shanghai Stock Exchange Index	Hang Seng China Enterprise – Share Price
Timing at Growth Cycle Peaks				
Feb-88	-14	-2	n.a.	n.a.
Feb-93	missed	-14	0	n.a.
Sep-95	missed	-20	19	23
Jan-00	-10	-5	18	-7
Dec-03	-2	-2	3	1
Mar-08	-7	missed	-5	-5
Extra Turns	2	0	0	1
Missed Turns	2	1	0	0
Mean	-8.25	-8.60	7.00	3.00
Median	-8.50	-5.00	3.00	-2.00
St. Deviation	5.06	8.05	10.89	13.76
Timing at Growth Cycle Troughs				
Feb-90	-8	-7	n.a.	n.a.
Nov-93	14	-8	8	n.a.
Feb-98	-24	-13	12	6
Feb-02	-14	-17	missed	8
Jul-04	9	13	16	16
Dec-08	-4	-5	-2	3
Extra Turns	0	0	0	1
Missed Turns	0	0	1	1
Mean	-4.50	-6.17	8.50	8.25
Median	-6.00	-7.50	10.00	7.00
St. Deviation	14.20	10.36	7.72	5.56
Combined Statistics				
Mean	-6.00	-7.27	7.67	5.63
Median	-7.50	-7.00	8.00	4.50
St. Deviation	11.15	9.01	9.07	10.11

Note: a. not all indicators are available from 1986. "n.a." refers to samples that are not available; b. "-" refers to leads.

Chart 6 Selected Monetary and Financial Indicators (de-trended)



Note: Above shaded areas represent China's growth cycles using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

Tendency Surveys of Business and Consumer Confidence

Tendency surveys are used to provide quantitative measures of qualitative phenomena: for example, consumers' propensity or expectations to spend (or save) more, business managers' propensity to increase (or curtail) investment and hiring, etc. They aggregate consumers' and business managers' assessments of current and future economic conditions, providing more timely information on business dynamics than may be available in statistics of real activity (which are often available after a longer lag). Historical series for these indicators are short in China, but their demonstrated usefulness in forecasting for other economies encourages us to use them in the China composite leading index. However, the caveat that our choices are tentative and subject to revision with the accumulation of future empirical evidence applies especially strongly here because of the lack of history.

Business Sentiment Indicators

People's Bank of China 5000 Enterprise Survey Diffusion Indices:

The People's Bank of China (PBoC) conducts a quarterly survey of senior managers of 5000 companies, gathering their qualitative assessments of actual business conditions in the current quarter and their expectations of the following quarter. Survey questions cover six categories: general enterprise operating conditions, supply conditions of production inputs, market demand conditions, funding conditions, cost structure/profitability, and investment conditions. Answers are aggregated into a diffusion index ("general business conditions," chart 7). All indices are reported on a scale of 0-100, with readings above 50 indicating expanding business conditions and reading below 50 indicating contracting conditions. The data for the indices begins in the second quarter of 1992. Hence, it is not possible to compare their performance against the existing business cycle chronology. Moreover, it's not very clear how representative the survey results are for the 30,000 medium and large firms and/or the 400,000 firms at or above designated size. To the extent that the surveys are not broadly representative, they could introduce some bias into the LEI, but the extent of the bias is difficult to measure.

Of the indicators produced by the PBoC 5000 survey, in addition to the overall general business conditions index, our analysis has focused on the sub-index for profitability, the sub-index for raw material supply conditions, and the sub-index for domestic orders. Diffusion indices have characteristics of leading indicators because they are closely related to changes in growth rates of the economy and because changes in growth rates tend to lead contractions and expansions in levels of economic activity. In other words, economic activity usually slows down before it starts to contract. The diffusion indexes reflect changing direction and intensity of production trends. These indices were evaluated primarily because of conceptual arguments for their timing relationship with growth cycles in China: since most investment in China is funded through retained earnings, improved profitability could lead to increased ability to invest in the near future, contributing to higher levels of investment and economic growth. Improved supply conditions, likewise, could facilitate higher production and increased levels of general economic activity. Orders are an obvious possible precursor to production. The composite index (i.e.

general conditions index), which is comprised of these and other sub-component categories, is included to cross-check if its information content could be superior to the sub-indices, perhaps because it is a more stable or less volatile measure of corporate sentiment.

The overall composite index and the sub-indexes show strong secular trends decreasing steadily from 1993 to 1998 and increasing subsequently to 2008 (see Appendix A, Chart 10). While it is possible that these strong secular trends may obscure shorter-term cyclical fluctuations, they also may capture information about long term changes in business conditions – the mid-1990's was a difficult period in China, especially for state-owned enterprises (SOEs), and SOE reforms in 1998 laid groundwork for a decade of expansion subsequently.

Prior to their evaluation for leading properties and estimation of the trends, all indicators were adjusted for seasonality with the Census X-12 seasonal adjustment procedure, which was modified to adjust for the irregular seasonality caused by the Chinese New Year holiday, an event scheduled by the lunar calendar. The profitability and domestic orders indices show clear seasonality, reduced by seasonal adjustment; the raw material supply sub-index appears to have some seasonality, but the case for using a seasonally adjusted data series is weaker than in other series; seasonal adjustment smoothes seasonal fluctuations in the 1992-1998 time period, but exacerbates them in the 1998-2009 period. This may be due to a special seasonal pattern in the investment decisions out of state budgets and has to be studied further.

Profitability Index: this indicator quantifies managers' assessment of whether profits will increase, continue at the same level, or decline. Like a majority of the PBOC 5000 survey components, profitability exhibits a large secular trend: declining from 1992-1998, increasing from 1998-2007, and declining from 2007-2009.

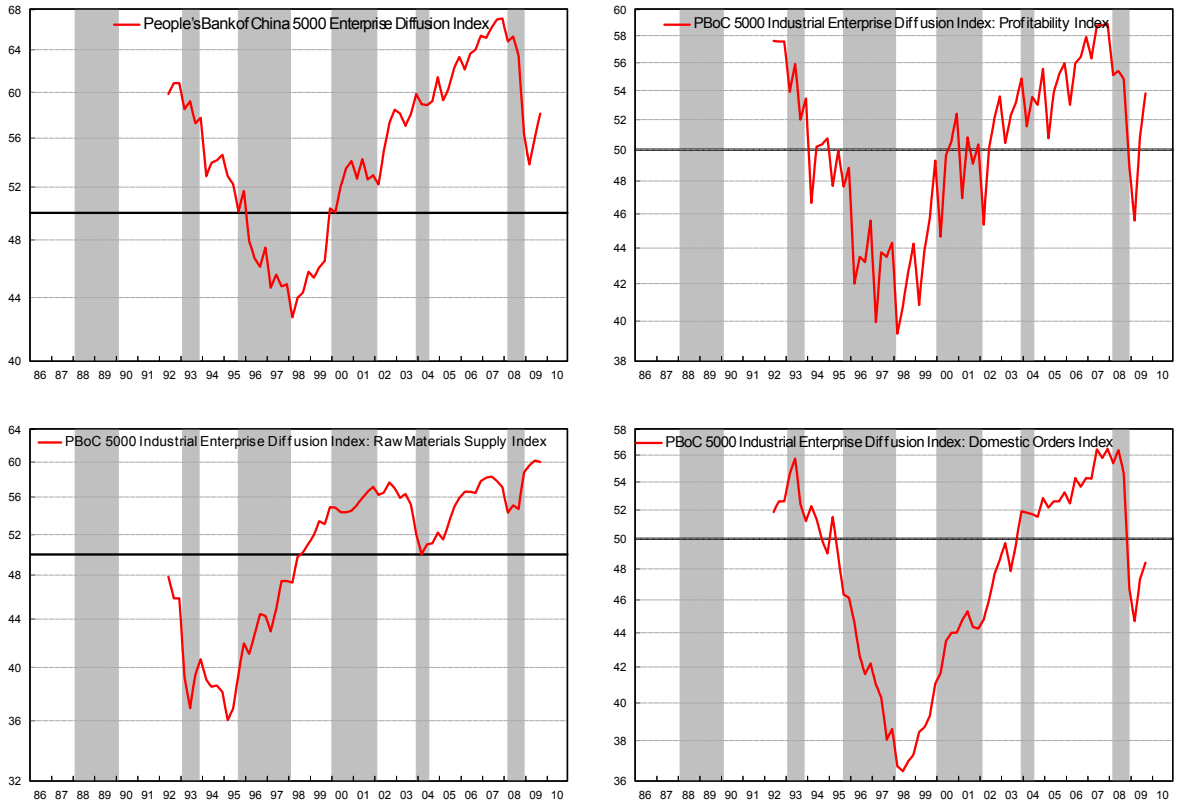
Raw Materials Supply Index: this indicator quantifies managers' assessments of whether raw material supplies will be "adequate, moderate, or inadequate," in the current and subsequent quarters. The possibility of capturing dynamics upstream in the manufacturing value chain offers an economic rationale for inclusion. Like the profitability diffusion index, the raw materials supply diffusion index exhibits a strong secular trend– a consistent increase from 1995 to 2002. In other periods covered in the index (1992-1994 and 2002-2009), more obviously cyclical patterns are apparent.

Domestic Orders Index: This indicator quantifies managers' assessments of whether domestic order levels are "plentiful, normal, or insufficient" in the current and subsequent quarters. Indicators of orders are natural candidates for leading indicators of future manufacturing activity because they quantify contractual obligations for future production activities.

The General Business Conditions Diffusion Index and the sub-indexes we've considered as potential LEI components neither conform closely to the growth cycle chronology nor do they appear to lead consistently. They exhibit many missed turning points (see Table 4 (1)). The General Business Conditions Diffusion Index also shows an extra cycle (Table 4 (1), col. 2).

The only exception may be the Raw Materials Supply Index, which is smoother and somewhat more closely aligned with the growth cycle contractions despite missing the trough of the growth cycle of September 1995 - February 1998. Comparing Raw Materials Supply Index against the CEI growth shows that it had its strongest correlation with the CEI (0.262) at (t-7) months in the 1986-1996 period. This is relatively strong performance compared to the other indicators evaluated in our search. Furthermore, the Raw Materials Supply Index describes the dynamics of raw materials sectors (e.g., cement, steel, etc.) that are very important to China's capital-intensive and infrastructure-intensive growth. While the evidence in support of this indicator is more ambiguous that the evidence for other likely LEI components, its potential to broaden the LEI's coverage of different aspects of the economy is a forceful argument in its favor.

Chart 7 Selected Business Sentiment Indicators



Note: Above shaded areas represent China's growth cycles using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

Table 4 (1) Leads and Lags of Selected Indicators of Business and Consumer Sentiment (de-trended) at Growth Cycle Peaks and Troughs

Turning Points for China Growth Cycles	5000 Industry Enterprises Diffusion Index	5000 Industrial Enterprise Diffusion Index: Profitability Index	5000 Industrial Enterprise Diffusion Index: Raw Materials Supply Index	5000 Industrial Enterprise Diffusion Index: Domestic Orders Index
Timing at Growth Cycle Peaks				
Feb-88	n.a.	n.a.	n.a.	n.a.
Feb-93	-2	missed	-10	4
Sep-95	-9	missed	-18	missed
Jan-00	8	17	-1	missed
Dec-03	missed	12	-15	missed
Mar-08	-3	-12	-9	-2
Extra Turns	1	1	0	0
Missed Turns	1	2	0	3
Mean	-1.50	5.67	-10.60	1.00
Median	-3.00	12.00	-10.00	1.00
St. Deviation	7.05	15.50	6.50	4.24
Timing at Growth Cycle Troughs				
Feb-90	n.a.	n.a.	n.a.	n.a.
Nov-93	4	-8	-5	missed
Feb-98	1	1	-35	4
Feb-02	1	1	missed	missed
Jul-04	missed	8	-4	missed
Dec-08	3	3	-8	3
Extra Turns	0	1	0	0
Missed Turns	1	0	1	3
Mean	2.25	1.00	-13.00	3.50
Median	2.00	1.00	-6.50	3.50
St. Deviation	1.50	5.79	14.76	0.71
Combined Statistics				
Mean	0.38	2.75	-11.67	2.25
Median	1.00	2.00	-9.00	3.50
St. Deviation	5.13	9.68	10.22	2.87

Table 4 (2) Leads and Lags of Selected Indicators of Business and Consumer Sentiment (de-trended) at Growth Cycle Peaks and Troughs

Turning Points for China Growth Cycles	NBS Manufacturing PMI	NBS Manufacturing PMI Sub-Indices: Orders	NBS Manufacturing PMI Sub-Indices: Supplier Deliveries, Inverted	NBS Manufacturing PMI Sub-Indices: Imports	Consumer Expectations Index
Timing at Growth Cycle Peaks					
Feb-88	n.a.	n.a.	n.a.	n.a.	n.a.
Feb-93	n.a.	n.a.	n.a.	n.a.	-5
Sep-95	n.a.	n.a.	n.a.	n.a.	-4
Jan-00	n.a.	n.a.	n.a.	n.a.	12
Dec-03	n.a.	n.a.	n.a.	n.a.	-10
Mar-08	1	1	-1	0	-9
Extra Turns	0	0	0	0	2
Missed Turns	0	0	0	0	0
Mean	1.00	1.00	-1.00	0.00	-1.50
Median	1.00	1.00	-1.00	0.00	-4.50
St. Deviation	n.a.	n.a.	n.a.	n.a.	9.26
Timing at Growth Cycle Troughs					
Feb-90	n.a.	n.a.	n.a.	n.a.	n.a.
Nov-93	n.a.	n.a.	n.a.	n.a.	13
Feb-98	n.a.	n.a.	n.a.	n.a.	-7
Feb-02	n.a.	n.a.	n.a.	n.a.	15
Jul-04	n.a.	n.a.	n.a.	n.a.	-1
Dec-08	-1	-1	2	-1	3
Extra Turns	0	0	0	0	2
Missed Turns	0	0	0	0	0
Mean	-0.50	-0.50	2.00	-1.00	4.80
Median	-1.00	-1.00	2.00	-1.00	8.00
St. Deviation	n.a.	n.a.	n.a.	n.a.	9.18
Combined Statistics					
Mean	0.00	0.00	0.50	-0.50	0.70
Median	0.00	0.00	0.50	-0.50	-2.50
St. Deviation	1.41	1.41	2.12	0.71	9.51

Notes: PBoC General Business Conditions Index and sub-indexes, as well as PMI and sub-indexes were not detrended.

