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Using rule-based updating procedures to improve the performance of composite indicators☆

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ABSTRACT

Ideally, the set of variables underlying composite indicators is checked and updated when needed on a regular basis. In practise, the timing and procedures of these updates are usually chosen *ad hoc*. We suggest a rule-based indicator selection updating procedure, performed at regular intervals, which reduces the arbitrariness of this process. We apply this procedure to one of the most prominent targeted composite leading indicator for Switzerland, which is based on bivariate associations of potential variables with a reference series reflecting the Swiss growth rate cycle. We show that in a simulated real-time analysis the targeted indicator selection procedure outperforms the widely used approach to combine as many potential variables as possible. Furthermore, the regular updating procedure preserves the leading properties of the composite indicator with respect to the reference time series, as compared to the same composite indicator without such updates.

1. Introduction

Composite leading indicators are based on either the assumption or else empirical evidence that they outperform single variable indicators in which respect whatsoever.

There are numerous composite leading indicators to help assess the current and near-term business cycle stance, released for example by the OECD and the Conference Board. Whilst the latter concentrates on publishing so-called Leading Economic Indices for 12 countries and, in addition, the euro area and the world, the OECD nowadays produces Composite Leading Indicators for 46 countries and regions all around the world.

For many countries, national institutes and central banks construct and publish other leading indicators, like the euro area-wide leading indicator proposed by De Bondt and Hahn (2014), or the (new) Eurocoin for the euro area, published by the Centre for Economic Policy Research (CEPR) and the Banca d'Italia (Altissimo et al., 2010). For Germany, the Ifo institute provides a series of economic indicators capturing economic tendencies in Germany and worldwide. In Switzerland, the KOF Economic Barometer is the most prominent leading composite indicator as measured by media attention and financial market impact. This paper focusses on the objectives and the innovative features that were introduced in the 2014 revision of this composite indicator.

Composite leading indicators usually have in common that variables are selected to enter the final indicator by their fit to a reference series. However, over time economic relationships, data availability and sometimes even historical data change. Hence, the variables that were selected at a certain moment may later turn out to be no longer optimal in reflecting the new data points or the latest vintages of a reference series, and their periodical overhaul is required. This is important to maintain the reliability of composite indicators. The need for such overhauls is widely acknowledged. As the OECD methodology guidelines regarding its system of composite leading indicators (CLI) put it: "Once these various factors and series have been selected the CLI specification is fixed until they are next reviewed, which occurs

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periodically to ensure the CLI retains its relevance" (OECD, 2012, p. 4). Likewise, Levanon et al. (2011) provide a description of the latest comprehensive benchmark revision of the Leading Economic Index released by the Conference Board for the United States. However, the timing and the exact procedure are in all of these indicators not fixed in advance.

Generally, it is difficult to determine when it is time to carry out such an overhaul. Usually, the need for a comprehensive benchmark revision becomes evident only after substantial deterioration in forecasting performance (Bujosa et al., 2013, p. 487). Furthermore, experience shows that an update of this kind can be quite time consuming, as the underlying procedures are often not clearly defined, leaving substantial room for discussion and interpretation. Hence, in this paper we propose not to wait until the first warning lights start blinking, but rather to have updates and routine maintenance taking place in a pre-defined manner at pre-set intervals. This allows such a leading indicator to adapt to a changing environment.

This paper's main contribution is to show how the typical *ad hoc* overhaul of composite leading indicators can be replaced by a rule-based procedure. In particular, we present a pseudo real-time evaluation of such a procedure for a real-world indicator, the aforementioned leading composite economic indicator for Switzerland (KOF Economic Barometer), published monthly by the KOF Swiss Economic Institute at ETH Zurich.[1] The selection algorithms for this composite leading indicator are determined *ex ante*, so that subsequent subjective judgement is largely eliminated. Such a transparent strategy can increase the trustworthiness into the published indicators substantially.

We show that the targeted indicator selection procedure outperforms the widely used approach to combine as many potential variables as possible. Furthermore, the regular updating procedure preserves the leading properties of the composite indicator with respect to the reference time series, as compared to the same composite indicator without such updates.

The rest of the paper is structured as follows. Section 2 provides a review of the literature and places our approach in its context. In Section 3, we describe the data set for the construction of our composite indicator. Section 4 provides a detailed description of the procedure. We document the computation of the latest version of the composite indicator and of its historical vintages in real and pseudo-real time. By constructing three alternative versions of the composite indicator, we are able to check the usefulness of our proposed regular rule-based indicator selection procedure in Section 5. Using real and pseudo-real time vintages, we carry out an out-of-sample analysis and find evidence supporting the value added of our approach. Section 6 concludes.

