Applying Lessons from the Past? Exploring Historical Analogies in ECB Speeches through Text Mining, 1997–2019*

Anselm Küsters

Max Planck Institute for Legal History and Legal Theory

By employing text mining methods such as structural topic modeling to examine all 2,135 speeches by ECB Executive Board members between February 1997 and October 2019, this paper identifies and analyzes a significant semantic change that occurred in ECB communication in the transition from the Great Moderation to the Great Recession. The methodology also allows for a structured and empirical assessment of the hypothesis that central bankers used "lessons from the past" during the crisis. The quantitative and qualitative results indicate that references to historical analogies indeed increased at the height of the crisis (2009–11) but often served only rhetorical functions.

JEL Codes: B29, C89, E58, N14.

1.   Introduction: Applying Lessons from the Past?

When the financial crisis of 2007 erupted, the limitations of mainstream economic models soon became apparent. Jean-Claude Trichet, then president of the European Central Bank (ECB), found the available models of limited help: "In the face of the crisis," he reported during an opening address in November 2010, "we felt abandoned by conventional tools." In the absence of clear guidance from existing analytical frameworks, one area of literature promised help: historical analysis. "Historical studies of specific crisis episodes highlighted potential problems which could be expected. And they pointed to possible solutions. Most importantly, the historical record told us what mistakes to avoid" (Trichet: November 18, 2010).[1]

Trichet's reflections were by no means an outlier. Following the crisis's outbreak, numerous observers used references to the Great Depression and the lessons that might be learned (e.g., Eichengreen and O'Rourke 2010; Ritschl 2012; Hesse, Köster, and Plumpe 2015, pp. 205–16; Eichengreen 2016). In his influential monograph, Eichengreen (2015) argues that during this period of crisis, a repeat of the 1930s was avoided because central bankers and politicians recognized the Great Depression's lessons regarding monetary and fiscal policy. Indeed, a whole generation of macroeconomists that influenced or commented on policy during this period, including Larry Summers, Paul Krugman, Ben Bernanke, Peter Temin, Bradford DeLong, and Christina Romer, had been influenced by Charles Kindleberger at the Massachusetts Institute of Technology to think they could learn from the Great Depression (Hansen 2019, p. 169). However, while applying historical lessons prevented the worst in 2008, Eichengreen (2015) argues, this ironically increased the duration of the Great Recession because large monetary and fiscal stimuli reduced the perceived need for subsequent reforms. By contrast, stimuli measures in the 1930s had been accompanied by substantial banking reforms. In effect, Eichengreen thus argues that those responsible only applied *certain* lessons while ignoring others.

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[1]References to ECB speeches that are included in the corpus are displayed in the main text and abbreviated with name of speaker and full date, but not listed separately in the References.

The argument that economic history played an important role in central bank action and communication during the crisis is largely based on sparse and anecdotal evidence. This paper, in contrast, carries out a structured and empirical assessment of the semantic change that occurred in ECB communication in the transition from the Great Moderation to the Great Recession. To do so, it examines all 2,135 speeches by ECB Executive Board members between February 1997 and October 2019, which also allows for a more nuanced, dynamic analysis of the extent to which policymakers applied historical analogies. In particular, the occurrence of such analogies is examined through the estimation of a structural topic model, frequency plots of key bigrams and dates, as well as manual classification of speeches. The quantitative and qualitative results indicate that references to historical analogies increased at the height of the crisis (2009–11) but often served only rhetorical functions.

This paper contributes to a growing literature that analyzes central bank communication, which has become an important monetary policy tool since the 1990s. Scholars have found that central banks' communication can move financial markets, enhance the predictability of monetary policy, and help achieve the banks' stabilization objectives (Blinder et al. 2008). However, since the publication of Morris and Shin's (2002) influential paper, central bankers are well aware that increases in the precision of the published information can also have welfare-reducing effects. In practice, therefore, communication strategies usually improve through a trial-and-error process (Woodford 2005). This paper contributes to a better understanding of the ECB's communication process during the Great Recession by analyzing the historical analogies contained in ECB Executive Board members' speeches. Since the literature suggests that central bank communication should be focused on topics closely related to monetary policy (Blinder et al. 2008), identifying the presence of complex and contested "lessons from the past" raises the question of whether the latter constitute "noise" that ultimately reduces the predictability, effectiveness, but also general accessibility (Haldane and McMahon 2018) of monetary policy decisions.

The following analysis rests on new text mining methods (overview: Bholat et al. 2015) and thus contributes in particular to a subset of this economics literature that aims to quantify central banks' communication through means of natural language

processing (e.g., Masawi, Bhattacharya, and Boulter 2014; Hansen and McMahon 2016; Hansen, McMahon, and Prat 2018; Takeda and Keida 2018; Hansen, McMahon, and Tong 2019; Hansson 2021). These computer-enabled approaches can investigate a large collection of documents ("corpus") at a scale that would be impossible by human close reading. Moreover, such approaches can extract meaning that would be overlooked by humans due to prior beliefs or expectations. It is therefore not surprising that recently, central banks' internal research departments have themselves started to use text mining methods—for instance to review the ECB's monetary policy during its first 20 years of existence (Hartmann and Smets 2018), to assess the effectiveness of forward guidance in unconventional times (Coenen et al. 2017), and to test empirically whether central banks' decisions and their justifications are communicated in clear language (Qvigstad and Schei 2018). By discussing the corpus of ECB speeches in detail and by introducing methods such as structural topic modeling that so far have been overlooked in the analysis of ECB communication, this paper aims to advance this strand of research.

The remainder of the paper is structured as follows. The first section presents and explores the ECB corpus via descriptive statistics and several text mining methods, thereby revealing significant changes in ECB communication after the outbreak of the Great Recession: the number of ECB speeches increased, their net sentiment dropped from a generally positive to a negative tone, and their semantic content changed considerably. To understand the drivers behind these trends, the following section estimates a structural topic model that allows us to capture the main topics discussed by ECB Board members and their evolution over time. Since one can detect significant semantic differences between pre- and post-crisis speeches, the second part of the paper turns to the question of whether this semantic change was accompanied by an increased usage of historical lessons, as argued by Eichengreen and others. To answer this question, the next two sections define and then analytically trace the specific historical lessons that the ECB allegedly relied on during the Great Recession. Based on the estimated topics' dynamics, a frequency analysis of key bigrams and dates as well as manual classification of key speeches, the paper concludes that although some historical lessons are echoed in ECB speeches at the

height of the Great Recession, this is qualified by the small propor-
tion of speeches that actually describe these lessons as opposed to
simply mentioning them as a rhetorical device.

2.   Corpus: Institutional Context
and Descriptive Statistics

The corpus of ECB speeches contains the content of all speeches
of ECB Executive Board members until October 11, 2019, together
with limited metadata such as name of speaker and date.[2] Some
of the oldest speeches predate the existence of the ECB and were
given by the president of the European Monetary Institute (EMI),
which was the forerunner to the ECB. Thus, the corpus starts with
a speech given by Alexandre Lamfalussy, the first EMI president,
on February 7, 1997. After some slight manual changes to the cor-
pus,[3] the resulting database contains 2,135 speeches consisting of
3,114,853 words.