Purchasing Managers' Surveys:

NBS Manufacturing PMI: The China National Bureau of Statistics jointly with the China Federation of Logistics and Purchasing Managers conducts a monthly survey of manufacturing enterprise purchasing managers to collect information on general business conditions in the manufacturing industry. The survey and its sub-components are widely used by analysts as a leading indicator of the Chinese economy. The Purchasing Managers Index (PMI) is an integrated index and includes 11 sub-indices: new orders, production, employment, delivery of suppliers, stock-in-trade, new exporting orders, purchasing, finished product stock, purchasing price, imports, and overstock order form. All PMI series are reported on a scale of 0-100 and readings above 50 usually indicate expanding economic conditions and readings below 50 indicate contracting conditions. PMI Supplier Deliveries Sub-Index is the only exception as discussed below. The PMI data begin in January 2005; the very short history presents a major difficulty in assessing its cyclical properties and that of its sub-indices. In this paper, we focus on the sub-indices for supplier deliveries, orders, and imports as potential LEI components. Because they are constructed as diffusion indexes related to changes in growth rates, we compare them directly with the growth cycle chronology. The PMI series and selected sub-components are graphed in Chart 8 against the growth cycle chronology.

As in our choice of PBoC 5000 enterprise survey components, we selected to evaluate those components which are most likely on economic conceptual grounds to exhibit strong leading characteristics. Supplier deliveries may be related to capacity utilization in the supply chain; as suppliers run closer to full capacity in booms (experience excess capacity in recessions), delivery times will lengthen (shorten).[18] Orders tend to lead manufacturing production by a similar logic (i.e., signaling capacity utilization). Imports are selected because of their potential ability to capture information on conditions in the export-oriented processing trade, which since 1995 has accounted for more than 50 percent of all exports, according to the China Statistical Yearbook.

PMI Supplier Deliveries Sub-Index: Supplier deliveries sub-index asks purchasing managers whether their major suppliers are making deliveries slower than the previous month, at

[18] Zarnowitz, *Business Cycles*, p. 308.

an unchanged speed, or faster than the previous month. Indexes of supplier deliveries measure the relative speed at which industrial companies receive deliveries from their suppliers. When purchasing managers indicate that their suppliers have been taking longer to deliver, this indicates a strengthening of demand conditions because their suppliers have more difficulty and less capacity to meet their needs. The reverse is true when demand conditions weaken because the suppliers can more easily fill orders from their clients and shorten delivery times. This index, therefore, tends to lead the business cycle.

The way this kind of index is used depends on its precise calculation. In the case of China, the diffusion index shows the proportion of respondents who indicate that delivery times are getting faster (shortening) or remaining the same.[19] Thus, in this case, this sub-index needs to be inverted since a shortening in delivery times means slowing demand conditions.[20] Inverting this series makes it procyclical and appropriate for inclusion in a composite leading economic index. Table 4 (2) shows the growth cycle turning points of this indicator. This index does not provide information on the first four growth cycles before 2005, and it roughly coincides with the March – December 2008 growth cycle (with a peak in February 2008 leading the growth cycle peak by 1 month and a trough in February 2009 lagging the growth cycle peak by 2 months). Despite its short history, the PMI supplier deliveries sub-index has the potential to be a useful demand indicator, as in other LEIs including the LEI for the United States, since its empirical performance likely reflects changing demand conditions in the manufacturing supply chain. Based on this limited track record as well as the economic reasoning linking this indicator to aggregate demand conditions and capacity utilization, we propose to use this sub-index as a component of the LEI.

PMI Orders Sub-Index: As discussed above, orders for future production are natural candidates for leading indicators. However, this index does not provide strong cyclical peaks or troughs around the March – December 2008 growth cycle (Table 4 (2), col. 3) – the peak of the PMI Orders sub-index was essentially coincident, lagging the CEI peak by 1 month, and its trough led the CEI trough by only 1 month.

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[19] Source: CFLP (http://www.chinawuliu.com.cn/uploadFace/20059185737pmi08.htm, translated from Chinese by The Conference Board). "The Suppliers' Delivery Time Index is an inverted index. When the index is under 50%, it shows supplier delivery time is slowing, deliveries take longer, the economy is vigorous, and the trend is improving; the converse indicates that supplier delivery times are accelerating, and the economy experiencing a declining trend."

[20] In this case, the PMI supplier deliveries sub-index can be inverted by subtracting the index values from 100.

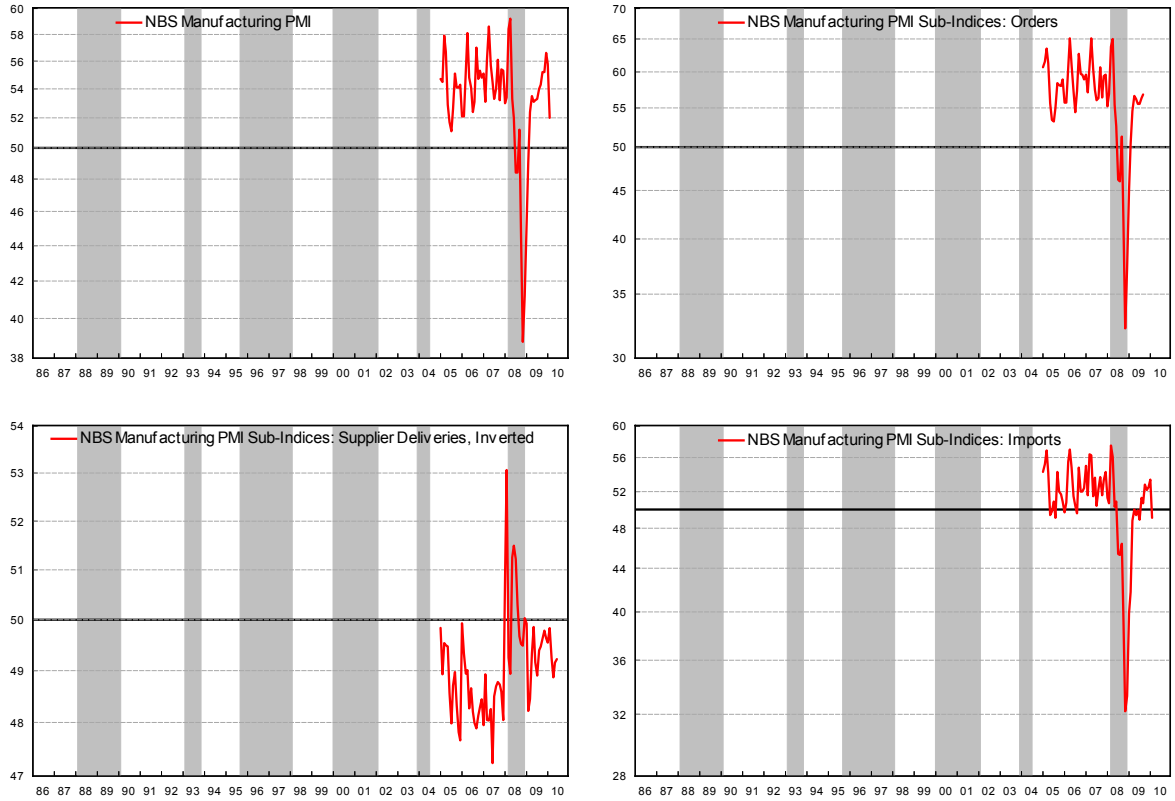
PMI Imports Sub-Index: Like the other two PMI sub-indices we focus on, this index also performs poorly in the most recent 2008 growth cycle (Table 4 (2), col. 5). The PMI Imports Sub-Index coincides the March 2008 peak and shows a 1-month lead to the trough in October 2008.

Consumer Sentiment Indicators

The China Economic Monitoring and Analysis Center of the National Bureau of Statistics has conducted a monthly survey of Chinese consumer sentiment since 1990 and publicly released survey data since 1998. The survey originally sampled adults (over the age of 15 years) in six cities, and has since expanded to cover 20 cities.[21] The survey questions cover five topics: assessments of current economic conditions, household income, inclinations to make large purchases, expectations of overall future economic conditions, and assessments of personal income.[22] Question results are aggregated into two diffusion indices, one assessing "consumer satisfaction" (i.e. current conditions) and one assessing "consumer expectations" (i.e. future conditions – chart 9) on a scale of 0-200, with 100 indicating no change from the previous month. The consumer confidence index combines consumer satisfaction and consumer expectations into a single indicator.[23] Of these indices, consumer expectations is the most obvious candidate for being a leading indicator. Consumer confidence and/or expectations indices are typical components for The Conference Board's leading indicators for other economies, and they generally show good empirical performance relative to business cycle turning points. As demonstrated by its relatively long history for China since 1990, its performance as a leading indicator is mixed. It leads the February 1993 peak by 5 months, but it reaches a trough 13 months after the growth recession ends. It lags the peak in early 2000 by 12 months and lags the trough in February 2002 by 15 months. It also lags the trough in December 2008 by 3 months. It leads the February 1998 trough by 7 months, but shows an extra movement at the end of the slowdown similar to the extra movement in 2003. Despite this inconsistent record, we propose to include the NBS Consumer Expectations Index in the China LEI because of its potential to forecast final consumer spending and its potential ability to capture consumers' impressions of economic trends.

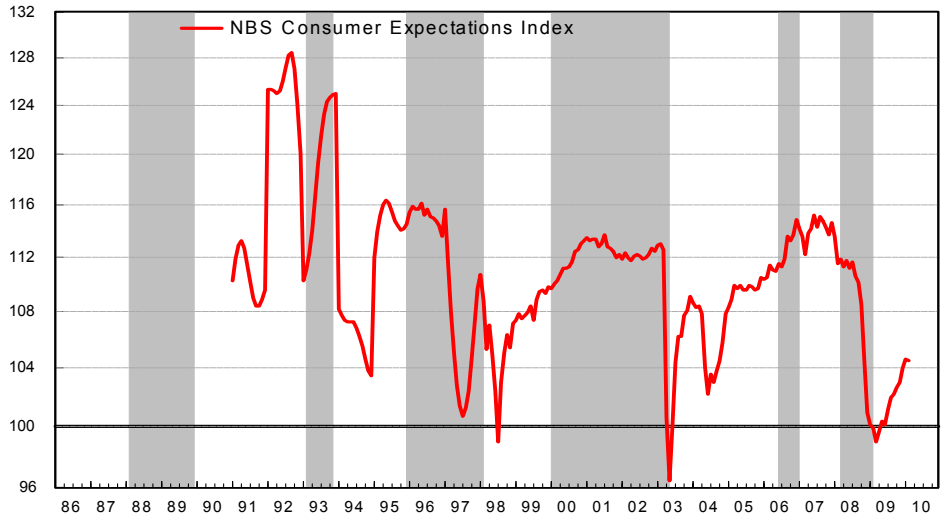
[21] CEIC indicator documentation, February 2010.
[22] Wu Wen-feng et al. (2004), pp. 447-448.
[23] NBS (2009) p. 234.

Chart 8 Selected Indicators from the PMI Survey



Note: Above shaded areas represent China's growth cycles using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

Chart 9 Consumer Expectations



Note: Above shaded areas represent China's growth cycles using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

Indicators of Shipments and Exports

Freight Carried (freight-tons and freight-ton-kilometers): These two series measure the overall level of freight shipping traffic in China, including shipping by rail, highway, and waterway. Shipping may be a leading indicator if it captures activity in the supply chain linking producers with their customers, or it may be a coincident indicator if it reflects the overall levels of production and consumption activity.

Freight-tons measures the quantity of shipping activity by the weight of freight shipped, while freight-ton-kilometers multiplies the weight shipped by the distance shipped to provide an alternate measure of utilization in the logistics sector. Data for this series begins in August 1998 and is reported monthly (see Appendix A, Chart 7). Even after seasonal adjustment, these data series show obvious seasonal distortions, possibly a result of changed data definitions over the course of the series (These distortions are most obvious in freight-tons, which has a major discontinuity in the data series in December of every year 1998-2003 and 2006-2008. The series spikes downwards in December of 1998, 1999, 2000, 2002, and spikes upwards in 2001, 2003, 2006, 2007, and 2008). Neither series displays obviously useful cyclical properties. Freight-tons

has a cyclical trough in December 1999 and a peak in January 2003; neither are close to the turning points of the coincident index business cycle chronology.

