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Do production managers predict turning points? A directional analysis

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ABSTRACT

This study evaluates the directional accuracy of production managers' forecasts by using a new market-timing test. By extending the directional analysis to the 4×4 case, this study investigates whether Japanese production managers' forecasts correctly predict turning points in production across different industries. This fills a gap in the literature that focused on predicting increase/decrease or acceleration/deceleration using directional analysis of the 2×2 case. It also illustrates its merit over the 2×2 case. This study shows that majority of the forecasts are not useful in predicting turning points in production; however, they are useful in predicting increase/decrease in production. Our findings suggest that the production managers' forecasts serve as early qualitative information of expansion and contraction on the Japanese economy and their accuracy does not differ by phases of business cycles.

1. Introduction

Researchers have recognized the importance of predicting the direction that a series of interest will move, upward or downward. The ability to predict the direction a series will move, whether up or down is nontrivial because business people and policymakers primarily focus on the likely direction of an economy, and make decisions on whether an economy expands and accelerates. Therefore, considerable attention has been given to the empirical examination of directional change in various macroeconomic variables. Schnader and Stekler (1990) introduced an approach of directional analysis based on 2×2 contingency tables that were developed by Henriksson and Merton (1981).

The directional analysis approach investigates whether the forecasts successfully predict the direction of change, that is, increase and decrease, or acceleration and deceleration, better than a naïve forecasting model. In the literature, forecasts are called 'useful' if they correctly predict the directional change. In contrast to many applications of 2×2 cases to examine whether economic activities expand and prices move up, few works focus on 4×4 cases.

This study extends the directional analysis to the 4×4 case and addresses the question of whether forecasts correctly predict turning points. Turning points provide crucial information of directional change. For example, business cycles are dated according to turning points, including peaks and troughs, when direction of economic activities changes based on key economic indicators. The peak refers to the last time period before several key indicators begin to fall while the trough refers to the last time period before several key indicators begin to rise. Naik and Leuthold (1986) used one-step- and two-step-ahead forecasts of agricultural prices and examined the turning point by 4×4 tables. They define a 4×4 contingency table as follows: $y_{t-1} < y_t > y_{t+1}$ for a peak, $y_{t-1} > y_t < y_{t+1}$ for a trough, $y_{t-1} < y_t < y_{t+1}$ for an upward turn, and $y_{t-1} > y_t > y_{t+1}$ for a downward turn, where y_t denotes the value of a variable in time t. Directional analysis of turning points provides richer qualitative information about the economy.

In particular, focusing only on 2×2 cases can lead to erroneous conclusions with respect to the usefulness of forecasts. To examine the turning points using one-step-ahead and two-step-ahead forecasts, one can apply a directional analysis of 2×2 cases to the respective forecasts: $y_{t-1} < y_t (y_{t-1} > y_t)$ and $y_t < y_{t+1} (y_t > y_{t+1})$ separately. One may conclude that the turning point forecast is useful when each analysis implies forecast usefulness. However, a directional analysis of the 4×4 case is not necessarily consistent with that of the 2×2 cases due to, for example, time-series dependence between those forecasts with different horizons. Therefore, the use of only 2×2 cases can mislead policymakers in their decision-making, and result in unintended outcomes. A directional analysis of 4×4 cases provides an advantage over that of 2×2 cases.

Attempting to fill the gap in the literature, this study examines the industrial index of production in Japan, with special focus on its three unique features. First, the index survey participants provide information about forecasted and actual production levels. Industrial production is one of fundamental variables to assess economic conditions and is

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used to determine business cycle dating. Second, forecasts by industry and the aggregate manufacturing sector are available. Such disaggregated forecasts have rarely been examined. Third, samples with two different forecast horizons are fairly large for application of directional analysis of the 4×4 case. One of the main reasons that there are few studies on the 4×4 case is the unavailability of datasets with a sufficiently large number of observations.

Recent studies (e.g., Chu et al., 2009) point out that Henriksson and Merton test and its variants are vulnerable to serial correlation. This is a noteworthy finding for economic variables subject to serial correlation in many cases. Furthermore, multiple horizon forecasts are likely to have term structure, which can results in serial correlation between forecasts with different forecast horizons. In particular, in our analysis, depending on the structure of production line in each industry, production managers might not be able to adjust their production levels flexibly once production levels are planned. Production managers might subsequently revise their forecasts. Therefore, there is a possibility that directional change in individual and multiple horizon forecasts or outcomes may be serially correlated. This requires us to consider the characteristic of the multi-horizon forecast. Therefore, this study uses a new test developed by Pesaran and Timmermann (2009) for tackling this issue.

Illustrating an application and advantage of the new test in comparison to tests used extensively in the existing literature, this study show that majority of the forecasts are not useful in predicting turning points in production, however, they are useful in predicting expansion and contraction in production. Our findings suggest that the production managers' forecasts serve as early qualitative information of expansion and contraction on the Japanese economy. This study also investigates whether directional accuracy differs between expansion and recession of the economy, and finds no difference according to phases of business cycles.