   Before turning to the explanatory analysis, it is helpful to reflect
on the nature of speeches as a source for analyzing the ECB's
decisionmaking and communication strategy. Speeches provide a
rich source of information (cf. Sussman, Ricchio, and Belohlav
1983, p. 188). Firstly, a speech captures the concerted effort of a
writer aiming to deliver a meaningful statement. Secondly, a speech

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[2]For a preliminary version of this paper, all speeches that were given by mem-
bers of the ECB's Executive Board between January 1, 2007 and December 31,
2015 were downloaded from the bank's digital archive and manually stored in
a single file. When this paper was prepared for final publication in October
2019, the ECB released a precompiled data set containing the content of all
ECB speeches on its website, together with some metadata. However, speeches
given at the time of the European Monetary Institute (1997–98) are not com-
plete. In order to facilitate comparisons with related work in the field of central
bank communication, the final version of this paper relies on this publicly avail-
able data set. Source: European Central Bank, Speeches data set. Retrieved from
https://www.ecb.europa.eu/press/key/html/downloads.en.html (accessed Octo-
ber 25, 2019).

[3]First, all non-English speeches were dropped in order to enable the later text
mining exercises. Second, all observations that merely referred to PowerPoint
slides instead of transcribed speeches were likewise dropped. Third, a speech
jointly held by Willem F. Duisenberg and Eugenio Domingo Solans on August
30, 2001 was dropped so that every speech could be linked to a single speaker.
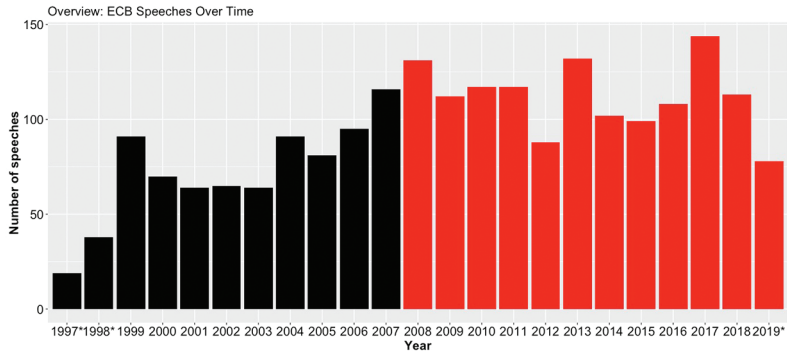Finally, the speakers' names within the texts were removed.

addresses an issue deemed important enough to consume time of an ECB Executive Board member. Thirdly, it is reasonable to assume that digitally available speeches are formally sanctioned by the ECB, meaning that they convey the institution's official position in an attempt to inform, persuade, or reinforce the beliefs of a given audience. Although devoted to a particular audience and occasion, speeches are, fourthly, indirectly addressed to a mass audience, and Board members are undoubtedly aware of this potential.

However, one has to keep in mind that central bankers follow certain communication rules that can be limiting. Most importantly, they have strong incentives to avoid dramatizing communication with the public. Central bankers try to manage expectations in an attempt to ensure the effectiveness of monetary policy, and their speeches are consciously developed to substantiate a given position. Additionally, the oral delivery influences these texts' length, size, and language (Volkens et al. 2013, p. 153). In short, ECB speeches are no objective display of the speaker's underlying thoughts but aim to influence the public's expectations.

Addressing the internal decisionmaking processes more directly would require access to source material that is currently not available. Particularly the internal memos and other declassified statements that have been shown to be particularly helpful in tracing the uses of the past (Neustadt and May 1986) are usually not accessible to scholars analyzing contemporary events. By contrast, today's public sources such as ECB speeches are available in an electronic machine-readable format that allows scholars to analyze them quantitatively in the hope that this aggregate approach can shed light on underlying preferences of these actors. Moreover, even if results derived from publicly available sources are biased by the central bank's communication strategy, it is important to know whether this strategy presents the past as a foundation of central bankers' decisions and, if so, how it discriminates among different historical experiences of member states. As an analysis of the narrative elements of ECB communication, the following results illuminate the ECB's framing of the crisis.

The remainder of this section explores the ECB corpus first via different basic descriptive statistics, followed by more sophisticated text mining methods. As will become clear, the outbreak of the Great Recession changed ECB communication significantly: the number of

Figure 1. The Corpus of ECB Speeches Given between February 1997 and October 2019, Plotted Over Time

Source: ECB corpus; see description in the main text.
Note: Since 1997, 1998, and 2019 feature only partial observations, they are not directly comparable and thus marked with an asterisk.

ECB speeches increased, their net sentiment dropped from a generally positive to a negative tone, and their semantic content changed considerably. To begin with, it is worth emphasizing that this corpus does not constitute a *sample* of ECB speeches, but rather captures the whole *population* of speeches since the ECB replaced the EMI on June 1, 1998. This means that the corpus does not suffer from any form of sample-selection bias. Plotting this population over time reveals a significant increase in number of speeches given over time (Figure 1). One could hypothesize that this increase in semantic data was linked to the challenges arising from the Great Recession. This interpretation is supported by the findings of Coenen et al. (2017, p. 9), who find that the minutes of central bank committee meetings of a large number of central banks, including the Federal Reserve, the Bank of England, the Bank of Japan, and the Swedish Riksbank, have become significantly longer since the crisis. Similarly, Meade, Burk, and Josselyn (2015) show that the diversity of views, as measured by the minutes of the Federal Open Market Committee, has increased particularly since the financial crisis.

Differentiating according to speaker underlines that ECB presidents (Willem Duisenberg, Jean-Claude Trichet, Mario Draghi) exhibit an important public function due to the more than 100 speeches that they deliver throughout their term (Table 1). However,

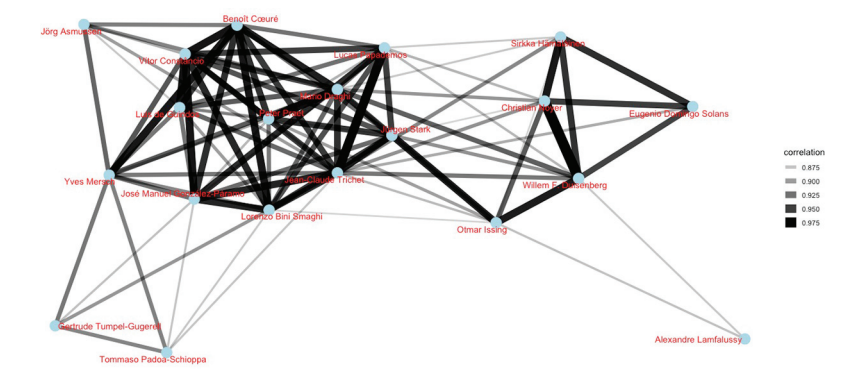**Table 1. Number of ECB Speeches Given by Each Executive Board Member between February 1997 and October 2019**

