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A text mining application on monthly price developments reports

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ABSTRACT

Text mining analysis provides big opportunities for economic research. Underlying natural language processing techniques allow us to read the monthly price developments reports (MPDR) of the Central Bank of the Republic of Turkey (CBRT) and to analyse the words, to explore topics and clusters inside. Previous literature on CBRT documents has focused on making word clouds, measuring the sentiments and therefore it is limited with text documents. This study sets out to close this gap and extends the text mining analysis to measure the statistical consistency of the MPRDs with the annual consumer price index (CPI) inflation figures for Turkey. In this study, we showed that MPDRs contain intensifying references to core-groups/sectors in evaluation of inflation as well as they are interested in the tendency of inflation rather than its level. We also showed that how the clusters of MPDRs are significantly consistent with the annual CPI inflation figures from statistical point of view.

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1. Introduction

The concept of an independent central bank, which has been enacted in the change in the law of the Central Bank of Republic of Turkey (CBRT) dated 5/5/2001 has brought transparency and accountability with it. Afterwards, it has been necessitated to increase the communication channels in the direction of enhancing the transparency of CBRT due to implicit and explicit inflation targeting strategies. The market agents are carefully examined all the communication channels used by CBRT and their economic and financial positions are determined according to the information they receive from these channels due to the global economically events such as crisis, turbulence, etc. especially occurred after the year 2008.

The impact of monetary policy tools on inflation realizes through “monetary transmission mechanism” (Christiano and Eichenbaum, 1992). The “expectations channel” in this mechanism is mostly affected by the communication channels of CBRT and the perceptions them create in the markets. Since the year 2005, CBRT has implemented the explicit inflation targeting, and it has been in a managerial position in the perceptions of the economic community with its communication channels (Kara, 2008). The communication channels of the CBRT can be divided into two parts (CBRT, 2016). The first is the Governor's speeches and the announcements about decisions of Monetary Policy Committee (MPC). The second is the research and publications which includes the reports, the monetary and exchange rate policy texts, the social media, the live webcasts, the press briefings, the Central Bank Review, the Research Blog, books, booklets and factsheets.

Among these communication channels, it can be suggested that the most influential in the short run is the Governor's speeches which is about the implementation of monetary policy, and the summary of the MPC meetings which reflects the decisions on short-term interest rates and the CBRT's thoughts on the economic situation. On the other hand, the reports under research and publications can be suggested as an important input to market agents in determining theirs medium-long term positions. The most important ones of them: the Inflation Report which presents current inflation targeting framework of the CBRT, the Monthly Price

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Developments Report (MPRD) which analyses monthly inflation developments to be interpreted by the public in a healthier manner, and the Financial Stability Report which the CBRT publicly shares its views and assessments on the financial sector. A closer look at the CBRT's reports reveals that many reports and researches are either irregular or have been published at intervals of 3 months or more (for example, the Inflation Report is published for 3 months and the Financial Stability Report for 6 months). The most frequent and regularly published report in terms of the frequency of publications is the MPDR.

Text mining allows to measure and analyse documents using natural language processing techniques (Feldman and Sanger, 2006), it can also be defined as the ability of a machine to analyse, understand, and generate text. In text mining, all types of the text information regardless of the format can be transformed to numbers indexed for each of documents, thus unstructured text data become the structured data which are similar to be used in economic research. With the transformation of unstructured data into structural data, the framework of economic analysis is also expanding. However, we will deal with not only the text mining analysis of the comments made in MPDRs but also measuring the consistency of them with the annual consumer prices index (CPI) inflation figures over time in this paper. We will analyse the MPDRs for a long time-span. By examining the MPDRs, we will try to extract frequent-words and to identify topics, and to assign MPDRs into clusters according to the words used in them. We will have some considerations about the consistency of the MPDRs with the annual CPI inflation figures.

The rest of this paper is organized as follows. We start by giving an overview of studies in the literature which mostly examines the monetary texts with limited them text mining analysis. Then, we introduce the dataset and provide a short description of the text mining approach used in this paper. In the results part, we first present the results of the text mining analysis steps such as filtering, topic identifying and clustering. Then, we present the findings of analysis of variance in which the clusters of MPRD and annual CPI inflation figures are examined. It is concluded with some suggestions for further research.