The remainder of the paper is organized as follows. Brief literature review is provided in the next section. Data description and a brief overview of the Japanese Indices of Industrial Production are given in Section 3. Section 4 introduces the statistical methods of directional analysis. Results are discussed in Section 5. Conclusions are included in the final section.

2. Literature review

Most studies of directional analysis have focused on the 2×2 case and forecasts of two types: (1) those made by international organizations such as the International Monetary Fund, the Organization for Economic Co-operation and Development, and central banks like the Federal Reserve System,[1] and (2) those made by professional forecasters and their related institutions.[2] These studies examined whether quantitatively measured forecasts successfully predict directional change in corresponding actual variables. For example, Greer (2003) examined the interest rate forecasts of the 30-year U.S. Treasury bonds with a horizon of one year made by *The Wall Street Journal*'s panel of economic forecasters.

Recently, consumer sentiments and business survey indices have been examined in directional analysis. Several studies have examined the directional accuracy of consumer sentiment indices over household consumption. Consumer sentiments are usually surveyed in consumer confidence indices in various countries. Consumers are asked to rate their willingness to consume in the next few quarters qualitatively, for example, ranging from 1 (strongly unwilling) to 5 (strongly willing), and they are indexed to represent consumer's sentiments for consumption. One can, therefore, examine whether consumer sentiments successfully predict directional change in household consumption. Easaw and Heravi (2004) and Easaw et al. (2005) find that consumer sentiment indices are useful predictors of growth in household consumption for both the UK and the United States. In analyzing the accuracy of subjective household forecasts of personal finance, Easaw and Heravi (2009) placed particular emphasis on the importance of consumer sentiment indices because of their use by policymakers and, ultimately, their role in monetary policy.

Similarly, one can examine whether business surveys predict directional change in real GDP growth and employment growth because they ask about prospects of general economic conditions and employment qualitatively. For example, Tsuchiya (2013) evaluated directional accuracy of Japanese business surveys. Hutson et al. (2014) also investigated the CESIfo World Economic Survey for the US economy. Note, however, that the scope of their paper is different from this one. They focused on interpreting qualitative responses and how to construct directional forecasts that provide better signals about the direction in which an economy will move.

Sinclair et al. (2010) is one of the few exceptions that jointly evaluated an increase/decrease in real GDP and inflation rate using 4×4 tables because the two variables are closely related. Tsuchiya (2014) also extends the directional analysis of the 4×4 case by jointly evaluating both increase/decrease and acceleration/deceleration for the main economic variables in the indexes of the Institute for Supply Management for the United States.

Stekler (1968) is a seminal work devoted to the investigation of turning point forecasts, focusing on directional changes. Naik and Leuthold (1986) and Kaylen and Brandt (1988) are pioneering works that explicitly rely on 4×4 contingency tables, and examine turning point forecasts of agricultural prices using one-step- and two-step-ahead forecasts. However, their study only relies on Henriksson and Merton tests.

3. Data

3.1. Forecast description

The Japanese Indices of Industrial Production (IIP) are compiled and published monthly by the Ministry of Economy, Trade, and Industry in Japan. The Survey of Production Forecast in Manufacturing, which is a part of the monthly survey, contains the Indices of Production Forecast.[3] For the production forecast survey, actual production levels for the previous month and predicted production levels for the current and the following month are collected from each principal entrepreneur. The year 2005 is considered as the base year (Index = 100 in 2005) for calculation of the indices. Therefore, the production forecast survey in time t includes the actual values, a_{t-1} (IIP series), the current-month forecasts, $f_{t,t}$ (F1), and forecasts for the next month, $f_{t,t+1}$ (F2). Such indices are collected for 11 industries and the aggregate manufacturing sector. The 11 industries considered for this study are as follows: Iron and Steel, Non-Ferrous Metals, Fabricated Metals, General Machinery, Electrical Machinery, Information and Communication Electronics Equipment, Electronic Parts and Devices, Transport Equipment, Chemicals, Pulp and Paper, and Others.[4]

The data used in this study covers the period January 2003–December 2012. Note that this study is not subject to an issue of data vintages because the survey directly collects the actual and forecast production levels and does not suffer from any revisions.

[1] See Artis (1996), Ash et al. (1998), Ashiya (2003), Baghestani (2011), Joutz and Skekler (2000), Pons (2000, 2001), and Sinclair et al. (2010).

[2] See Ashiya (2006), Greer (2003), Lai (1990), Leitch and Tanner (1995), Öller and Barot (2000), Schnader and Stekler (1990), and Stekler (1994).

[3] For more information, see http://www.meti.go.jp/english/statistics/tyo/iip/index.html.

[4] "Others" include Precision Instruments, Ceramics, Clay and Stone Products, Petroleum Products, Rubber Products, Textiles, and other products.