Speaker (Nationality)	Period	# Speeches (Absolute)	# Speeches (in %)	# Months Active	Speeches/Months (Average)
Alexandre Lamfalussy (Hungarian/Belgian)	Feb. 1997–Jun. 1997	7	0.33%	5	1.4
Benoît Cœuré (French)	Feb. 2012–Sep. 2019	177	8.29%	92	1.9
Christian Noyer (French)	Nov. 1998–Apr. 2002	46	2.15%	42	1.1
Eugenio Domingo Solans (Spanish)	Dec. 1998–Apr. 2004	59	2.76%	65	0.9
Gertrude Tumpel-Gugerell (Austrian)	Jun. 2004–May 2011	136	6.37%	96	1.4
Jean-Claude Trichet (French)	Nov. 2003–Oct. 2011	318	14.89%	96	3.3
Jörg Asmussen (German)	Mar. 2012–Dec. 2013	36	1.69%	22	1.6
José Manuel González Páramo (Spanish)	Nov. 2004–May 2012	96	4.50%	91	1.1
Jürgen Stark (German)	Jul. 2006–Dec. 2011	66	3.09%	66	1.0
Lorenzo Bini Smaghi (Italian)	Oct. 2005–Dec. 2011	108	5.06%	75	1.4
Lucas Papademos (Greek)	Mar. 2003–May 2010	87	4.07%	87	1.0
Luis de Guindos (Spanish)	Jun. 2018–Oct. 2019	33	1.55%	17	1.9
Mario Draghi (Italian)	Nov. 2011–Oct. 2019	182	8.52%	96	1.9
Otmar Issing (German)	Jul. 1998–May 2006	82	3.84%	95	0.9

Table 1. (Continued)

Speaker (Nationality)	Period	# Speeches Absolute	# Speeches (in %)	# Months Active	Speeches/Months (Average)
Peter Praet (Belgian/German)	Jun. 2011–May 2019	118	5.53%	96	1.2
Philip R. Lane (Irish)	Jul. 2019–Oct. 2019	4	0.19%	4	1.0
Sabine Lautenschläger (German)	Feb. 2014–Jun. 2019	79	3.70%	65	1.2
Sirkka Hämäläinen (Finnish)	Oct. 1998–Apr. 2003	43	2.01%	55	0.8
Tommaso Padoa-Schioppa (Italian)	Sept. 1998–Nov. 2004	46	2.15%	75	0.6
Vitor Constâncio (Portuguese)	Jul. 2010–May 2018	125	5.85%	95	1.3
Willem F. Duisenberg (Dutch)	Jun. 1997–Oct. 2003	149	6.98%	77	1.9
Yves Mersch (Luxembourgian)	Feb. 2013–Sept. 2019	138	6.46%	80	1.7
Total		**2,135**	**100.00%**	**1,492**	**1.4**

Source: ECB corpus; see description in the main text.
Note: "Period" refers to the period during which the respective Board member gave speeches; this does not necessarily have to correspond to the official period of employment.

Figure 2. Correlation Network between ECB Executive Board Members' Speeches

Source: ECB corpus; see description in the main text.
Note: Using the phi coefficient, correlation was calculated as correlation among words, which indicates how often they appear together relative to how often they appear separately.

some Board members such as Benoît Cœuré, Yves Mersch, and Gertrude Tumpel-Gugerell have been comparably active speakers. Each member, except Philip Lane, who was the latest addition to the Board at the end of the period examined here, is represented by several dozen speeches, meaning that the results will not be driven by a single dominant speaker. The calculated statistics on average speeches per month strengthen this argument.

The impression that there is no single dominant speaker is further corroborated by the correlation network displayed in Figure 2, which quantifies how similar speakers tend to be to each other with respect to speech content (cf. Silge and Robinson 2017).[4] Rather than a high number of small clusters of speakers, one large network

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[4]In order to identify speakers that are similar to each other in semantic content, one has to find the pairwise correlation of word frequencies within each speaker's speeches. Here, correlation among words indicates how often they appear together relative to how often they appear separately. On a technical level, this is done by calculating the so-called phi coefficient, a measure for binary correlation (which is equivalent to the well-known Pearson correlation when being applied to binary data). Next, one can filter for stronger correlations among speakers, and visualize them in a network, as done in Figure 2. For more details, see Silge and Robinson (2017).
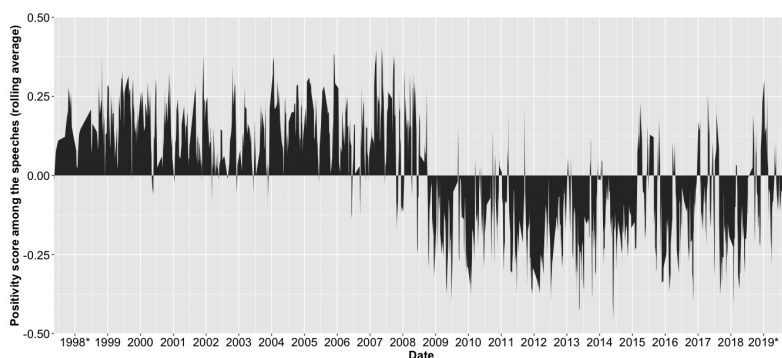
with strong correlations between almost all of the speakers emerges, indicating a strong semantic similarity between their speeches. The only speakers that do not reach the necessary threshold for inclusion in the network figure are the recently added Philip Lane as well as Sabine Lautenschläger, whose speeches are semantically very distinctive due to their almost exclusive focus on banking supervision. This strong semantic similarity reflects the speakers' belonging to a close epistemic community of global monetary policy experts with a shared vocabulary as well as the presence of an underlying overall ECB communication strategy.

Still, a closer look reveals that the high semantic correlation holds particularly for the second and third generation of Board members that can be associated with the fight against the Great Recession. In contrast, the cluster surrounding the first ECB president, Willem Duisenberg, is relatively less correlated with the rest of the speakers. This cluster is solely formed by Board members that served during the first years of Duisenberg's term such as Otmar Issing, Sirkka Hämäläinen, Christian Noyer, and Eugenio Domingo Solans as well as Alexandre Lamfalussy, the EMI's founding president.[5]

Next, the ECB corpus is explored via sentiment analysis, a method that detects emotional content of text programmatically (cf. Bholat et al. 2015, p. 8). This method assumes that the sentiment of a text can be gauged by considering the text as a combination of its individual words and the sentiment content of the whole text as the sum of the sentiment content of the individual words. One therefore needs a sentiment dictionary, i.e., a list of words that allocates sentiment scores to individual words within the text. Following everyday language, the popular Harvard IV-4 dictionaries, as used by Tetlock (2007), associate words like "tax," "cost," and "liability" with negative sentiment, although these words' tone is rather neutral in the context of financial markets. The following analysis is therefore based on the Loughran and McDonald (2011) dictionary that allocates words into six different categories (negative, positive, uncertainty, litigious, constraining, superfluous) based on the most

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[5]The only exception is Tommaso Padoa-Schioppa, who finds himself in the lower left corner of the network close to Gertrude Tumpel-Gugerell, with whom he shares the responsibility for financial integration and the European payment system.

**Figure 3. ECB Speeches' Sentiment Over Time
(five-point rolling average)**

Note: Based on the Loughran/McDonald dictionary, net sentiment is calculated for each date that featured one or more speeches by using the positivity score (as described in the main text) and then plotted over time. Since 1998 and 2019 feature only partial observations, they are not directly comparable and thus marked with an asterisk.

likely interpretation of a word in a business context. By using the Loughran/McDonald dictionary, it is taken into account that ECB speeches contain numerous financial terms, thereby ensuring that these terms are not counted as negative per se.