The deviations from trend in the Freight-ton-kilometers series is graphed in Chart 10. It leads the 2000 cycle peak by 8 months, leads the 2003 cycle peak by 36 months, and lags the 2008 peak by 11 months (see Table 5 col. 2). Its leads at the troughs of the 2000 - 2002 and 2003 - 2004 slowdowns are slightly more consistent, but it lags the December 2008 trough by 2 months. The relatively small number of turning points, data irregularities, and erratic behavior at cyclical turning points make it a less obvious candidate for an LEI component.

Another indicator of shipments, cargo handled at principal seaports (see Appendix A, Chart 5), does not have a strong economic reason to be included in a leading index because it is basically a broad measure of the volume of traded goods; furthermore, it does not show any clear leads. Thus, it does not perform particularly well as a leading indicator. Therefore, we argue that none of these indicators of shipments are useful as components of a leading index.

Total Value of Exports (Bn. of US Dollars): China's exports account for an average of 38 percent of China's GDP in the last 5 years. Exports are closely linked to China's economic growth by not only contributing to GDP growth, but also by their impact on increasing firm productivity in manufacturing. To the extent that foreign demand and orders for Chinese goods lead manufacturing activity and industrial production, measures of the export sector may be good leading indicators.

Total Value of Exports series begins in January 1986 and is reported monthly. Values of export goods are recorded on the date when the goods are cleared through Customs, and are valued on a FOB basis. This series is in billions of US dollars, and any transactions value in terms of a currency other than RMB or US dollars are converted into RMB or USD at the exchange rate issued by the State Foreign Currency Administrative Bureau.

The deviations from trend in this series are graphed in Chart 10. This series shows good leads on the peaks of the first three growth cycles (1988, 1993, and 1995) in the early part of our sample, but its leading properties appear to have deteriorated since 2000 and it fails to lead consistently the cycles since 2000. Moreover, the value of exports in US dollars reflects little domestic inflation/deflation, and is heavily affected by price changes in raw materials globally as

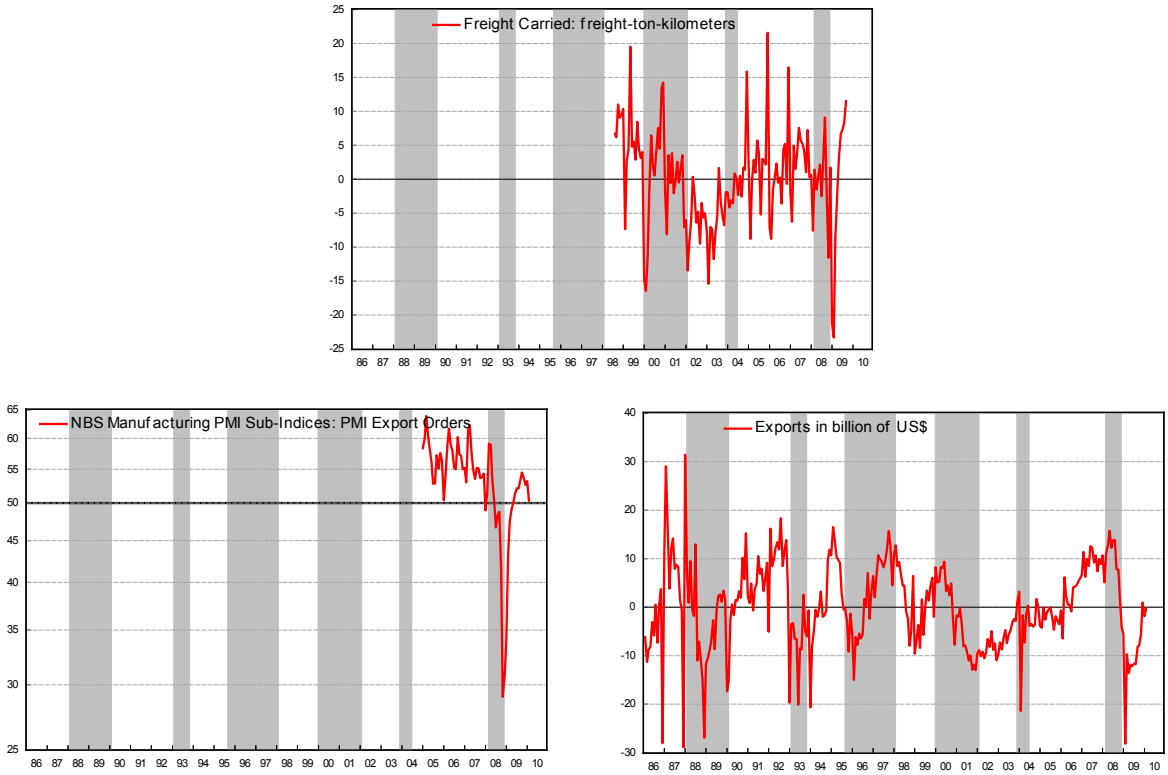
well as fluctuations in currency exchange rates. In other words, an increase in the value of exports may not necessarily indicate an increase in the volume of exports. We have also evaluated this series converted to RMB and in inflation-adjusted (real) terms, but we find that the value of exports does not perform well as a leading indicator. Therefore, we turn to a measure of export orders from the widely quoted PMI survey next.

PMI Export Orders sub-index: Since the quantity of export orders is not yet available in China, we consider whether the PMI Export Orders series which only begins in 2005 is a useful alternative (see Chart 10). From 2005, both deviations from trend of the exports series and PMI Export Orders diffusion index move similarly, but the latter appears to have a slightly earlier lead with respect to the trough of the most recent 2008 growth cycle. Furthermore, because PMI Export Orders is a diffusion index, it does not require deflation or currency conversion, an additional complication of using exports as a leading index component. Therefore, we propose to use a combination of Total Value of Exports (pre-2005) and PMI Export Orders sub-index (post-2005) as components of a leading index.

Table 5 Leads and Lags of Selected Indicators of Shipments and Exports (de-trended) at Growth Cycle Peaks and Troughs

Turning Points for China Growth Cycles	Freight Carried: freight-ton-kilometers	NBS Manufacturing PMI Sub-Indices: PMI Export Orders	Exports in billion of US$
Timing at Growth Cycle Peaks			
Feb-88	n.a.	n.a.	-12
Feb-93	n.a.	n.a.	-6
Sep-95	n.a.	n.a.	-7
Jan-00	-8	n.a.	5
Dec-03	-36	n.a.	1
Mar-08	11	1	2
Extra Turns	0	0	0
Missed Turns	1	0	0
Mean	-11.00	1.00	-2.83
Median	-8.00	1.00	-2.50
St. Deviation	23.64	n.a.	6.49
Timing at Growth Cycle Troughs			
Feb-90	n.a.	n.a.	-14
Nov-93	n.a.	n.a.	-5
Feb-98	n.a.	n.a.	-24
Feb-02	-24	n.a.	-2
Jul-04	-17	n.a.	-5
Dec-08	2	-1	2
Extra Turns	0	0	0
Missed Turns	2	0	0
Mean	-13.00	-1.00	-8.00
Median	-17.00	-1.00	-5.00
St. Deviation	13.45	n.a.	9.44
Combined Statistics			
Mean	-12.00	0.00	-5.42
Median	-12.50	0.00	-5.00
St. Deviation	17.24	1.41	8.18

Chart 10 Selected Indicators of Shipments and Exports*



Notes: Above shaded areas represent China's growth cycles using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm. The charts for freight carried and exports show deviations from trend. The PMI Exports orders chart shows the diffusion index.

Indicators of Construction

The construction sector, residential and nonresidential, generally leads the economy, especially in a developing country like China. Because of limited empirical evidence we rely strongly on economic reasoning to choose a real estate sector indicator and (as discussed in the introduction) our selection remains tentative and subject to revisions as more data and experience accumulates. The National Bureau of Statistics reports monthly data on investment and construction activity in the real estate sector, including the quantity and value of land purchased for development, the RMB value of real estate investment, quantities of floor space started, under construction, and completed, and the floor space and value of real estate sold. Data are generally reported in year to date cumulative terms, which we de-cumulate and deflate by the

appropriate price index as necessary. With some exceptions, indicators are reported as aggregates for the entire real estate sector, as well as for many sub-categories of construction activity. In addition, provincial- and municipal-level Statistical Bureaus report many of the same data for their geographies. As in other sectors, we focus our research on indicators likely to lead the overall real estate sector: real estate investment, total floor space started, and residential floor space under construction. Chart 11 compares Floor Space Started, Residential Floor Space under Construction, and Real Estate Investment.

Real Estate Investment (RMB Billions): This series measures "investment by real estate development companies, commercialized buildings construction companies and other real estate development units."[24] Real estate investment includes investment in buildings for residential, commercial, and industrial use, and also includes infrastructure investment related to real estate development projects. It is deflated by PPI.

Data reporting on real estate investment begins in 1996, thus this series cannot be evaluated against the 1988-1989 business cycle. In theory, trends in real estate investment should reflect expectations of future prices and sales activity in the real estate sector, both of which tend to be pro-cyclical in other economies. The available data for this series graphed in Chart 11 shows that this series had a smooth trend (compared to the other monthly series in Chart 11), but there appear to be some unexplained spikes in the early part of the sample, 1996-1997, that could be due to residual seasonality. Similar movements, but of a smaller magnitude appear in 2001-2005. Real estate investment declined slightly during the 2008 growth cycle, with only 2 months of decline from December 2008 to February 2009 (Chart 11), but lagged the CEI significantly. After removing our estimate of its long-term growth trend, these unexplained movements appear as outliers, unrelated to the growth cycles (see Chart 12). This data series is dominated by rising growth trends and short-term irregular movements, and shows little cyclical fluctuation. Real Estate Investment's very limited cyclical properties, and the absence of evidence that it can lead China's economic cycles, suggest it is not an appropriate candidate for a composite leading index.

[24] *China Statistical Yearbook 2009, p. 237*.

Total Floor Space Started: This series measures total floor space of newly started buildings during the reference period. It is measured in thousands of square meters, making adjustment for inflation unnecessary.

Like Real Estate Investment, the series begins in 1996 and is dominated by a strong secular growth trend. However, Total Floor Space Started, graphed in Chart 11, shows a strong cyclical decline around the 2008 growth cycle, falling almost 25 percent between May and October 2008, demonstrating vividly the stress on the real estate construction industry during that cyclical slowdown. This fluctuation is particularly striking when observing the series in detrended form[25] (Chart 12). Its empirical performance in predicting turning points is not especially compelling (Table 6, col. 2); Total Floor Space Started lagged the December 2003 growth cycle peak by 2 months, the March 2008 peak by 3 months, and the December 2008 trough by 5 months. Nevertheless, Total Floor Space Started has a high correlation with the CEI at t-1 month,[26] and seems to perform better at growth cycle turning points than the other indicators for the real estate industry.

Residential Floor Space Under Construction: This series (see Chats 11 and 12) refers to the floor space of residential buildings among the total space of buildings under construction during the reference period, including floor space of newly started buildings during the reference period, floor space of construction extended from the previous period to the current period, and floor space of construction suspended during the previous period and resumed in the current period. The series includes only commodity residential floor space, i.e., only including floor space under development for the consumer market. It does not include non-commodity residential floor space like university dormitories or (probably) low income housing. This fact will tend to imply that the Residential Floor Space Under Construction series will be more influenced by market forces and market expectations and less influenced by central planning than the Total Floor Space Started series.

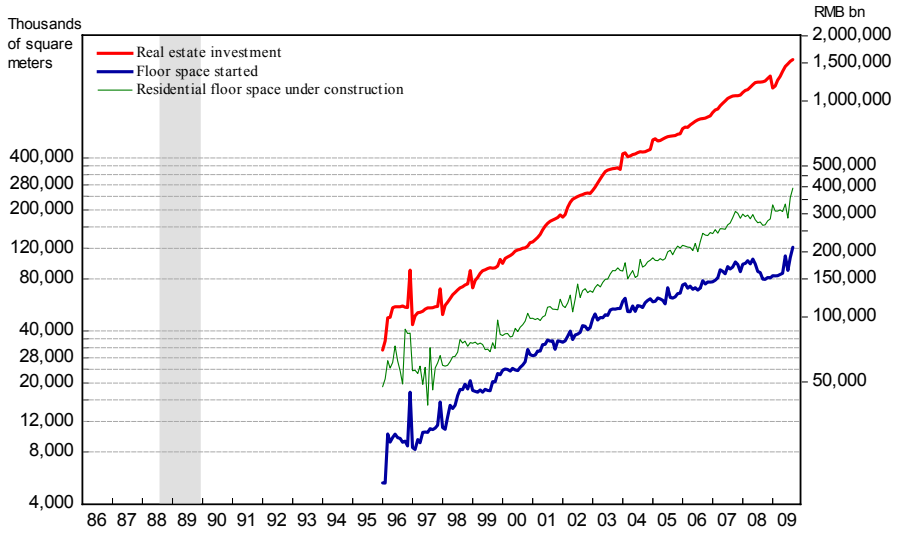
Residential Floor Space Under Construction led the CEI ahead of growth cycle peaks and troughs in 7 of 8 turning points in its history (see Table 6, col. 3). The strongest correlation of its

[25] As with the estimation of the growth cycle chronology of the CEI, de-trending by passing the data series through a Hodrick-Prescott filter.
[26] Its correlation with the lagged CEI at t-1 is 0.1645. However, its correlation is even stronger at zero or negative lags, indicating that it may be coincident or lagging rather than leading.

six month growth rate with that of the CEI occurs at t-2 months. But, despite these empirical leads, the series is a measure of current economic activity and not limited to newly started construction activity, and therefore not a good candidate as a leading indicator. Floor space of construction completed in the current period, and floor space of construction started and then suspended in the current period are also included in the floor space under construction of the current year.

