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The predictive power of the business and bank sentiment of firms: A high-dimensional Granger Causality approach

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ABSTRACT

We study the predictive power of industry-specific economic sentiment indicators for future macro-economic developments. In addition to the sentiment of firms towards their own business situation, we study their sentiment with respect to the banking sector – their main credit providers. The use of industry-specific sentiment indicators results in a high-dimensional forecasting problem. To identify the most predictive industries, we present a bootstrap Granger Causality test based on the Adaptive Lasso. This test is more powerful than the standard Wald test in such high-dimensional settings. Forecast accuracy is improved by using only the most predictive industries rather than all industries.

1. Introduction

Sentiment indicators are often considered to be among the most important leading indicators of the real economy (Dreger & Kholodilin, 2013) and are therefore closely followed by business cycle analysts, central banks and business owners (Claveria, Pons, & Ramos, 2007; Martinsen, Ravazzolo, & Wulfsberg, 2014; Vuchelen, 2004). However, studies on the predictive power of sentiment indicators find mixed results. While many studies find that sentiment indicators have predictive power for future economic developments (Abberger, 2007; Christiansen, Eriksen, & Moller, 2014; Hansson, Jansson, & Lof, 2005; Klein & Oezmucur, 2010; Kumar, Leone, & Gaskins, 1995; Lemmens, Croux, & Dekimpe, 2005), others conclude that sentiment indicators provide only limited information for predicting economic variables (Claveria et al., 2007; Cotsomitis and Kwan, 2006; Dreger and Kholodilin, 2013 and Bruno, 2014).

An important communality between these studies is the use of aggregate sentiment indicators. This paper, instead, examines the predictive power of disaggregate sentiment indicators. Especially in the context of business sentiment – as is the topic of this paper – some segments have more predictive power than others. Here, we segment firms according to their industry. Our methodology takes into account that different industry segments might contain predictive power for different macro-economic indicators.

To study the predictive power, we use a Granger Causality approach. A set of time series Granger Causes another time series if the former has incremental predictive power for the latter. Granger Causality tests in *low-dimensional* time series settings have a long history. They are used, among others, in macro-economics to study the predictive power of monetary aggregates for output and price variables (Sahoo & Acharya, 2010), in operational research to study the predictive power of academic literature for practitioner literature (Ghosh, Troutt, Thornton, & Offodile, 2010), or in finance to study the predictive power of volume for stock prices (Blasco, Corredor, Del Rio, & Santamaria, 2005). Because predictive analysis based on disaggregate sentiment indicators requires handling a large number of such indicators, we introduce a Granger Causality test for *high-dimensional* time series data.

Recently, testing procedures for high-dimensional cross-section data has gained attention, for instance Meinshausen, Meier, and Bühlmann (2009); Wasserman and Roeder (2009) and Chatterjee and Lahiri (2011). We extend the residual bootstrap procedure of Chatterjee and Lahiri (2011) to high-dimensional *time series* data. The bootstrap test statistic, based on the Adaptive Lasso (Zou, 2006), identifies those industry segments whose predictive power is statistically significant. Our simulation study shows that this test statistic is more powerful than the standard Wald test statistic in a high-dimensional setting. Furthermore, important gains in forecast accuracy are obtained by not using all industry segments but by first selecting the most predictive ones using the bootstrap test.

We use a unique data set that not only measures the sentiment of firms towards their own situation ("*business* sentiment") – as is classical for sentiment indicators – but also measures the

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sentiment of firms towards the banking industry ("*bank* sentiment"). For the economy to be able to grow, it is essential that firms have access to credit, typically provided by banks. Especially in the aftermath of the recent economic downturn and banking crises, distressed banks can constrain the economy (Dell'Ariccia, Detragiache, & Rajan, 2008; Fernandez, Gonzalez, & Suarez, 2013; Kroszner, Laeven, & Klingebiel, 2007).

The remainder of this article is structured as follows. In Section 2, we discuss the contribution of our paper to the Business Sentiment literature. Section 3 describes the data on business and bank sentiment, as well as the macro-economic indicators. Section 4 introduces Granger Causality Testing in high-dimensional time series models. In Section 5, a simulation study shows the good performance of our methodology in terms of size and power of the test statistic and forecast accuracy. In Section 6, we apply the proposed methodology to identify the most predictive industry segments for several future macro-economic indicators. In Section 7, we show that forecast accuracy can be improved by using only the most predictive industry segments instead of all industry segments. The robustness of our findings is investigated in Section 8. Finally, Section 9 concludes.

2. Contribution

Our objective is to study the predictive power of Business Sentiment Surveys for future macro-economic growth. Business Sentiment Surveys are carried out on a monthly basis by various public and private institutions. These surveys are the most popular channel to get insight into the beliefs of economic agents at the supply side of the economy. If business owners feel confident about their current and future economic situation, they might invest more and increase their activity. Hence, Business Sentiment Surveys are often seen as early indicators for future economic developments.