After classifying all tokens, one can count the number of uses of each sentiment-associated word. For instance, the positive term that occurs most often is "stability" (16,372 times), probably referring to the ECB's primary objective of price stability, whereas the most frequent negative term is "crisis" (9,744 times), which predominantly refers to the Great Recession. Using the Loughran/McDonald dictionary ensures that a frequent term like "risk" (9,991 times) is not counted as negative, but as signaling uncertainty. Based on these classifications, net sentiment is calculated for each day that featured one or several ECB speeches via the positivity score, which equals $\frac{\sum \text{positive tokens} - \sum \text{negative tokens}}{\sum \text{positive tokens} + \sum \text{negative tokens}}$.

Based on these positivity scores, a rolling average of order 5 is shown, providing an approximation of the sentiment trend-cycle (Figure 3). The results make clear that throughout the Great Moderation, i.e., the first decade of the ECB's existence, ECB speeches were usually positive in tone, revealing the contemporary satisfaction
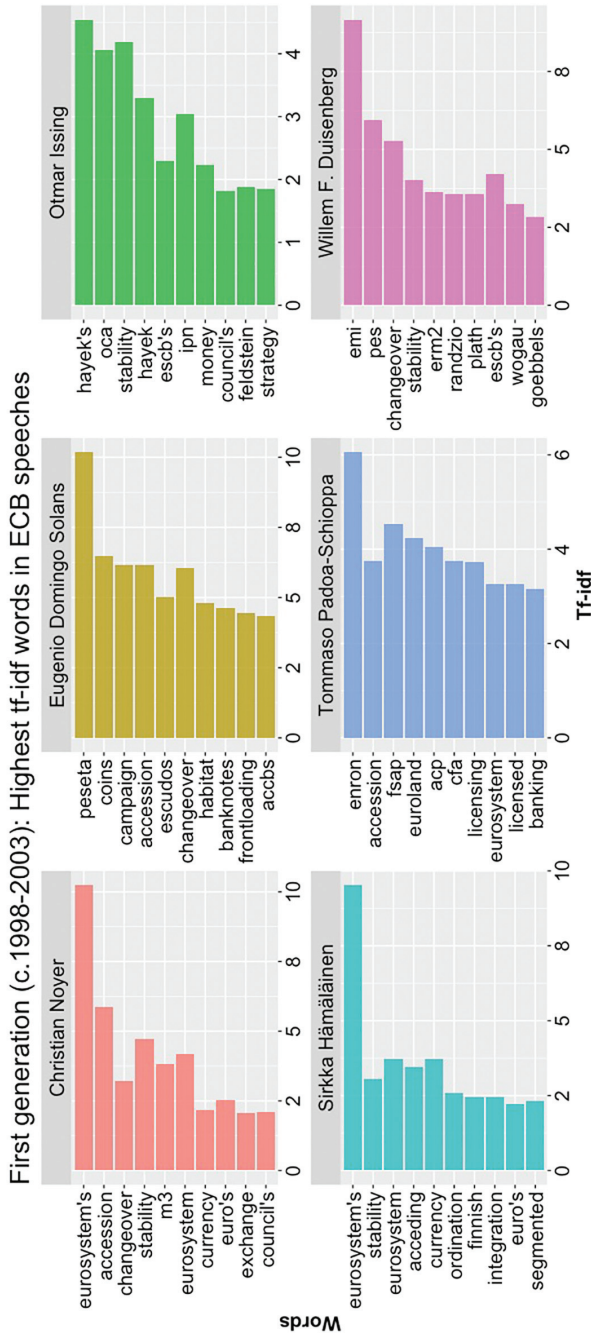
with the macroeconomic climate of these days. However, starting with Lehman Brothers' bankruptcy, the positivity score declines rapidly, achieving its lowest point during 2011 when contagion spread from Greece to other southern euro-zone member states. Despite ECB President Mario Draghi's announcement that "the ECB is ready to do whatever it takes to preserve the euro" in July 2012, the index recovers only slowly and stays predominantly negative until 2018.

These findings already point towards the usage of historical lessons that will be analyzed in the second part of this paper. It is plausible that such lessons were used more often in times of crisis and that sentiment analysis can help show when these times are occurring. Indeed, Eichengreen (2015, p. 377) postulates that historical analogies are "especially influential in crises, when there is no time for reflection" and "they resonate most powerfully when an episode is a defining moment for a country and society." Given the net sentiment pattern shown above, these two psychological prerequisites for the appearance of historical lessons—sense of urgency and perceived turning point—are fulfilled for the last decade of the corpus. Thus, if the hypothesis regarding the role of historical analogies in handling a crisis situation is true, one should find historical lessons in ECB speeches during the period of the Great Recession. The later analysis will show that this was indeed the case.

In the remainder of this section and the subsequent section, more advanced text mining methods will be employed in order to substantiate the semantic change between the first and the subsequent generations of Board members. These methods share the assumption that a speech's content can be quantified by looking at the underlying words (for an overview, see Silge and Robinson 2017; also, Wickham and Grolemund 2017). Typically, researchers start by calculating each term's tf-idf (term frequency–inverse document frequency) score, the frequency of a term adjusted for how rarely it is used. This score measures how important a word is to a document in a corpus of documents (cf. Silge and Robinson 2017). One gets a good impression of the most important topics in ECB speeches by determining the highest tf-idf words that were most specific to each speaker.

Figure 4 starts by plotting the 10 highest tf-idf words for the first generation of ECB Board members consisting of then President Willem

Figure 4. The 10 Highest tf-idf Words for Each Speaker in the First Generation of ECB Executive Board Members

First generation (c.1998–2003): Highest tf-idf words in ECB speeches

Source: ECB corpus; see description in the main text.