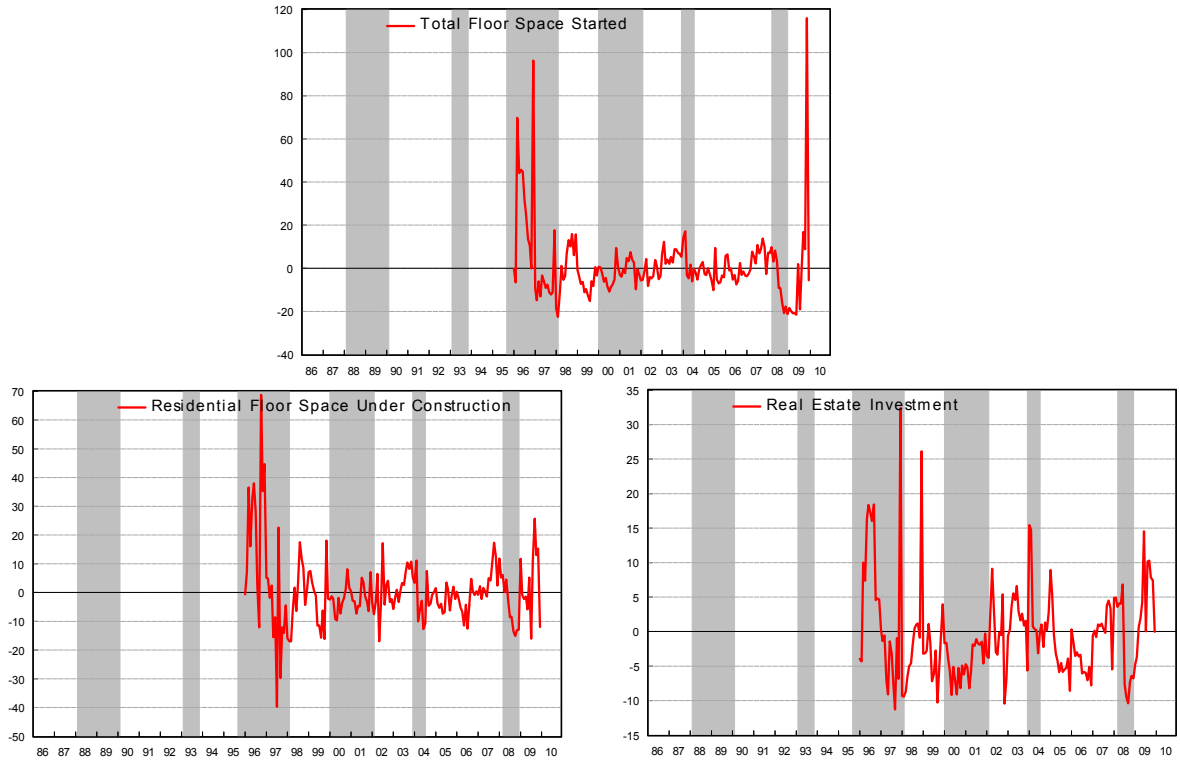
Inclusion of one of these construction indicators in a composite LEI could provide information that helps to forecast the future development of the construction sector and/or the economy as a whole. Both Total Floor Space Started and Residential Floor Space Under Construction had particularly striking declines during the 2008 slowdown, but beyond the 2008-2009 period their leading performance was less compelling, limited to a decade of real estate investment measured alternatively in floor area and inflation-adjusted RMB.

Chart 11 Floor Space Started vs. Real Estate Investment



Note: Above shaded areas represent China's economic recession using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

Chart 12: Detrended Series for Residential Floor Space under Construction, Residential Investment, and Total Floor Space Started



Note: Above shaded areas represent China's growth cycles using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

Given limited empirical evidence, we rely strongly on economic reasoning to choose a real estate sector indicator. As such, Total Floor Space Started seems the strongest candidate. Its definition is closely related to "starts." Broader coverage of the entire real estate sector makes it superior to Residential Floor Space Under Construction. While the latter indicator has slightly more consistent leads and a higher correlation, because by definition it includes previously started construction activity that was later suspended, we are disinclined to use it as a leading indicator. The apparent lead times may be due to a cyclical or phase distortion caused by measurement issues rather than truly leading property of the data.[27] These considerations

[27] Alternate configurations of a China LEI (available from the authors) show that inclusion of residential floor space under construction does not yield materially improved performance at predicting growth cycle turning points or growth rates.

motivate us to include Total Floor Space Started in the composite leading index, but we plan to re-examine this decision in the future as more data becomes available.

Table 6 Leads and Lags of Selected Indicators of Construction Activity (de-trended) at Growth Cycle Peaks and Troughs

Turning Points for China Growth Cycles	Total Floor Space Started	Residential Floor Space Under Construction	Real Estate Investment
Timing at Growth Cycle Peaks			
Feb-88	n.a.	n.a.	n.a.
Feb-93	n.a.	n.a.	n.a.
Sep-95	n.a.	15	n.a.
Jan-00	-13	-10	-13
Dec-03	2	-1	1
Mar-08	3	-5	3
Extra Turns	0	0	0
Missed Turns	0	0	0
Mean	-2.67	-0.25	-3.00
Median	2.00	-3.00	1.00
St. Deviation	8.96	10.81	8.72
Timing at Growth Cycle Troughs			
Feb-90	n.a.	n.a.	n.a.
Nov-93	n.a.	n.a.	n.a.
Feb-98	0	-7	-1
Feb-02	-30	3	9
Jul-04	-1	-1	17
Dec-08	5	-2	-3
Extra Turns	0	0	0
Missed Turns	0	0	0
Mean	-6.50	-1.75	5.50
Median	-0.50	-1.50	4.00
St. Deviation	15.89	4.11	9.29
Combined Statistics			
Mean	-4.86	-1.00	1.86
Median	0.00	-1.50	1.00
St. Deviation	12.54	7.62	9.44

4. Selecting and Combining the Leading Indicators into a Composite Index

Given the business and growth cycle chronologies discussed in section 2 and the review of the cyclical characteristics of selected leading indicators, we are ready to ask whether a composite index of selected leading indicators can provide signals of changes in direction in economic conditions more reliably than any individual indicator can.

Our aim is to create a composite index with broad coverage of the economy while using indicators selected on sound economic reasoning. The composite index should be able to improve on the predictive performance of the individual components by allowing the noise in the series to offset one another and bring about a better estimate of the cyclical movement of leading sectors of the economy. We focus explicitly on economic reasoning and coverage because of the scarcity and very short history of high frequency data series in China: there is insufficient historical evidence to choose indicators based on empirical performance alone.

With this goal in mind, we attempted to identify and incorporate the best performing indicators in a composite leading economic index. We selected six indicators as components of our proposed composite LEI: **1) Total loans, 2) exports (before 2005), Manufacturing PMI Exports Orders (after 2005), 3) Manufacturing PMI Supplier Deliveries sub-index (inverted), 4) PBoC 5,000 Raw Materials Supply sub-index, 5) NBS Consumer Expectations Index, and 6) Total Floor Space Started.**

We consider the sectoral coverage of the indicators we have identified to represent as broadly as possible the leading sectors of the Chinese economy as shown in Table 7 below. As the table shows, our search considered other sub-indices of the PBoC 5000 Industrial Enterprise Survey General Conditions composite index, as well as those of the PMI Manufacturing Survey in addition to the top-line composite indices reported for those surveys that get the most attention. As described in the overview of components above, the PBoC 5000 Raw Materials Supply sub-index and the Manufacturing PMI Supplier Deliveries sub-index both appear to be more obviously cyclical than the other components, and are likely to possess better leading properties.

Table 7: Sectoral Coverage of Selected LEI Components

Relevant sectors	Indicator Name
Money and Credit	Total loans
Manufacturing / Export	Exports (pre-2005) / PMI export orders (post- 2005)
Manufacturing	Manufacturing PMI Supplier Deliveries, inverted
Manufacturing	PBoC 5000 Raw Materials Supply sub-index
Household and Consumer Attitudes	Consumer expectations
Construction	Floor space started

The proposed LEI gives highest weight in its composition to manufacturing (three of six indicators) largely because there are many more indicators related to manufacturing in China. Attaching a strong weight to manufacturing may be justified given its large share of GDP (approximately 1/3) and strong cyclicality. Because of the challenges of using stock prices and money supply as cyclical indicators for China and their empirical performance, discussed above, we did not include these variables (which have been traditionally part of composite leading indicators in other countries). The share of the financial sector in the Chinese economy is less than 10 percent of GDP; furthermore, the total loans series that we propose to use as a component is highly correlated with money supply M2 and stock prices. We believe including only the total loans series (as the best financial indicator) avoids over-weighting the financial sector, as well as avoids problems from the less adequate nature of money supply M2 and Shanghai Stock Index. However, this means that the parts of money supply M2's fluctuations that are less correlated with total loans (currency in circulation and foreign reserves) are not included in the LEI.

In addition to the economic reasoning behind the selection of the components we also considered two approaches to check the robustness of our selection. First, we compared the turning points of the indicators with the turning points of the CEI (both in detrended form), evidence which was already presented individually in the description of potential components

above. These results are collected in Table 8 for the selected components. This table focuses exclusively on a comparison of the turning points of the selected components (in deviations from trend) with those of the CEI growth cycle (turning points in the deviations from CEI trend). Table 6 helps to assess the mean and consistency of the leads with respect to the reference cycle.

As discussed in section 1, this method is a modification of the traditional turning point analysis which was originally developed at the NBER. The turning point analysis compares peaks and troughs (turning points) of indicators with the business cycle (growth cycle) peaks and troughs of a reference series to assess the degree to which the indicators conform to the cycle in current economic conditions measured by reference series, the CEI in this case.

Table 8: Leads and Lags of Selected Leading Indicators and Composite Indexes at Growth Cycle Peaks and Troughs

Turning Points for China Growth Cycles	5000 Industrial Enterprise Diffusion Index: Raw Materials Supply Index	Total Floor Space Started	Total Loans Issued by Financial Institutions	NBS Manufacturing PMI Sub-Indices: PMI Export Orders	NBS Manufacturing PMI Sub-Indices: PMI Supplier Deliveries, inverted	Consumer Expectations Index	Exports in billion of US$	China LEI (LEI27) 6 Components
Feb-88	n.a.	n.a.	-2	n.a.	n.a.	n.a.	-12	**-1**
Feb-93	-10	n.a.	-14	n.a.	n.a.	-5	-6	**-9**
Sep-95	-18	n.a.	-20	n.a.	n.a.	-4	-7	**-21**
Jan-00	-1	-13	-5	n.a.	n.a.	12	5	**-2**
Dec-03	-15	2	-2	n.a.	n.a.	-10	1	**-11**
Mar-08	-9	3	missed	1	-1	-9	2	**-13**
Extra Turns	0	0	0	0	0	0	0	**1**
Missed Turns	0	0	1	0	0	0	0	**0**
Mean	-10.60	-2.67	-8.60	1.00	-1.00	-1.50	-2.83	**-9.50**
Median	-10.00	2.00	-5.00	1.00	-1.00	-4.50	-2.50	**-10.00**
St. Deviation	6.50	8.96	8.05	n.a.	n.a.	9.26	6.49	**7.42**
Timing at Growth Cycle Troughs								
Feb-90	n.a.	n.a.	-7	n.a.	n.a.	n.a.	-14	**-8**
Nov-93	-5	n.a.	-8	n.a.	n.a.	13	-5	**-5**
Feb-98	-35	0	-13	n.a.	n.a.	-7	-24	**-39**
Feb-02	missed	-30	-17	n.a.	n.a.	15	-2	**-17**
Jul-04	-4	-1	13	n.a.	n.a.	-1	-5	**-1**
Dec-08	-8	5	-5	-1	2	3	2	**-1**
Extra Turns	0	0	0	0	0	0	0	**1**
Missed Turns	1	0	0	0	0	0	0	**0**
Mean	-13.00	-6.50	-6.17	-1.00	2.00	4.80	-8.00	**-11.83**
Median	-6.50	-0.50	-7.50	-1.00	2.00	8.00	-5.00	**-6.50**
St. Deviation	14.76	15.89	10.36	n.a.	n.a.	9.18	9.44	**14.57**
Combined Statistics								
Mean	-11.67	-4.86	-6.33	0.00	0.50	0.70	-5.42	**-10.67**
Median	-9.00	0.00	-5.00	0.00	0.50	-2.50	-5.00	**-8.50**
St. Deviation	10.22	12.54	9.90	1.41	2.12	9.51	8.18	**11.09**

Second, we also looked at the cross-correlations of each indicator with the CEI (in six-month growth rates, seasonally adjusted as necessary). As discussed in section 2, many potential LEI components were obviously unsuitable for a thorough turning point analysis: their histories were too short, their detrended time series were extremely volatile, or the Bry-Boschan algorithm did not identify any turning points in the series. Some of these other indicators were discussed above. In this respect, considering the cross-correlations between the indicators is a complementary method to provide empirical evidence for component selection. The results, reported in Table 7, show the highest correlation of each indicator with the CEI and the number of lags at which this highest correlation occurs over the whole sample period and two sub-samples. Our selected

indicators, reported in this table, tend to have the highest correlations and the longest lead times considered among the set of 22 potential leading indicators.[28]

The numbers in the parentheses in Table 9 identify the lag length at which the highest correlation between the proposed LEI component and the CEI occurs. We calculated the correlations for all of the 1986-2009 sample as well as two subsamples, 1986-1996 and 1997-2009. For example, the Total Loans Issued by Financial Institutions series had a correlation of 0.421 with CEI growth at (t-4) months during the whole sample, 0.539 at (t-2) months in the first subsample, and 0.253 at (t-6) months in the second subsample. The results suggest that there were some important changes with respect to the relationships between these variables and general economic conditions as measured by the CEI during this period. While some correlations fall in the latter sample some rise. The lead at which the highest correlation occurs also changes. It is worthwhile to note that as more data for the series with shorter histories accumulates, the evidence for the relationships between the variables may strengthen or deteriorate. This table illustrates the changing nature of China's economy as it develops and transforms towards a more market driven economy. Thus, the component set of leading indicators should be monitored and updated as necessary to reflect the current structure of the economy. The instability of the correlations across the subsamples hints at possible difficulties that would be encountered when applying other econometric approaches to estimating unobserved factors at business cycle frequencies. A comparison of our approach using a small subset of carefully selected components with econometric methods that extract common factors from large datasets, such as principal components analysis and dynamic factor analysis, is left for future research.[29]

[28] See Appendix Table B1 which reports the correlations for the full set of potential leading indicators.
[29] For recent papers on this see, for example, Inklaar et. al. (2004) and Bulligan et. al. (2008).