The Joint Harmonized EU Programme of Business and Consumer Sentiment Surveys systematically collects sentiment data using surveys. The Business Sentiment Survey includes questions on several aspects of the firm's economic situation, such as their expected production, selling prices and exports. In contrast to Consumer Sentiment Surveys that include questions on the consumer's assessment of the overall economy, Business Sentiment Surveys typically only consist of an evaluation of each firm's own economic situation, i.e. the well-known "business sentiment" (e.g. Abberger, 2007; Christiansen et al., 2014; Claveria et al., 2007; Gelper and Croux, 2010; Hansson et al., 2005; Klein and Oezmucur, 2010; Lemmens et al., 2005.).

In addition to business sentiment, we also study "bank sentiment", i.e. the sentiment of firms towards the banking industry. Studying bank sentiment is relevant since access to financial resources is crucial for firms being able to grow. Typically, these financial resources are provided by banks. This is especially true for small- to medium-sized firms (e.g. Angilella & Mazzu, 2015; Beck & Demirguc-Kunt, 2006). Germany, the country we study in this paper, is dominated by this type of companies: in our sample, around 93% of the respondents are small- to medium-sized firms. To the best of our knowledge, we are the first to study the importance of sentiment towards the banking industry.

Studying the predictive power of these business and bank sentiment indicators is challenging given the large amount of sentiment indicators that is available. In our sentiment application, 150 sentiment indicators are measured over 40 months. We combine all 150 sentiment indicators in one large model. To handle this high-dimensionality, we use Penalized Maximum Likelihood estimation. Our approach also involves a selection procedure: out of the 150 sentiment indicators, we select the most predictive ones using a Granger Causality test. These selected sentiment indicators are then used to forecast macro-economoic growth.

Table 1
Industry segments. Businesses are divided into 10 industry segments.

Industry	Description	Sector
Industry 1	Agriculture, forestry, fishing, mining and quarrying and other industry	Primary
Industry 2	Manufacturing	Secondary
Industry 3	Construction	Secondary
Industry 4	Wholesale and retail trade, transportation and storage accommodation and food and service activities	Tertiary
Industry 5	Information and communication	Quaternary
Industry 6	Financial and insurance activities	Quaternary
Industry 7	Real estate activities	Quaternary
Industry 8	Professional, scientific, technical administration and support service activities	Quaternary
Industry 9	Public administration, defense, education,	Quaternary
Industry 10	Other services	Quaternary

To handle the high-dimensionality of sentiment data, previous studies either (i) summarize the information from all individual sentiment indicators into a aggregated sentiment indicator and study the latter's predictive power (Abberger, 2007; Christiansen et al., 2014; Claveria et al., 2007; Gelper & Croux, 2010; Hansson et al., 2005; Klein & Oezmucur, 2010), or (ii) estimate separate models for the individual sentiment indicators and combine the forecast from these models (Martinsen et al., 2014). However, these approaches involve several issues. By aggregating, one risks losing valuable information. Though aggregate indicators are often followed by business analysts and used in economic research, the individual sentiment indicators might contain even more relevant and interesting information (Roos, 2008). Indeed, Martinsen et al. (2014) find that forecast models with individual sentiment indicators considerably improve models with aggregated sentiment indicators. An advantage of our approach compared to the forecast combination approach of Martinsen et al. (2014) is that we investigate whether forecast performance can be improved by using only the most predictive indicators instead of using all. Our empirical results, to be discussed in Section 7, show that further improvements in forecast performance are indeed obtained by using only the most predictive indicators.

3. Data

We use a unique data set provided to us by EUWIFO, the European Economic Research Institute. EUWIFO is an owner-managed business that conducts business climate interviews. By conducting interviews with firms spread over Germany, EUWIFO gathers information on the confidence these firms have in their own economic situation and in the banking sector. Firms are divided into segments according to the industry in which they are active. To this end, we use NACE codes since this is the standard business classification framework in the European Union (e.g. Weinstein, 2013). We consider 10 industry segments, as listed in Table 1.

The interviews consist of two parts. In the first part, the Business Survey, firms are asked to assess their own situation. In the second part, the Bank Survey, firms are asked to assess the German bank sector.

Business Survey. Each firm receives 9 questions to assess their own economic situation. They are asked to assess changes (this year compared to last year) in (1) turnover, (2) earnings, (3) number of employees, (4) investments, (5) incoming domestic orders, (6) incoming foreign orders, (7) utility and maintenance costs, (8) tax burden, and (9) cost through government red tape. For each question, answers are favorable, neutral or unfavorable. For all the firms within an industry segment, we calculate a balance of opinion for