Note: This is based on calculating each term's tf-idf, which equals the frequency of a term adjusted for how rarely it is used. To enable better readability, the very low tf-idf values were scaled by a factor of 10,000. Of course, this does not change their relative size and therefore the message of this figure.
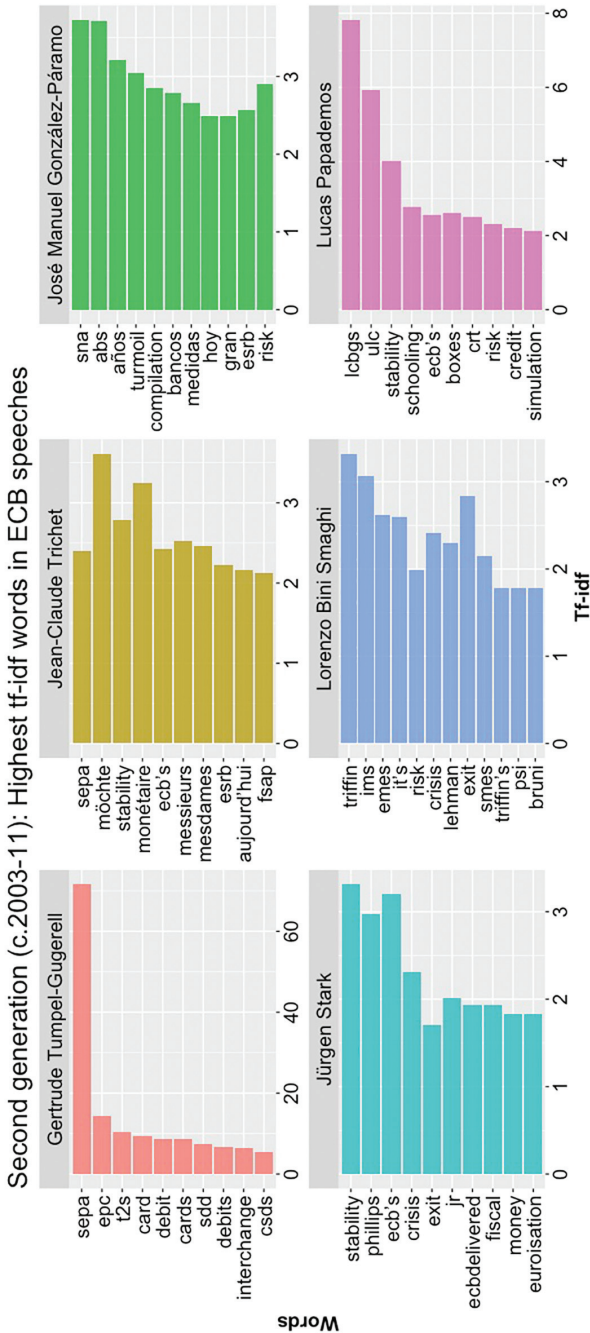
Duisenberg, his Vice President Christian Noyer as well as Otmar Issing, Tommaso Padoa-Schioppa, Sirkka Hämäläinen, and Eugenio Domingo Solans. Echoing the very beginnings of the ECB's institutional existence, terms like "accession," "changeover," and "Eurosystem" can be found multiple times. Issing, the ECB's first chief economist, was responsible for developing a monetary policy strategy in pursuit of price stability (Issing et al. 2001), and his word profile accordingly includes the term "strategy." Eventually, the ECB adopted a novel "two-pillar" strategy that combined a prominent role for money with a broadly based assessment of the outlook for price developments and risks to price stability (cf. Hartmann and Smets 2018, p. 10). This is echoed in the omnipresence of the term "stability," which is featured in four word profiles (Issing, Hämäläinen, Duisenberg, Noyer). The quantitative reference value for the growth rate of a broad monetary aggregate, "M3," can be found in Noyer's word profile. Finally, some terms indicate idiosyncratic national influences, e.g., the apparent importance of "Hayek" in Issing's speeches and the term "finnish" in Hämäläinen's word profile.

Turning to the second generation of ECB Board members, grouped around the presidency of Jean-Claude Trichet, one detects significant semantic changes (Figure 5). Most importantly, the second generation had to deal with the onset of the "crisis" (Smaghi, Stark) that unfolded in the wake of the "Lehman" collapse (Smaghi) and brought financial "turmoil" (González-Páramo) and "risk" (Papademos, González-Páramo) to the global economy. In such troubled times, less time was spent discussing "stability" of prices (cf. Section 5 below), but the term still appears in three word profiles (Trichet, Stark, Papademos). Another major challenge was the "SEPA" initiative, which was frequently mentioned by Jean-Claude Trichet and particularly Gertrude Tumpel-Gugerell. Interestingly, the word profile of Trichet also captures his inclination to integrate German or French sentences into his speeches whenever he visited one of these countries.[6]

Finally, Figure 6 displays the highest tf-idf words for Mario Draghi's term as ECB president, which ended—together with the

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[6]When preparing the corpus, all English, German, and French stop words were removed via standard stop-word lists. The presence of German and French words within the highest ranked tf-idf words thus indicates that Trichet's speeches included not only simple terms but also whole sentences in foreign languages.

Figure 5. The 10 Highest tf-idf Words for Each Speaker in the Second Generation of ECB Executive Board Members

Second generation (c.2003–11): Highest tf-idf words in ECB speeches

Figure 6. The 10 Highest tf-idf Words for Each Speaker in the Third Generation of ECB Executive Board Members

Third generation (c.2011-19): Highest tf-idf words in ECB speeches

observation period of this corpus—in October 2019. The figure is characterized by numerous abbreviations related to finance and banking such as "SSM" (Single Supervisory Mechanism), "CCP" (central counterparty clearing house), or "ABS" (asset-backed security). Together with other technical terms like "macroprudential," they belong to the large group of high tf-idf words that are used by several speakers alike and reflect the analyses and solutions that the ECB proposed in the face of the Great Recession. This also indicates that most speeches refer to the same underlying discourses or deliver the same official message. Nevertheless, there are a few specialized terms that can be linked to individual speakers, such as "schooling" (Papademos), "Brexit" (Lautenschläger), "Libra" (Mersch), and "gender" (Asmussen). This in turn suggests a certain division of labor among Board members.

In sum, explanatory analysis of the ECB corpus via descriptive statistics and text mining methods suggests a decisive break in the semantic message of ECB speeches between the pre- and the post-crisis period. Following the outbreak of the Great Recession, the number of ECB speeches increased significantly, their net sentiment dropped from a generally positive to a negative tone, and their semantic content changed considerably (as measured by word correlations and td-idf). In the next section, the associated change in speech content will be traced more precisely via topic modeling.

3.   Topic Modeling: Capturing Content and Dynamics

This section estimates a specific type of probabilistic topic model known as a structural topic model (STM).[7] Generally, topic models are algorithms for discovering the main themes that pervade a large collection of texts (Blei 2012). Without any prior categorization, topics emerge from the analysis of semantic data as captured in speeches and the model then organizes the corpus according to the discovered themes. These models are generative models of word counts, with a topic being defined as a mixture of words, with each word having a probability of belonging to a topic (cf. Silge and Robinson 2017). Analogously, a speech is understood here as a mixture of topics. The

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[7]For an overview, see http://www.structuraltopicmodel.com (accessed December 2, 2020).

key innovation of STM is that it allows document-related information to be incorporated into the topic model. In the case of the ECB corpus, metadata corresponds to the speaker's name and the year in which the speech was given. The following analysis traces the effect of these metadata on topical prevalence, i.e., the frequency with which a topic is discussed. STMs have been applied to international newspapers (Roberts, Stewart, and Airoldi 2016), online class forums (Reich et al. 2015), and religious texts (Lucas et al. 2015).

The usual pre-processing steps are performed, including the removal of stop words (uninformative words like "the"), numbers, and punctuation. In addition, all words with less than three characters are removed, i.e., mostly abbreviations. Next, a threshold needs to be defined, which corresponds to the minimum number of speeches in which a word needs to appear in order for the word to be kept within the vocabulary. Here, a threshold of 2 is selected, meaning that a term has to be mentioned at least twice in order to be kept within the corpus. Following these pre-processing steps, the final corpus consists of 1,989 speeches, 19,244 terms, and 1,423,280 tokens.

Topical prevalence is modeled as a formula consisting of relevant "covariates." Since the ECB speeches' content varies according to speaker and phase of the crisis, it is intuitive to allow topic prevalence to vary with these metadata. Consequently, the frequency with which a topic is discussed (*prevalence*) is defined as a function of the *speaker* variable, indicating the speaker's name, and the variable *year*, which is an integer measure of years running from 1997 to 2019.[8] Based on this formula, a 10-topic model is estimated.[9]

Why estimate precisely 10 topics? STM requires a fixed user-specified number of topics, but there is not a "right" answer to the number of topics that is appropriate for a given corpus (cf. Grimmer and Stewart 2013). Assuming too few topics results in distinct issues being aggregated, whereas too many topics results in several unstable clusters referring to similar issues. While some statistical metrics for calculating the optimal number of topics do exist (e.g.,

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[8]The variables are entered additively, and the year variable is allowed to have a nonlinear relationship in the estimation stage.