Table 9: Correlation between leading indicators and alternative composite indexes with CEI (six-month growth rates)

Sample:	1986-2009*		1986 – 1996*		1997-2009*	
Indicator:	Correlation	Lead	Correlation	Lead	Correlation	Lead
Total Loans Issued by Financial Institutions	0.421	(-4)	0.539	(-2)	0.253	(-6)
Exports in billion of US$	0.104	(-10)	0.112	(-10)	0.306	(-1)
NBS Manufacturing PMI Sub-Indices: PMI Export Orders	0.671	(-1)	n.a.	--	0.671	(-1)
5000 Industry Enterprises Diffusion Index: Raw Materials Supply Index	0.129	(-8)	0.116	(-6)	0.150	(-8)
Consumer Expectations Index	0.183	(-12)	0.338	(-8)	0.380	(0)
Total Floor Space Started	0.230	(0)	n.a.	-	0. 230	(0)
NBS Manufacturing PMI Sub-Indices: PMI Supplier Deliveries, inverted	0.373	(-2)	n.a.	--	0.373	(-2)

Evaluating the Composite LEI Performance

We combined the selected indicators into a composite index using the methodology followed by The Conference Board to calculate the leading economic index for the United States.[30] The indexing methodology uses an unweighted, volatility-adjusted average of the contributions of each component, and the performance of the composite index appears to be superior to that of any individual indicator. The top panel of Chart 13 shows this index (LEI) in levels compared to the business cycle chronology for China as well as the long term trend of the LEI. The bottom panel of the chart shows its deviations from trend and compares them to the growth cycle chronology. The peak of the leading index precedes the business cycle peak in July 1988 by 6 months and the trough of October 1989 by 11 months. Then, it shows a rapid recovery following the recession trough that continues until 1992. Between 1992 and 1994 the growth trend in the

[30] For details of the methodology see footnote 4 and Business Cycle Indicator Handbook (2001).

LEI slows down considerably[31] before picking up again after 1999. Since 1999 the LEI has expanded continuously, only interrupted by fairly short lived slowdowns. As the bottom panel of Chart 13 shows, the LEI moves from above trend to below trend (the zero line) ahead of growth cycle contractions shown as the shaded areas in the bottom panel and the peaks (troughs) in the deviation from trend generally precede peaks (troughs) in the growth cycle.

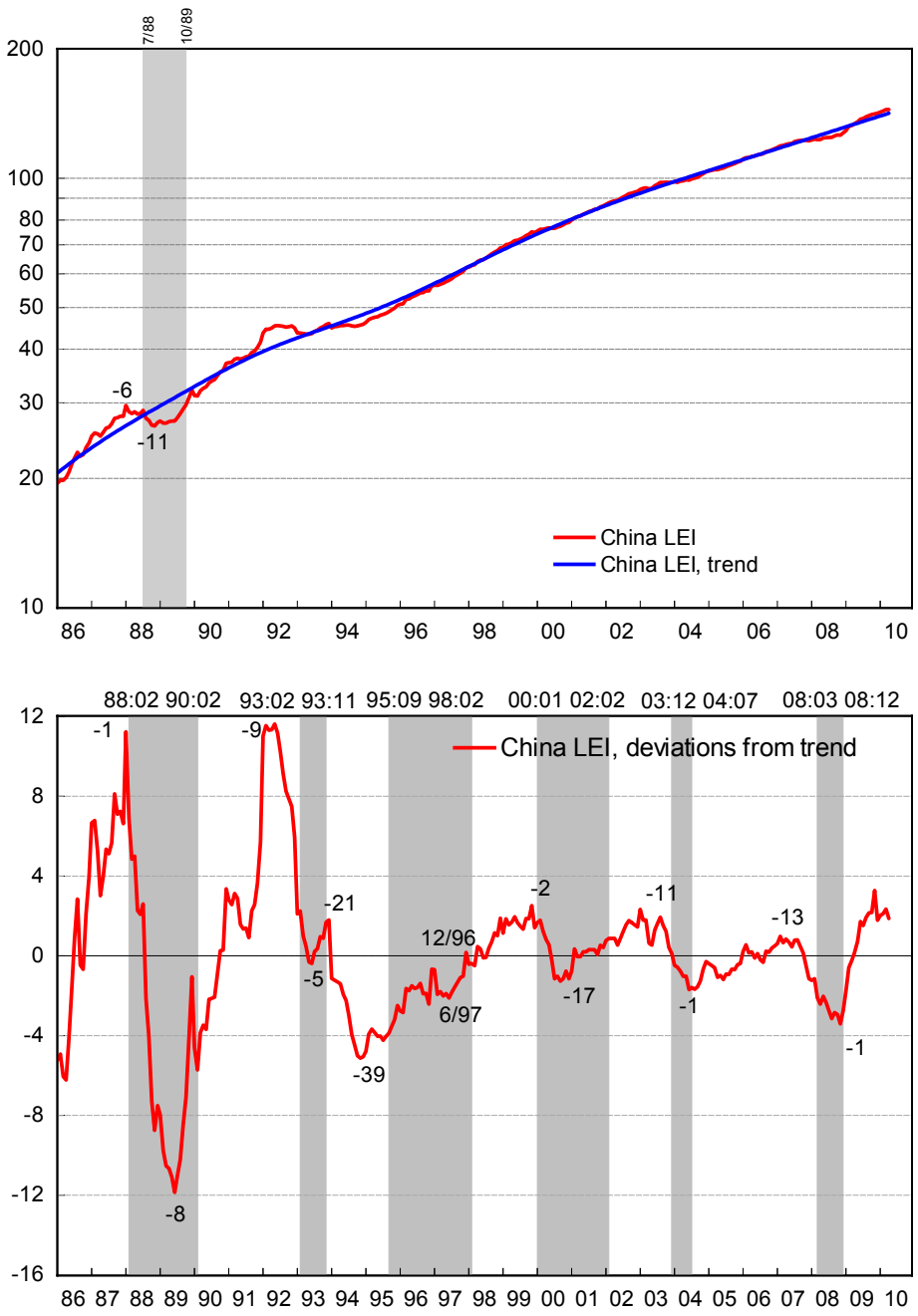
While individual indicators may be correlated with the CEI and have reasonable cyclical characteristics relative to the growth cycle of China's economy, none of the selected indicators are ideal leading indicators by themselves. When combined into a composite index using a simple and transparent indexing procedure, the resulting composite index track and leads the economic cycles in China's evolving economy fairly well and does so somewhat more consistently than the individual indicators.

The last column of Table 8 shows the cyclical performance measures of the proposed composite index of the six leading indicators. For the growth cycles, in 1988-89, 1993, 1995-1997, 2000-2002, 2004, 2008, the turning points in the deviations from trend of the LEI match the growth cycle turning points reasonably well. The median lead ahead of growth cycle turning points is about 8.5 months, but the leads show a high degree of variability. For example, the deviations from trend in the LEI show very long leads ahead of the peak and trough in the September 1995 – February 1998 growth cycle.[32] The lead in the LEI ahead of the February 1993 peak was also long, while the lead ahead of the February 1988 peak was quite short. In addition, the leads at the growth cycle troughs show a greater degree of variability than the leads at peaks, as standard deviation of the leads at troughs is twice as high as that of the leads at peaks.

[31] The LEI in fact signals a business cycle peak in June 1992 and trough in May 1993, although an absolute economic decline did not materialize.

[32] Indeed, it's not clear whether the peak and trough in the LEI can be matched with the peak and trough in the growth cycle. The amplitude of the fluctuations in the LEI deviations from trend are much larger before 1994 than afterward. The LEI stays relatively flat between 1992 and 1994 relative to the higher growth trends before and after this period. Both of these factors lead to the LEI staying below trend despite the economy which is exhibiting a growth cycle expansion during 1994-1995.

Chart 13: Leading Economic Index: Levels, Trend, and Deviations from Trend



Note: Above shaded areas represent China's growth cycles using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

Robustness Checks

We have checked the robustness of our selected set of components, by creating alternative LEIs with closely related but different sets of components. Table 10 reports the turning point analysis for these results. The table replicates the last column of Table 8 and shows leads of five alternative versions of the LEI. These versions are:

LEI 1 (six components): Total Loans Issued by Financial Institutions, Money Supply M2, Shanghai Stock Index, Consumer Expectations Index, 5000 Industry Enterprises Diffusion Index, Exports in billion of US$

LEI 19 (eight components): Total Loans Issued by Financial Institutions, 5000 Industry Enterprises Diffusion Index: Raw Materials Supply Index, NBS Manufacturing PMI Sub-Indices: PMI Supplier Deliveries (Inverted), Consumer Expectations Index, Residential Floor Space Under Construction, Fertilizer Production, Freight Shipped (ton-kilometers), Exports in billion of US$

LEI 24 (seven components): Total Loans Issued by Financial Institutions, 5000 Industry Enterprises Diffusion Index: Raw Materials Supply Index, NBS Manufacturing PMI Sub-Indices: PMI Supplier Deliveries (Inverted), Consumer Expectations Index, 5000 Industry Enterprises Diffusion Index: Enterprise Profits, Freight Shipped (ton-kilometers), Exports in billion of US$

LEI 26 (eight components): Total Loans Issued by Financial Institutions, 5000 Industry Enterprises Diffusion Index: Raw Materials Supply Index, NBS Manufacturing PMI Sub-Indices: PMI Supplier Deliveries (Inverted), Consumer Expectations Index, Residential Floor Space Under Construction, Fertilizer Production, Freight Shipped (ton-kilometers), Exports in billion of US$

LEI 29 (six components): Total Loans Issued by Financial Institutions, 5000 Industry Enterprises Diffusion Index: Raw Materials Supply Index, NBS Manufacturing PMI Sub-Indices: PMI Supplier Deliveries (Inverted), Consumer Expectations Index, Residential Floor Space Under Construction, Exports in billion of US$ (before 2005), NBS Manufacturing PMI Sub-Indices: Export Orders (after 2005)

Although many components overlap in these versions, some of the alternative versions have significant differences. The alternative versions allow us to see how the LEI would be affected by the inclusion of one or more alternative components despite the various shortcomings of those components discussed above. For example, LEI1 includes money supply and stock prices; LEI19 includes fertilizer production and freight shipped (ton-kilometers) and so on. Our proposed LEI with the six selected components (listed in Table 9) is labeled LEI27 in the following tables.

Broadly speaking, each alternative composition shows cyclical movements that share roughly the same timing relative to the growth cycle turning points as reported in Table 10.