2. Literature review

Following the seminal contributions of Stock and Watson (2002a, 2002b), large-scale factor models have become popular in composite indicator construction. Estimates of approximate factor models with (static) principal components are also documented in Bai and Ng (2002) and Bai (2003). Another type of dynamic factor approach was developed by Forni and Lippi (2001, 2010), Forni et al. (2000, 2005). Factor models were used for example by Giannone et al. (2008) or Luciani (2014) to construct business cycle indicators.

However, for composite leading indicators, a more widespread approach is to select a handful of underlying indicators. For example, the leading composite indicators of the Conference Board for the United States and the euro area consist of ten and seven variables, respectively. The business conditions index for the United States presented by Aruoba et al. (2009) is based on six variables, including quarterly GDP. The euro area-wide leading indicator (ALI) proposed by De Bondt and Hahn (2014) is composed of nine variables. The composite leading indicator for the Spanish economy of Bujosa et al. (2013) consists of four monthly indicators, to which they refer as "cycle drivers". The EURO-STING indicator of Camacho and Perez-Quiros (2010) is based on ten variables. The composite short- and long-term leading indicators for the euro area constructed by Rua and Nunes (2005) are based on eight and ten variables, respectively. The OECD composite leading indicator for Switzerland currently consists of six variables (OECD, 2012).

A noticeable exception to the practise of only including a relatively limited set of variables is the Eurocoin indicator published by the CEPR and the Banca d'Italia. The first generation of the Eurocoin indicator, described in Altissimo et al. (2001), is based on 246 variables, selected from a much larger initial data set comprising 951 time series. The second generation Eurocoin was introduced in 2007 (Altissimo et al., 2010). Apart from changes in computational methodology and redefinition of the reference time series, the new version is based on a smaller data set of 145 variables, which nevertheless still by far exceeds the typical number of variables combined into composite indicators.

The focus of this paper is on the KOF Economic Barometer. The objective of this indicator has always been to provide early signals regarding the Swiss economy. For this, it targets a reference series derived from official GDP data using various sources of information (variables). In its construction, revisions of past values of the leading indicator are avoided to the extent possible. Not only the current fourth version follows these principles, also the previous three versions of the KOF Economic Barometer are rooted in this tradition. The first two versions, released in 1976 and 1998, were based on six variables. The third and previous version [released in 2006, Graff (2010)] increased the number of variables to 25, but the selection was still *ad hoc*.

The modelling framework suggested in this paper is related to the approaches of Altissimo et al. (2001, 2010), Bair and Tibshirani (2004) and Bair et al. (2006). We start with a large number of variables; and rather than extracting one or more common factors from all available variables at hand, we first perform a preselection based on well-specified statistical criteria ("supervised principal components"). Extracting common factors from a pre-selected subset of indicators has also been labelled as "targeted predictors" approach (Boivin and Ng, 2006; Bai and Ng, 2008). The rationale for "targeted" or "supervised" common factors is that extending a data set with more and more variables that bear little information about the targeted reference series does not necessarily improve the in- or out-of-sample fit. On the contrary, leaving out irrelevant data and the associated false signals produces a composite indicator that is focussed on the reference series rather than purely on the common variance of a large data set, where the latter may be ill defined from an economic observer's perspective.

Principal components are usually extracted in data rich environments. The availability of many predictors was the reason for Stock and Watson to apply principal components in forecasting (Stock and Watson 2002a). The method also belongs to the standard toolkit for the construction of composite indicators (OECD, 2008). However, as the principal component procedure exclusively addresses the covariance of the indicators, it is not guided by a target. That is why principal component analysis is often classified as an "unsupervised" approach (James et al. 2013, p. 375). Thus, for composite indicators, some implicit selection or screening process is often performed in advance. This screening in data rich environments is important, because a bulk of unsuited indicators could shift the first principal component away from measuring the business cycle. To avoid such a shift away from the target the individual indicators should be clearly related to the target.

[1] The KOF Economic Barometer, a composite indicator resulting from the procedure suggested in this paper, is published monthly since April 2014. For details and all data vintages, see http://www.kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-economic-barometer.html. For a detailed documentation of this composite indicator, see Abberger et al. (2014); for earlier versions, see Graff (2010). A brief history of the KOF Economic Barometer from the first version in 1976 is given in Appendix A of this paper.