[9]Using *spectral initialization*, which means that independent of the seed that is set, the same results will be generated.
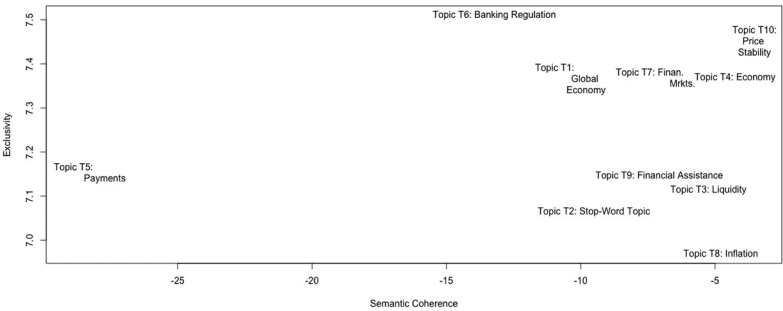
Cao et al. 2009), these measures only deliver the optimal number in a technical sense, while the true optimal number "depends on the research question" (Wehrheim 2019, p. 113, footnote 63). In a recent paper, ECB researchers apply a word-clustering approach (similar, but not equal, to STM) to a corpus of ECB speeches and estimate 50 topics, which they then manually group around 10 more general themes (Hartmann and Smets 2018). While their goal is to identify very specific topics in order to provide a detailed chronological history on the occasion of the ECB's 20th anniversary, this paper rather aims to detect communicative shifts in the ECB's general priorities. It is therefore justifiable to estimate 10 topics (a number that is also in line with the 10 general themes described by these ECB researchers) in order to understand the broader issues that the ECB was concerned with over the last 20 years.[10]

As a robustness check, one can measure the topic quality of the estimated topics through a combination of their semantic coherence and exclusivity. Semantic coherence is maximized when the most probable words in a given topic frequently co-occur together (cf. Mimno et al. 2011), whereas exclusivity of words to topics is included to ensure that high semantic coherence is not the result of a few topics being dominated by very common words (cf. Roberts et al. 2014). Figure 7 plots the semantic coherence and exclusivity scores for the 10 estimated topics. The results show that the selected model features desirable properties in both dimensions since the average scores of most topics tend to cluster towards the figure's upper right side.[11]

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[10]Experimenting with other topic numbers confirms that selecting 10 topics is the best choice to ensure that the resulting topics are coherent and can be compared to the main historical lessons outlined by Eichengreen (2015).

[11]Given the scaling of the figure, it appears that topics 5 (payments) and 8 (inflation) could be statistical outliers that might bias the analysis. However, this impression is deceptive and is based on the fact that the *stm* package aligns the scaling of the axes for semantic coherence and exclusivity with the estimated values of the topics and not with the usual range of values. For example, if the exclusivity axis were to start at 0 instead of 7.0, T5 would be much further along the upper right ideal point. The same is true for semantic coherence, which stops at the left end of the axis at about –25 but can easily reach –100 in many STM applications. A comparison of the topics estimated here with the semantic coherence and exclusivity values of the topics estimated by Silge (2018) shows that all values are robust and should not be considered as outliers.

Figure 7. Topic Quality Measures for Each of the 10 Estimated Topics

Source: 10-topic STM, with M = 8 (M equals the number of words to use in semantic coherence and exclusivity calculations, since for computational reasons not all words can be used. For a discussion of M, see the foundational paper by Mimno et al. (2011), who mention a range of M = 5–20. The default in the R *stm* package is 10. Slightly changing M within this range (e.g., to M = 10) does not change the trends or general results of Figure 7. M = 8 was chosen for the pragmatic reason that it enabled plotting all topic labels without overlaps). For the estimation procedure, see description in the main text.
Note: Semantic coherence is maximized when the most probable words in a given topic frequently co-occur together, whereas exclusivity of words to topics is included to ensure that high semantic coherence is not the result of a few topics being dominated by very common words. For the complete labels, see Table 2.

In the context of STM, a topic can be understood as probability distributions over words, meaning that the estimated model returns several lists of words that have been identified computationally as having a high probability of occurring together. To interpret the computational output, researchers thus look at the words associated with each topic and manually attach a meaningful label. For instance, Küsters, Volkind, and Wagner (2019, p. 245) apply topic modeling to two recent Oxford handbooks on legal history, resulting in a list that consists of words such as "genocide," "nazi," "jewish," "criminal," and "tribunal," which suggests that the topic encompasses the discourse on "National Socialism and Law" that is present in many handbook articles. If a topic lacks a straightforward interpretation, it is helpful to read the documents that possess a large share of this topic in order to get a better sense for the appropriate label.

Table 2 gives four different types of word profiles, including the standard output of a topic model, i.e., the highest-probability words based on the probabilities that each word is generated from each topic. Three additional metrics are included. FREX indicates words that are frequent *and* exclusive to each topic (Airoldi and Bischof 2016). "Lift" weights words by dividing by their frequency in other topics, thereby prioritizing words that appear less frequently in other topics (Taddy 2013). Similar to lift, "score" divides the log frequency of the word in the topic by the log frequency of the word in other topics.[12] By combining various word profiles, it is possible to label the estimated topics much more precisely compared to the standard procedure in the literature that relies only on the highest-probability words. In particular, these word profiles help to identify 10 distinctive topics (Table 2).[13]

Topic 1 deals with "globalization" in general and "China," the "US," and "OECD" "countries" in particular. With terms like "productivity," "competitiveness," and "reforms," the emphasis is on domestic structural reforms whose necessity arises from the pressure of this *Global Economy* (T1). In most topic modeling exercises, there are a few topics that identify linguistical patterns lacking any kind of useful meaning and that can be safely ignored for the remainder of the analysis (cf. Wehrheim 2019, p. 90). The next topic, T2, represents such a topic because it acts like a corpus-specific *stop-word* list capturing many uninformative words that appear frequently in ECB speeches (e.g., the speaker's name, which is listed at the beginning of each speech) but were not captured by the general stop-word list implemented when estimating the STM.[14] However, this residual topic does not pose any problems since it constitutes only a minor share of the 10 estimated topics and does not exhibit any significant trends, which implies that it is not distorting the *relative* proportions of the other topics (cf. Figure 8 below).

Turning to the next topic, one encounters the *Liquidity Measures* (T3) that were enacted by the central banks as a reaction to the

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[12]See https://cran.r-project.org/package=lda (accessed June 19, 2020).

[13]The manually attached labels are given in italics, whereas the key terms from the word profiles are marked via single quotation marks.

[14]This is known as the "boilerplate" problem (cf. Boyd-Graber, Mimno, and Newman 2015, p. 228). For the descriptive statistics (such as the tf-idf word profiles) provided in Section 2, however, the speakers' names were removed.