Table 10: Alternative Compositions of the LEI

Turning Points for China Growth Cycles	China LEI (LEI 27)	China LEI (LEI 1)	China LEI (LEI 19)	China LEI (LEI 24)	China LEI (LEI 26)	China LEI (LEI 29)
Timing at Growth Cycle Peaks						
Feb-88	-1	-1	-1	-1	-1	-1
Feb-93	-9	-8	-9	-9	-9	-9
Sep-95	-21	missed	-21	missed	-21	-21
Jan-00	-2	-3	-9	-3	-8	-1
Dec-03	-11	-2	-11	-9	-11	-4
Mar-08	-13	-6	-13	-22	-6	-8
Extra Turns	0	0	0	0	0	0
Missed Turns	0	1	0	1	0	0
Mean	-9.50	-4.00	-10.67	-8.80	-9.33	-7.33
Median	-10.00	-3.00	-10.00	-9.00	-8.50	-6.00
St. Deviation	7.42	2.92	6.50	8.20	6.65	7.50
Timing at Growth Cycle Troughs						
Feb-90	-8	-8	-8	-8	-8	-8
Nov-93	-5	28	-6	11	-3	-5
Feb-98	-39	missed	-40	missed	-40	-38
Feb-02	-17	-4	-14	1	-14	-14
Jul-04	-1	10	0	2	0	0
Dec-08	-1	-1	-1	-1	-1	-1
Extra Turns	0	0	0	0	0	0
Missed Turns	0	1	0	1	0	0
Mean	-11.83	6.50	-11.50	1.00	-11.00	-11.00
Median	-6.50	3.00	-7.00	1.00	-5.50	-6.50
St. Deviation	14.57	14.49	14.86	6.82	15.13	14.17
Combined Statistics						
Mean	-10.67	0.67	-11.08	-3.90	-10.17	-9.17
Median	-8.50	-3.00	-9.00	-2.00	-8.00	-6.50
St. Deviation	11.09	10.94	10.94	8.79	11.17	10.98

Table 11 Panel A reports the correlations between the six-month growth rates of alternative LEI versions and CEI. The highest correlation between the growth in CEI measured as a six-month percent change and the growth in our proposed composite index occurs at t-4 and is 0.23. However, in the 1997-2009 sample period the highest correlation of our proposed index with CEI falls considerably to 0.08 (and it occurs at t-4). The lead of about four or five months is fairly consistent. The highest correlation ranges from 0.22 to 0.26 across the alternative compositions of the LEI in the full sample period.[33] In the first half of the sample, these correlations range from 0.29 to 0.32, but in the second half of the sample there is a wider range of 0.07 to 0.4 with greater variability in both the highest correlations and the lead at which they occur (-1 to -12).

Table 11 Panel B also shows the correlations between the deviations from trend in alternative LEI versions and CEI. In general, the correlations are higher between the detrended series than between their growth rates. The highest correlation between the detrended series occur at a lead of 3 to 10 months, compared to the 1 to 12 months leads in the correlations between growth rates in Panel A. The highest correlation between the detrended CEI and our proposed LEI, detrended, (shown in Chart 13) occurs at t-8 and is about 0.44. Moreover, the same pattern of higher correlations in the first half of the sample discussed above holds in Panel B as well.

It is important to note that although we report the cross correlation results and use them as a check on our selected composition for the LEI, we did not rely on them to make the final selection which was based on the turning point analysis and economic reasoning. While all of the correlations reported in panels A and B of Table 11 are close to one another for a given sample and given alternative LEI (and show similar leads), our proposed LEI doesn't necessarily show the highest correlation or the longest lead based on these correlations among the alternatives. Also, note there appears to be fairly large differences in the correlation patterns before and after 1996. Combined with the apparent differences in the volatility and amplitude of the cyclical

[33] The lead at which the highest correlation occurs (i.e. 4-5 months) is fairly stable in the full sample period. However, note that in the 1997-2009 sample period the correlation of all versions of the LEI are less than those in the first subsample. It's interesting to note also that the highest correlation of our proposed index (LEI27) with CEI falls considerably to 0.07 (and it occurs at t-4). In contrast, in the same subsample, the alternative index labeled LEI1 has a higher correlation with CEI close to 0.4 (specifically, 0. 396), but it has a short lead time of t-1 month.

movements before and after the mid 1990s shown in Chart 13, this suggests a possible structural break in these data.[34]

Table 11: Correlation between alternative LEIs and CEI

Table 11 Panel A: Correlation between Six Month Growth Rates in the LEI and CEI

Sample:	1986-2009*		1986 – 1996*		1997-2009*	
Indicator:	Correlation	Lead	Correlation	Lead	Correlation	Lead
LEI 1	0.264	(-4)	0.302	(-4)	0.396	(-1)
LEI 19	0.227	(-4)	0.302	(-5)	0.133	(-12)
LEI 24	0.217	(-4)	0.292	(-4)	0.170	(-1)
LEI 26	0.227	(-5)	0.302	(-5)	0.134	(-12)
LEI 27	0.234	(-4)	0.320	(-5)	0.071	(-4)

Table 11 Panel B: Correlation between Deviations from Trend in the LEI and CEI

Sample:	1986-2009*		1986 – 1996*		1997-2009*	
Indicator:	Correlation	Lead	Correlation	Lead	Correlation	Lead
LEI 1	0.490	(-7)	0.559	(-8)	0.342	(-3)
LEI 19	0.437	(-8)	0.437	(-8)	0.330	(-8)
LEI 24	0.516	(-8)	0.585	(-9)	0.250	(-3)
LEI 26	0.437	(-8)	0.472	(-8)	0.332	(-8)
LEI 27	0.439	(-8)	0.498	(-8)	0.180	(-8)

/* Not all components in the composite indexes are available from 1986. The available sample prior to 1996 is used to calculate the indexes.

Comparison with NBS and OECD Composite Leading Indexes

We have also compared our proposed index to two others published by NBS and OECD. Because those indexes are constructed as growth cycle (deviations from trend, in the case of

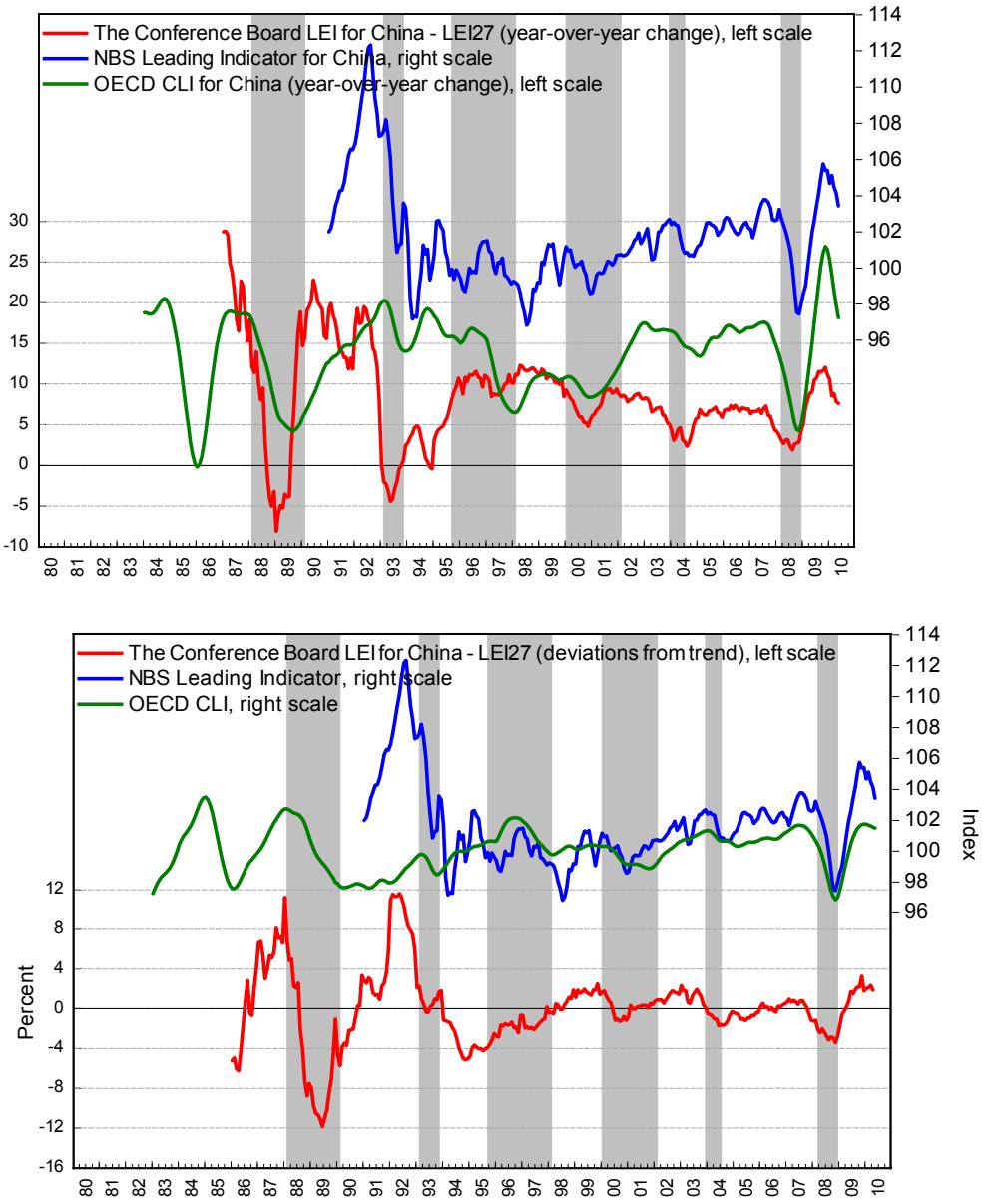
[34] Investigation of possible structural breaks is left for future research.

OECD[35]) or growth rate cycle indexes (in the case of NBS[36]), we compare both the year-over-year growth rates of our proposed leading economic index as well as its deviations from trend. Chart 14 shows the results with the top panel showing growth rates of our LEI with the NBS and growth rates of trend-restored OECD leading indicators, and the bottom panel showing the same with the deviations from trend for our composite index. Both panels show the growth cycle chronology we have developed in this paper. The three indexes are fairly similar in their description of the major fluctuations of China's economy since 2000. This is not surprising as there are similarities in composition although their methodologies and component selections follow different approaches. Before 2000, although there are broad similarities among the three indexes, there are also short periods of divergence. The OECD CLI is the smoothest of the three indexes in detrended form (Chart 14), whereas, our proposed index shows the highest degree of irregular movements. The same holds for the year over year growth rates, but in that case the NBS Leading Indicator is smoother than the OECD CLI. We generally regard the greater volatility of our index as a positive characteristic of the index as it suggests the methodology does not smooth the data excessively. Excess smoothing of the data could lead to unintended phase shifts in the cycle, resulting in a mismatch between the cycle in current economic activity, measured by the CEI, and leading economic activity measured by the LEI. The contemporaneous correlation between our proposed LEI (detrended) and the NBS Leading Indicator is quite high, at 0.71. The correlation between the LEI and the OECD CLI (both detrended), on the other hand, is fairly low, only at 0.08.

A possible advantage of our proposed LEI over the NBS and OECD leading indicators is that it makes it possible to monitor un-smoothed seasonally-adjusted month on month growth rates. By contrast, the NBS growth rate cycle index tracks year over year growth rates of economic activity, and the OECD CLI measures smoothed deviations from trend of a composite of economic indicators requiring detrending and normalization of the underlying component data. Since both of these techniques have the risk of building a lag into economic fluctuations, our proposed index may provide more timely (albeit more volatile) signals of changes in the business and growth cycles than the alternatives.

[35] Nilsson (2006).
[36] Pan (2009).

Chart 14: LEI 27, OECD CLI, and NBS Leading Indicator



Note: Above shaded areas represent China's growth cycles using CEI, and the turning points are determined by the Bry-Boschan (1971) algorithm

LEI: is shown as year-over- year growth rates (top panel) and deviations from trend (bottom panel) to facilitate comparison with the OECD and NBS indicators.

5. Discussion

In this paper, we propose two new composite indexes for business cycle measurement for China. The first composite index builds on Guo et. al. (2009) and is a coincident economic index (CEI) that measures current economic conditions. We use this index to develop chronologies of business and growth cycles for China during 1986-2009. The second index is a leading economic index (LEI) that helps to anticipate cyclical fluctuations defined by the CEI. Despite the challenges of limited data availability and limited histories of the available data, we have attempted to apply the indicator approach that has been proven over the years in the development of such leading indexes for the US and elsewhere. Potential data problems and biases, some of which are unique to the case of China's statistics make our decisions on the indexes presented here conditional on the best available data and information so far. The LEI development should be viewed from the perspective of a continuous evolving and improving process.

The indicator approach is particularly suited to work with the available data in China because it does not rely heavily on econometric estimation which could be negatively influenced by finite samples and instability of estimated coefficients. Instead, the indicator approach relies on a detailed evaluation of the empirical properties of the indicators and turning point analysis. Where possible, we have utilized additional empirical evidence without deviating too far from the core of the indicator approach. The main departure has been to rely more heavily on a growth cycle chronology.

Our proposed composite index includes six indicators chosen on the basis of empirical performance, economic reasoning and coverage of the current structure of the Chinese economy as components: 1) Total loans, 2) exports (before 2005), Manufacturing PMI Exports Orders (after 2005), 3) Manufacturing PMI Supplier Deliveries subindex (inverted), 4) PBoC 5,000 Raw Materials Supply sub-index, 5) NBS Consumer Expectations Index, and 6) Total Floor Space Started. While individual indicators selected as components for the China LEI may be correlated with the CEI and have reasonable cyclical characteristics relative to growth cycles of China's economy, none of the selected indicators are ideal in and of themselves. When combined into a composite index, using The Conference Board's simple and transparent indexing method, the

resulting composite index tracks and leads the turning points in the economic cycles of China's rapidly evolving economy fairly well and does so more consistently than individual indicators.

The main areas of extension to improve the usefulness of the proposed LEI lie in better quantitative data on investment commitments (new orders, contracts) measuring demand for capital goods and for residential and commercial construction. Another area of improvement is labor market indicators such as the average workweek and unemployment insurance claims that are not currently available. Thus, as discussed above, our choices were inevitably limited and tentative.

