J. Japanese Int. Economies 34 (2014) 116–134

Contents lists available at ScienceDirect

Journal of The Japanese and International Economies

journal homepage: www.elsevier.com/locate/jjie

Real-time GDP forecasting for Japan: A dynamic factor model approach

Satoshi Urasawa *

Cabinet Office, Japan
Organisation for Economic Co-operation and Development, France

ARTICLE INFO

Article history:
Received 23 January 2014
Revised 26 May 2014
Available online 7 June 2014

JEL classification:
E37
C53
E17

Keywords:
Business cycle indicator
Early GDP estimate
Forecast accuracy
Real-time data

ABSTRACT

Urasawa, Satoshi—Real-time GDP forecasting for Japan: A dynamic factor model approach

Accurate and timely information on GDP is important to gauge the overall state of the economy and is thus essential for economic policymaking. A single-index dynamic factor model is estimated using mixed-frequency data on GDP, industrial production, employment, private consumption and exports to obtain early estimates of Japan's quarterly GDP growth in real time. The results of a real-time forecasting exercise suggest the model performs well in comparison to the consensus forecasts, in terms both of its accuracy, measured by the size of forecast errors, to predict actual GDP estimates, and of its ability to signal turning points in GDP, showing the advantage of using the model for early assessment of ongoing economic activities in Japan. An equally important goal of this study is to share with other forecasters the results of ongoing real-time GDP forecasts for Japan, aiming at increasing knowledge regarding Japan's GDP forecasting. *J. Japanese Int. Economies* **34** (2014) 116–134. Cabinet Office, Japan; Organisation for Economic Co-operation and Development, France.

* Address: Cabinet Office, 1-6-1 Nagata-cho, Chiyoda-ku, Tokyo 100-8914, Japan.
E-mail address: surasawa@umich.edu

http://dx.doi.org/10.1016/j.jjie.2014.05.005
0889-1583/

1. Introduction

Gross domestic product (GDP) is arguably a key macroeconomic indicator, indicating where the economy is in the cycle and feeding very prominently into economic policymaking. In particular, appropriate policy formulation and implementation require not only to examine GDP's historical development but also to predict its current and future path, to enable prompt responses to changes in economic conditions. Accurate and timely information on GDP is thus crucial.

However, GDP data are published after significant time lags. Similar to other countries, Japan publishes its first estimate of quarterly GDP approximately 45 days after the end of a quarter and revises it about 25 days later, before presenting the third estimate in the annual report in December the following year. The figure is revised further about a year later, taking into account source data that become available with longer lags.[1] The lag between the end of a quarter and the time of the first official estimate for that quarter makes it challenging to track GDP in real time. Consequently, considerable resources are devoted into making GDP forecasts about the immediate past (*back-casting*), the current conjuncture (*now-casting*) and the future developments (*forecasting*).

Forecasting techniques vary from those that primarily rely on judgment to those that use statistical models mechanically, without any judgment. In any case, the most important factor in forecasting is using real-time data—the flow of data releases, including data revisions, in real time—to capture economic developments, which tends to fluctuate from time to time. The day-to-day monitoring using real-time data makes it possible to assess ongoing economic activity early on, while upgrading the assessment by incorporating new information. In short, real-time forecasts take advantage right away of data releases, which are published at higher frequencies than GDP, to derive a real-time GDP estimate ahead of the official estimate.

Since Evans (2005) and Giannone et al. (2008), the literature has developed a formal statistical model—referred to as the "dynamic factor model"—to produce real-time GDP estimates, combining the idea of linking high-frequency indicators to low-frequency GDP data and the idea of using real-time data within a single statistical framework. The key concept inherent in this framework is to summarize the most recently published, real-time monthly information with latent, common factors estimated from the monthly indicators, and use this summary in GDP forecasting. Specifically, in order to incorporate a large information set of real-time data releases in an efficient manner, the model is designed to exploit the co-linearity of the series by summarizing all the available information within a few artificial common factors that represent the main source of variation in the dataset; this is done while using the Kalman filtering technique to calculate the expected value of the common factors in a latent space process. This enables the model to capture the bulk of the dynamic interaction among the series while realizing its parsimonious nature; this can allow for efficient forecasts (see, for instance, Stock and Watson, 2011). In addition, it allows the model to deal not only with the mixed-frequency data issue, but also with the "jagged" edges of the real-time data flow, both of which are central challenges associated with real-time forecasting.

To date, various types of short-term GDP forecasting models have been developed for different economies. Examples include Lahiri and Monokroussos (2013) in the United States, who study the role of survey data in now-casting; Angelini et al. (2011), Banbura and Rünstler (2011), and Camacho and Perez-Quiros (2010), in the euro area; Barhoumi et al. (2010) in France, who compare several factor extraction techniques; Marcellino and Schumacher (2010) in Germany, who propose an approach that combines mixed-data sampling techniques with a factor model; and Yiu and Chow (2010) in China. In addition, real-time exercises using the dynamic factor model have been implemented in several institutions, including the European Central Bank (ECB, 2008) and the International Monetary Fund (Matheson, 2011).[2] Results in the literature have provided several general findings, which indicate a clear gain from developing such a model for use in the early assessment of ongoing economic activities: (i) a statistical model that does not include a judgment process performs as well as institutional forecasts that are allowed to incorporate their own judgment (ii) now-casting becomes progressively more accu-

[1] The shift in the base year results in yet another revision of the GDP estimate. Note that seasonal adjustments are applied retrospectively whenever GDP estimates are revised, leading to non-negligible changes.

[2] An extensive review of the literature on GDP now-casting, including its theoretical basis, is provided by Banbura et al. (2012).