2. Related studies

Since the texts of monthly reports has not been extensively studied in the literature, the review in this paper is mostly based on the quarterly and annual reports. Blinder et al. (2008) and Acosta (2015) studies have a very good compilation of how the text mining analysis is used in the examination of the central bank communication policies. Previous literature shows us that it has been used text mining techniques in so many different forms to analyse the documents, however these findings obtained from the analysis of text mining have been rarely used to obtain new findings in advanced analyses. As highlighted in Iglesias et al. (2017), the big empirical challenge for the text mining analysis is to transform the texts into significant variables which they can be used in another model or analyse.

From this point of the view, the closest papers in the literature are Lucca and Trebbi (2009) and Hansen and McMahon (2015). In the study of Lucca and Trebbi (2009), they applied computational linguistic tools to Federal Open Market Committee (FOMC) statements and measure the effects of them on the macroeconomic variables. They used a vector autoregression framework to measure the effects of the variables constructed by using FOMC statements on the macro-economic variables.

Similarly, Hansen and McMahon (2015) constructed some variables, using Latent Dirichlet Allocation (LDA) for topic modelling and dictionary methods to measure the sentiments, from FOMC texts to represent the dimensions of the monetary policy of Federal Reserve (Fed). Then, they examined the effect of these variables on macro-economic variables with a factor augmented vector autoregression approach.

Of course, the issue of central bank's communication has been studied not only for Fed's texts but also for other central banks'. In the study of Jansen and Haan (2010), they tried to assess the consistency of European Central Bank (ECB) Communication using Word scores method and they suggest that ECB's communication during the years between 2002 and 2009 of European Monetary Union (EMU) as internally consistent but sometimes was flexible. Also, Ranaldo and Rossi (2010) studied effects of Swiss National Bank announcements on the financial market.

Two studies attempting to analyse CBRT's its communication policy with text mining have been found in the literature as far as we can detect. These are the works of Kahveci and Odabas (2016) and Iglesias et al. (2017). However, these works have been limited to the analysis of texts only, and there is no attempt to make an advanced analysis using the findings of text mining.

Kahveci and Odabas (2016) argue that their study differs from the literature in terms of the period of analysis examined and the software used. In their studies comparing the communication policies of the Fed, ECB and CBRT, they found that the optimistic tone of Fed has decreased over time while its certainty tone has increased. The authors say that there is no significant tone difference in the certainty, the optimism and the realism of ECB and CBRT, however they emphases that there is a significant increase of the optimistic tone for the CBRT's statements of the years 2014 and 2015.

The main contribution of the work done by Iglesias et al. (2017) is seen as an improvement of a computational approach to incorporate dynamics and topic evolution by applying not only LDA algorithm, but also Dynamic Topic Models. From topics of the minutes and statements published by CBRT, they inferred that the communication policy of CBRT have been changing over time as the global economic conditions have changed substantially, and the complexity of monetary policy strategy of CBRT has increased as the financial crisis amplified capital flows volatility. In Iglesias et al. (2017), they highlighted that the focus of communication has strengthened in the recent period (last two years) and the tone confirms the strategy of providing price stability.

3. Data and methodology

3.1. Data

MPDRs are published by CBRT within one working day, following the announcement of price statistics by the Turkish Statistical Institute. These monthly reports have important roles since they include CBRT's initial remarks on the inflation figures and aim to contribute to a sounder interpretation of the monthly inflation developments by the public during the period between the announcement of the official price statistics and the MPC meeting. These reports mainly mention the developments in the CPI inflation, while at least the developments in the Producer Prices Index (PPI) inflation are mentioned.

In this paper, we examined the MPDRs reports published between June-2006 and Jan-2018. A total of 138 reports[1] those are available for this time interval have been analysed. These reports

[1] According to time span, there should be 140 MPDRs were published, but we successfully downloaded 138 reports from http://www.tcmb.gov.tr. Two reports in English are missing for the periods April-2009 and July-2012, however they are available in Turkish.

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