As the Chinese economy evolves and develops further, the growth of new sectors will likely change the structural relationships between data series – thus, it will be essential to periodically revisit the selection of indicators for the China LEI to ensure they continue to fulfill the criteria identified above. Furthermore, China's statistical system will likely improve in the future, making further improvements in the selection of the leading indicators possible.

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APPENDIX A:

Chart 2 Total Loans Issued by Financial Institutions 1986 – 2008

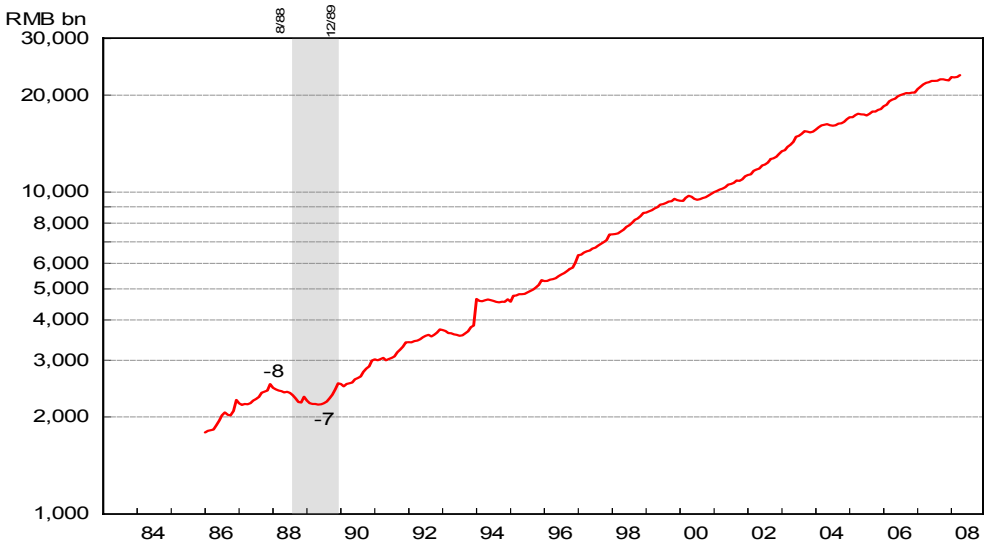


Chart 3 Money Supply M2 1986 – 2008

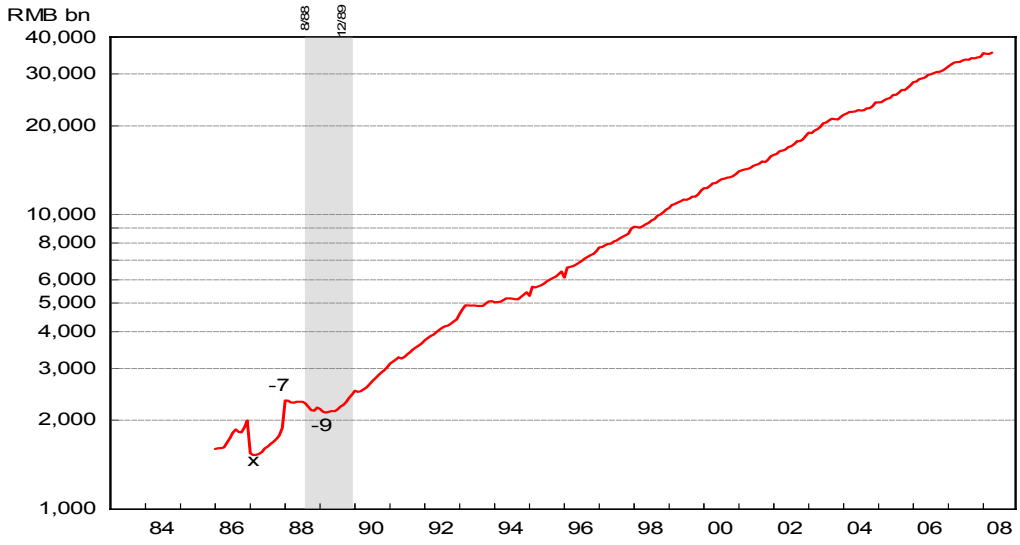


Chart 4 Exports 1986 – 2008

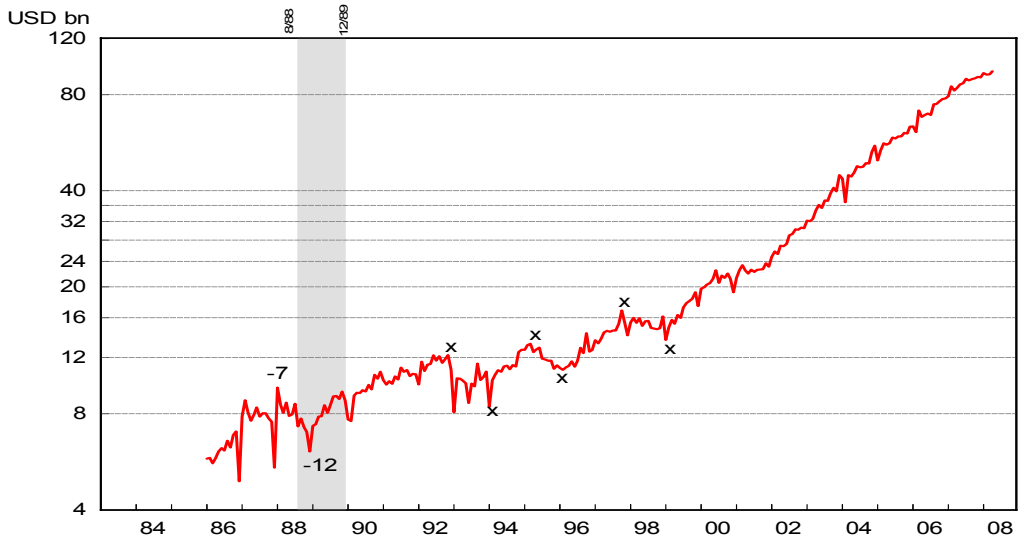


Chart 5 Cargo Handled at Principal Seaports 1986 – 2008

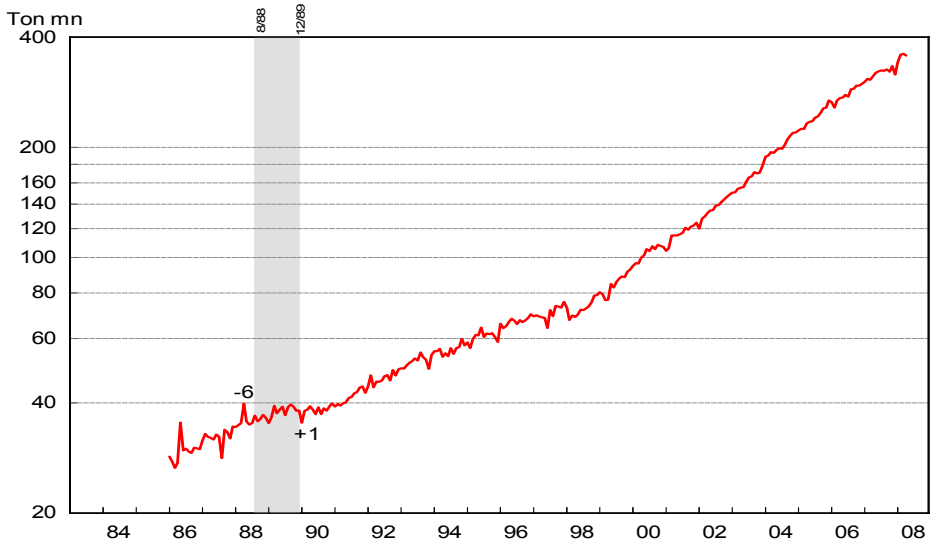


Chart 6 Fixed Assets Investment 1986 – 2008

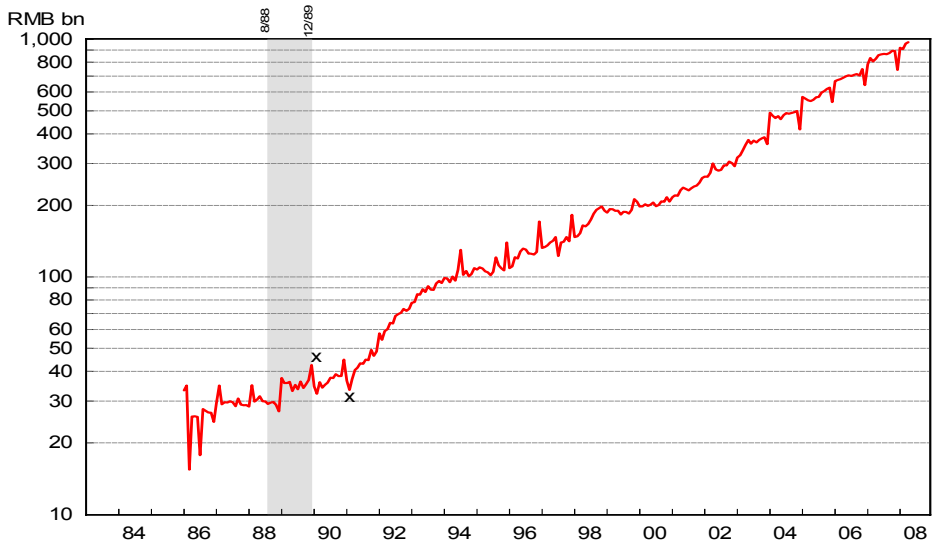


Chart 7 Freight Turnover Volume 1986 – 2008

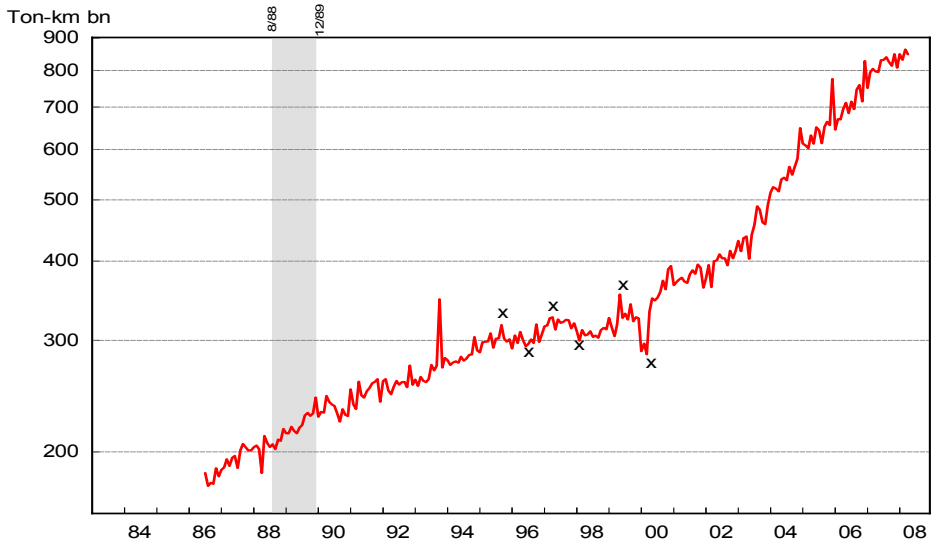


Chart 8 Shanghai Stock Exchange Index 1991 – 2008

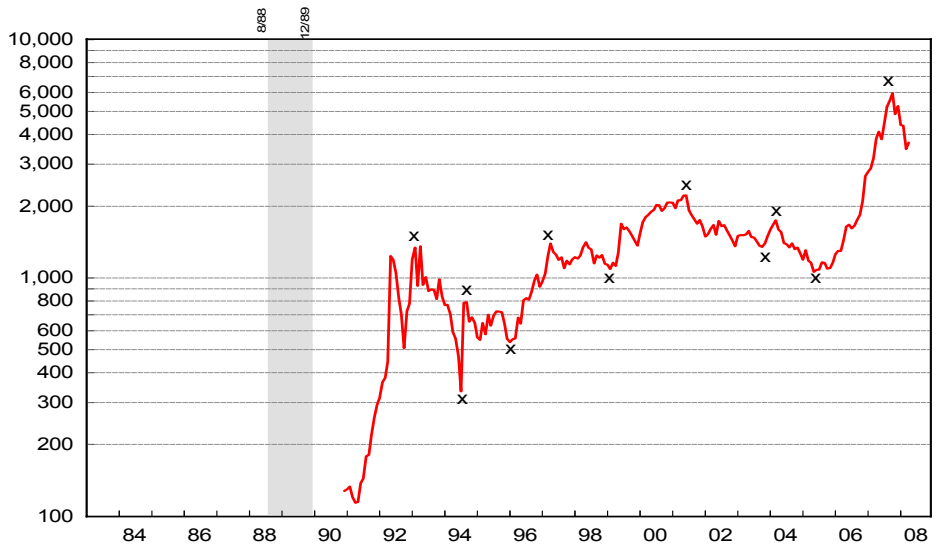


Chart 9 Consumer Expectations Index 1991 – 2008

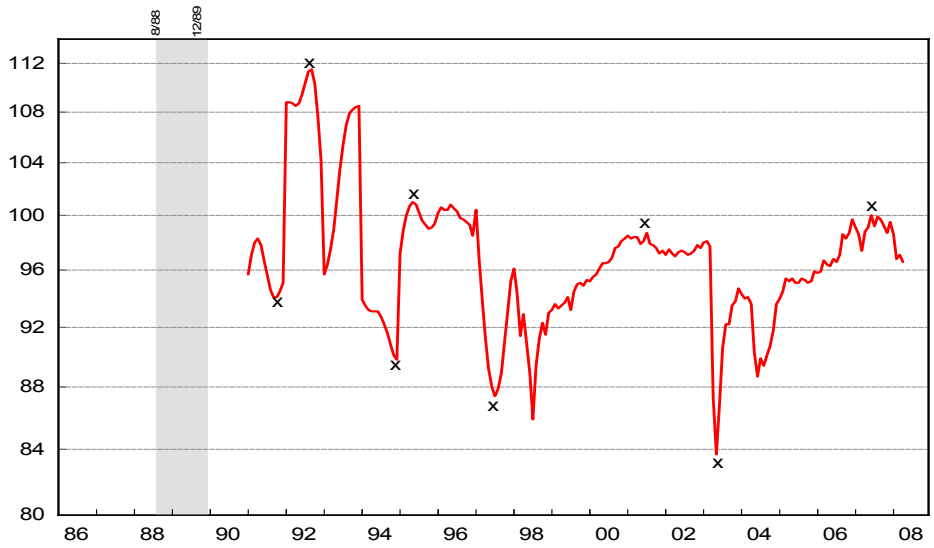


Chart 10 5000 Industry Enterprises Diffusion Index (General Business Condition)