Table 2. A Topic Model with 10 Topics, 1,989 Documents, and a 19,244-Word Dictionary
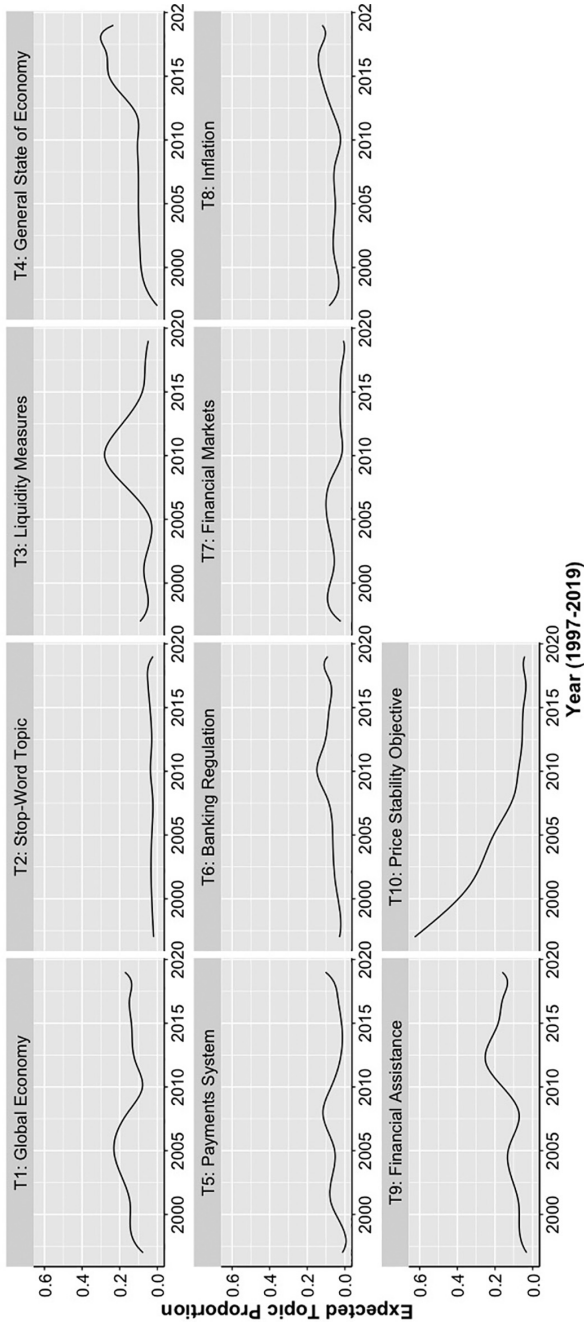
Topic	Label	Metric	Word Profile
Topic 1	Global Economy	Highest Prob.	euro, growth, area, countries, economic, labor, global
		FREX	productivity, globalization, labor, china, oecd, workers, imports
		Lift	us, americans, catch, catching, comparisons, competitiveness, education
		Score	labor, productivity, wage, euro, inflation, reforms, unemployment
Topic 2	Stop-Word Topic	Highest Prob.	banks, one, even, many, just, time, bank
		FREX	bini, smaghi, lautenshläger, don't, thing, sabine, lorenzo
		Lift	even, ballot, bonaparte, button, cake, catalonia, cheated
		Score	lautenschläger, sabine, peseta, bini, smaghi, vice-chair, people
Topic 3	Liquidity Measures	Highest Prob.	financial, crisis, liquidity, banks, market, central, risk
		FREX	omts, turmoil, non-standard, lehman, tensions, allotment, exit
		Lift	appreciation, enhanced, default, deleveraging, emergency, enhanced, fault
		Score	crisis, liquidity, non-standard, omts, financial, operations, funding
Topic 4	General State of Economy	Highest Prob.	area, euro, inflation, growth, rates, policy, monetary
		FREX	outlook, recovery, quarter, oil, subdued, purchases, sustained
		Lift	access, careful, hysteresis, lifting, abschließend, abschluss, accommodation
		Score	inflation, app, recovery, euro, rates, wage, slack
Topic 5	Payments System	Highest Prob.	payment, euro, payments, european, sepa, market, central
		FREX	sepa, cards, epc, debit, card, payments, payment
		Lift	debits, sdd, ages, bitcoin, card—present, ethical, mined
		Score	sepa, banknotes, epc, debit, cyber, cards, settlement
Topic 6	Banking Regulation	Highest Prob.	financial, banks, banking, risk, supervisory, supervision, system
		FREX	ccps, supervisory, macroprudential, supervisors, macro-prudential, supervision, esrb
		Lift	ensuring, existing, know, lead, marrying, micro-based, recovery
		Score	macro-prudential, esrb, ssm, ccps, macroprudential, supervisory, supervisors

Table 2. (Continued)

Topic	Label	Metric	Word Profile
Topic 7	Financial Markets	Highest Prob.	financial, market, markets, euro, integration, area, banking
		FREX	repo, mortgage, securitization, equity, diversification, bond, corporate
		Lift	buy-hold, cut, illusion, indicators, interstate, near-perfect, white
		Score	integration, financial, securities, bond, repo, euro, market
Topic 8	Inflation	Highest Prob.	policy, monetary, central, inflation, price, bank, rates
		FREX	zero, policy, equilibrium, monetary, phillips, bound, jackson
		Lift	predicting, reverse, commoditized, coordinating, cross-checking, empirical, flattening
		Score	inflation, policy, monetary, phillips, price, asset, central
Topic 9	Financial Assistance	Highest Prob.	european, euro, union, area, fiscal, economic, countries
		FREX	sovereignty, union, esm, legitimacy, emu, fiscal, political
		Lift	private, endogeneity, destin, oca, ever, m, secular
		Score	fiscal, union, integration, emu, pact, euro, european
Topic 10	Price Stability Objective	Highest Prob.	euro, monetary, policy, stability, price, area, central
		FREX	accession, escb, ecbs, erm, eurosystems, reference, treaty
		Lift	testing, training, bi-weekly, bones, boskin, bosnia–herzegovina, centripetal
		Score	accession, inflation, euro, monetary, erm, price, stability

Note: For each estimated topic, the table lists the seven most important words together with the manually given label. The seven words are ranked by statistical importance. The specified words given in this table are manually cleared word forms of the underlying tokens. Since no lemmatization procedure was applied when creating the corpus, the latter contains the actual word forms as used in the ECB speeches, including apostrophes and punctuation marks. These grammatical characters have been manually removed for the table to ensure better readability. For example, "appreciation'" was shortened to "appreciation". For the different metrics, see the explanations in the main text.

Figure 8. Graphical Display of Topic Prevalence

Source: 10-topic STM; for the estimation procedure, see description in the main text.
Note: Each topic's prevalence is plotted as a smooth function of year, holding speaker's influence at sample median, without confidence intervals.

market "turmoil" and "tension" following the "Lehman" collapse. This topic also includes "non-standard" measures such as the ECB's purchases in secondary, sovereign bond markets known as outright monetary transactions ("OMTs"). Words like "growth," "outlook," "recovery," "quarter," and "slack" suggest that topic 4 deals rather abstractly with the general state of the economy (T4), explaining trends in important macroeconomic indicators. This is underlined by the presence of some German words that suggest that this topic was mainly estimated on the basis of President Trichet's high-level speeches.[15] Topic 5 refers to the European payments system (T5) that was successively created through the ECB's "SEPA" payment-integration initiative and includes the diverse means of payments available to Europeans, ranging from "banknotes" and "coins" to "debit" "cards" and even "bitcoins."