1992 – 2008

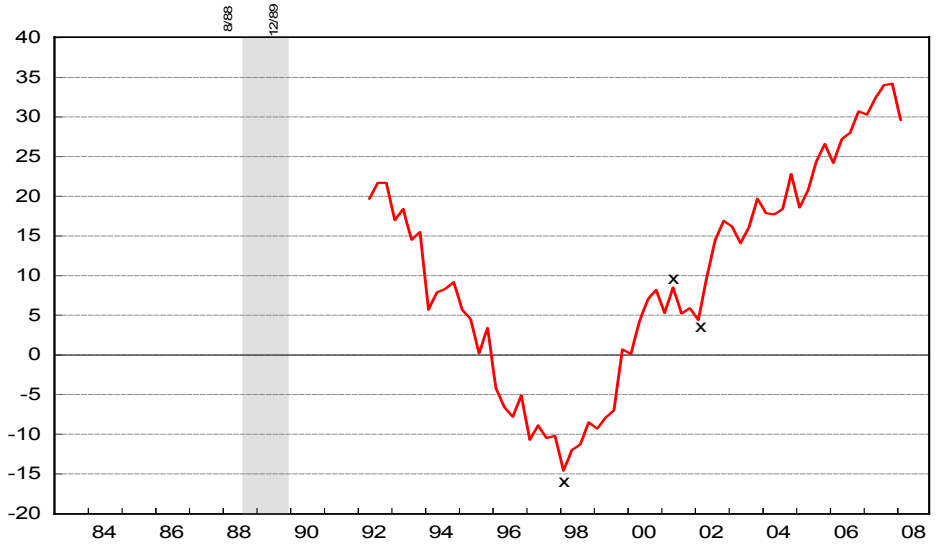


Chart 11 Hang Seng China Enterprise Price Index 1993 – 2008

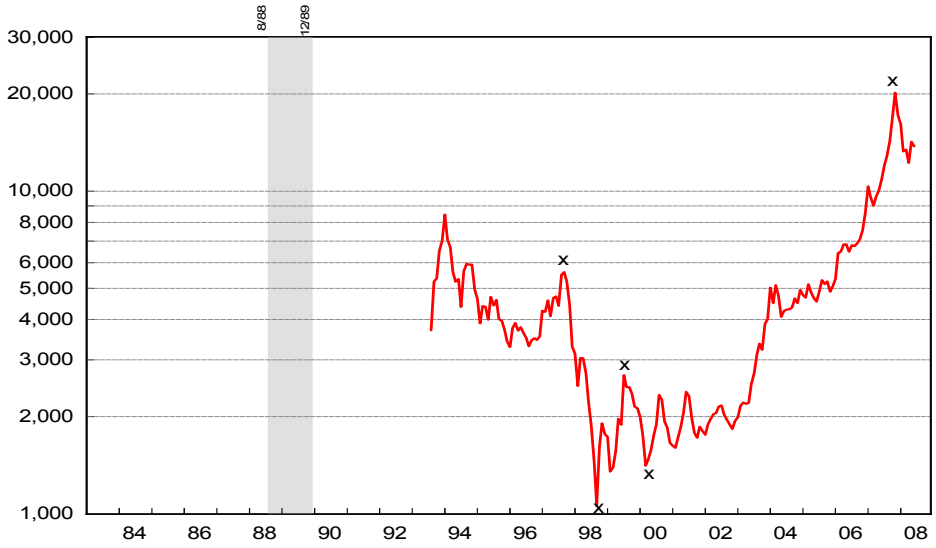


Chart 12 Total Floor Space Started 1996 – 2008

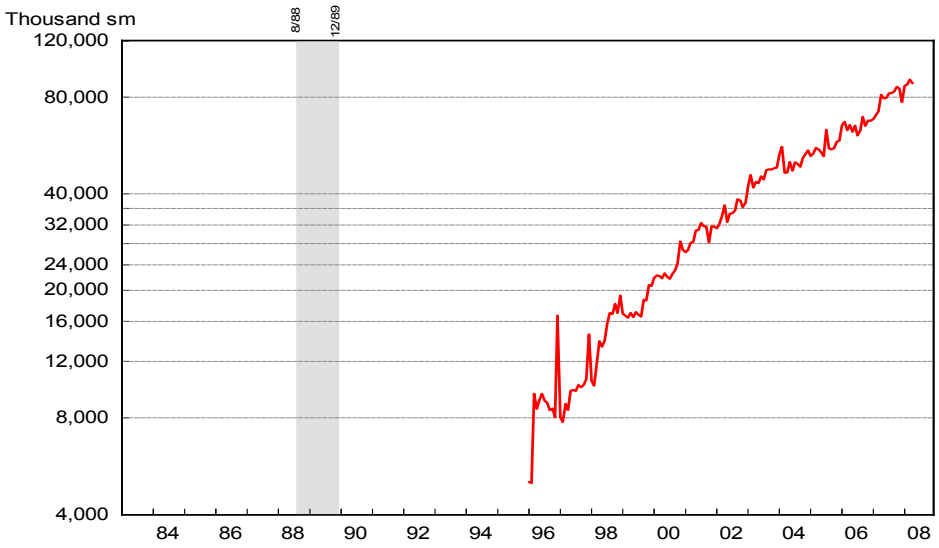


Chart 13 Residential Floor Space Under Construction 1996 - 2008

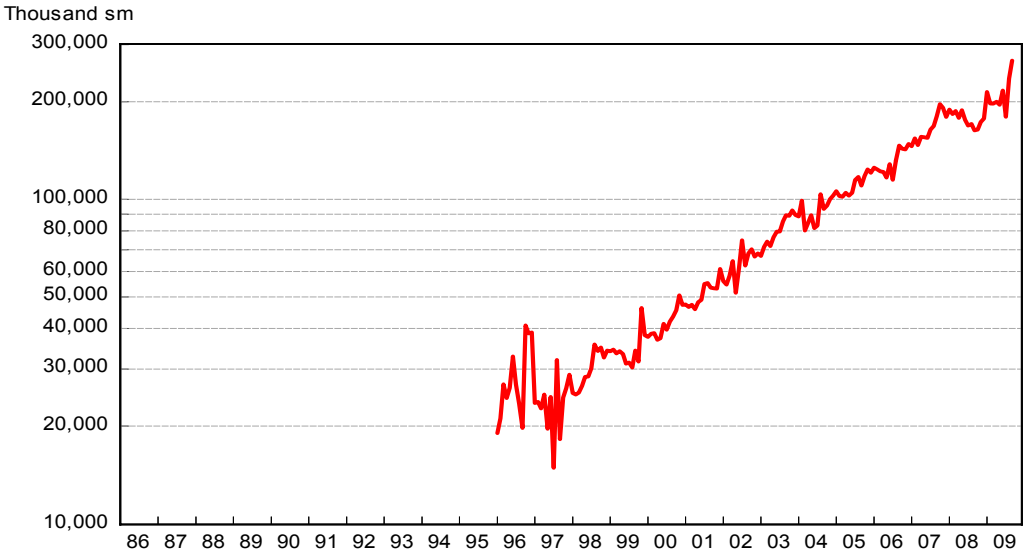
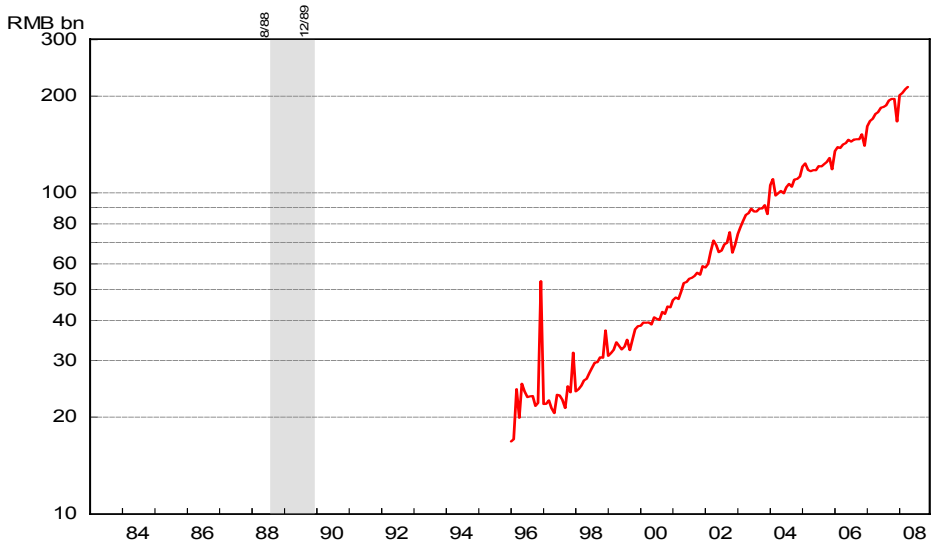


Chart 14 Real Estate Investment 1996 - 2008



Appendix B:

Table B1: Correlation between leading indicators and composite indexes with CEI (6 month growth rates)

Sample:	**1986-2009**		**1986 - 1996**		**1997-2009**	
Indicator:	**Correlation**	**Lead**	**Correlation**	**Lead**	**Correlation**	**Lead**
Total Loans Issued by Financial Institutions	**0.421**	**(-4)**	**0.539**	**(-2)**	**0.253**	**(-6)**
Exports in billion of US$	**0.104**	**(-10)**	**0.112**	**(-10)**	**0.306**	**(-1)**
5000 Industry Enterprises Diffusion Index: Profitability Index	0.352	(-1)	0.154	(-1)	0.497	(-1)
5000 Industry Enterprises Diffusion Index: Raw Materials Supply Index	**0.129**	**(-8)**	**0.116**	**(-6)**	**0.150**	**(-5)**
5000 Industry Enterprises Diffusion Index: Domestic Orders Index	0.223	(-1)	0.384	(-1)	0.252	(-1)
Money Supply	0.209	(-3)	0.289	(-1)	0.232	(-6)
Cargo Handled at Principal Seaports	0.120	(-6)	n.a.	--	0.120	(-6)
Fixed Assets Investment	0.071	(-4)	0.130	(-2)	0.094	(-1)
Freight Carried: freight-ton-kilometers	0.233	(-5)	n.a.	--	0.233	(-5)
Freight Carried: freight-tons	0.116	(-1)	n.a.	--	0.116	(-1)
Stock Price Index Shanghai Stock Exchange	0.273	(0)	0.302	(-11)	0.333	(-3)
Consumer Expectations Index	**0.183**	**(-12)**	**0.338**	**(-8)**	**0.380**	**(0)**
5000 Industry Enterprises Diffusion Index	0.257	(-3)	0.568	(-4)	0.508	(-1)
Hang Seng China Enterprise – Share Price	0.231	(-6)	0.286	(-7)	0.305	(-6)
Total Floor Space Started	**0.230**	**(0)**	**n.a.**	**-**	**0.230**	**(0)**
Construction Investment	0.044	(-5)	0.123	(-3)	0.048	(-5)
NBS Manufacturing PMI	0.671	(-1)	n.a.	--	0.671	(-1)

NBS Manufacturing PMI Sub-Indices: PMI Supplier Deliveries (inverted)	**0.373**	**(-2)**	**n.a.**	**--**	**0.373**	**(-2)**
NBS Manufacturing PMI Sub-Indices: PMI Orders	0.716	(-1)	n.a.	--	0.716	(-1)
NBS Manufacturing PMI Sub-Indices: PMI Imports	0.639	(-1)	n.a.	--	0.639	(-1)
NBS Manufacturing PMI Sub-Indices: PMI Export Orders	**0.671**	**(-1)**	**n.a.**	**--**	**0.671**	**(-1)**
Residential Floor Space Under Construction	0.215	(-2)	0.245	(-2)	0.237	(-2)
Total (i.e., commodity) Floor Space Under Construction	0.069	(0)	0.282	(-3)	0.071	(0)
FAI - excluding real estate	0.145	(-12)	n.a.	--	0.145	(-12)
FAI - equipment purchases	0.275	(-12)	n.a.	--	0.275	(-12)