The references to regulatory concepts such as "macroprudential" policy, the recently established European Systemic Risk Board ("ESRB"),[16] and new institutions for "supervision" of "banks" link topic 6 to the area of banking regulation (T6). Topic 7 refers to the integration of financial markets (T7) and their various products based on "securitization" of "mortgage," "diversification," or repurchase operations ("repo"). This is followed by a topic dedicated to the ECB's main activity, namely dealing with inflation (T8) through "monetary" "policy" and understanding its causes through academic analysis. The latter aspect is echoed in terms such as "Phillips" (curve), "empirical," and "equilibrium." Topic 9 deals with financial assistance that was granted to indebted euro-zone countries during the Great Recession, above all through the European Stability Mechanism ("ESM")—hence, the label financial assistance (T9). T9 also mentions the fiscal "pact," which enshrined the requirement to have a balanced budget rule in domestic legal orders, and touches upon issues of "legitimacy" and national "sovereignty" that were heatedly discussed in recipient countries. Finally, topic 10, labeled price stability objective (T10), refers to the "treaty" that describes the ECB's primary task to pursue "price" "stability." This topic is

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[15]As mentioned and shown at an earlier stage, Trichet particularly liked to include German and French words in his speeches, not least to impress his audiences in these countries.

[16]The ESRB was established in 2010 to oversee the European Union's financial system and mitigate systemic risk.

largely estimated on the basis of early speeches, since it includes terms like "accession" and "testing."[17]

In addition to capturing the key content of ECB speeches over more than 20 years, the STM output also allows us to investigate the temporal dimension of these topics by plotting topic prevalence as a function of *year* (Figure 8). Taken together, the 10 topics mirror the evolution of the Great Recession quite remarkably. The presence of inflation concerns (T8), the ongoing focus on payments integration (T5), and the simultaneous disinterest in any types of liquidity measures (T3) before and throughout the 2007 ECB speeches reflect the then-prevailing narrative of Great Moderation. Following the Lehman bankruptcy in 2008, the shares of speeches discussing liquidity measures (T3) or banking reforms (T6) began to rise only gradually. Ultimately, speeches describing the ECB's fiscal assistance (T9) to states in financial difficulty peaked in 2012, when Greece received a second bailout package and the ESM was established as a permanent firewall for the euro zone (cf. Bistis 2016). Remarkably, inflation fear (T8) and insistence on price stability as primary objective (T10) formed an integral part of ECB speeches even in the most dramatic moments. Still, their individual trajectories differ significantly: While T10 is steadily declining and cannot reach pre-crisis levels for the entire duration of the Great Recession, inflation concerns (T8) intuitively bottomed out in the depths of the crisis but recovered quickly thereafter, reaching an all-time high after 2015. Accompanied by relatively late proposals for banking regulation (T6) that only peaked in 2010, these topics also formed the intellectual background for the bailout negotiations during the acute phase of the euro-zone crisis. As part of the Troika, the ECB participated in these negotiations.

It is particularly interesting to compare the development of the liquidity measures topic (T3) with the topic describing the ECB's concerns regarding inflation (T8), since the optimal extent of central banks' accommodating monetary policy during the Great Recession is controversially discussed until this day (Baldwin and Wyplosz 2015, p. 510; Eichengreen 2015; Mody 2018, p. 225). Interestingly, the share of speeches discussing liquidity measures, including OMTs, peaked in 2010, which is two years before Draghi's well-known

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[17]It thereby complements T8, which focuses rather on the practical tools to analyze inflationary processes and is focused on the later period.

"whatever it takes" remarks. At the same time, inflations concerns (T8) were at their all-time low. From 2010, however, the share of speeches discussing the inflation topic increased significantly, pointing towards a change in priorities that will be further investigated below when discussing the "historical lessons" prevalent at that time.

This polarity is not only due to the ECB's statute with its single priority of price stability but might also reflect more broadly the internal disagreements between German "hawks" and Southern "doves" within the Board (on this general "battle of ideas," see Brunnermeier, James, and Landau 2016), which eventually became public when the German Board member Jürgen Stark resigned unexpectedly. In his January 2012 farewell letter to ECB employees, he justified his disagreement with a lesson that he had supposedly gained from looking at the past: whenever in history a central bank had subordinated itself to budgetary policy, Stark argued in his letter, it had to make concessions in its actual task of keeping the monetary value stable (*Der Spiegel* 2012). The following two sections take a closer look at similar historical analogies in ECB speeches in order to investigate whether historical lessons played a role in ECB communication during the Great Recession.

4.   Defining "Lessons from the Past"

In the aftermath of the Great Recession's outbreak, numerous observers used references to the Great Depression and the lessons that might be learned (e.g., Eichengreen and O'Rourke 2010; Eichengreen 2016), including leading macroeconomists, central bankers, and economic historians (Hansen 2019, p. 169). Did historical analogies also play a role in ECB communication during this period? Research shows that ECB speeches constitute a "special category" within the ECB's regular communication because they sometimes contain elements of meta-communication—for instance, when Board members use the opportunity to reflect on their own approaches to monetary analysis (Noordegraaf-Eelens 2010, pp. 52f.). The existence of such elements of meta-communication means that one would expect to find references to "historical lessons" if they played a meaningful role within the ECB's decisionmaking or communication strategy during the crisis. In order to determine whether such historical analogies formed a part in the semantic

shift of ECB speeches determined above, one first needs an analytical benchmark that allows to compare them with the estimated topics.

Such a benchmark can be derived from Eichengreen's monograph *Hall of Mirrors* that so far presents the most concise analysis of the various usages of the past by both politicians and central bankers during the Great Recession. Throughout the book, Eichengreen (2015, p. 1) emphasizes "how conventional wisdom about the [1929 crisis], what is referred to as 'the lessons of the Great Depression', shaped the response to the events of 2008-09." The narrative structure of these lessons evolves around some historical experiences but marginalizes others. This is crucial because "what is not told is not remembered, and what is not remembered cannot be taken into account in decision making" (Hansen 2015, p. 559). This perspective reflects the audience that Eichengreen addresses with his book. *Hall of Mirrors* is a book intended to be read by policy participants and therefore necessarily offers "less a history of crisis than a handbook," whose purpose "is to learn lessons, indeed to learn lessons about learning lessons" (Tooze 2015, p. 140).

A careful close reading of *Hall of Mirrors* enables the reader to identify seven distinctive lessons from the past that can be grouped around two phases of the crisis: lessons that inspired the immediate monetary and fiscal reactions when the crisis erupted and spread from the United States to Europe (2007–09); and lessons that shaped the later handling of the sovereign debt crisis in Europe (2010–15). All references to historical analogies that were mentioned multiple times by Eichengreen are summarized in Table 3, which lists the respective event and date, the lesson Eichengreen stated was learned, page references, and if Eichengreen is indicating whether the lesson was used by the ECB. These seven *lessons* (L1–L7), briefly described in the following, provide the analytical benchmark for the subsequent analysis of ECB speeches and therefore have to be kept conceptually apart from the *topics* in ECB speeches that were estimated through the STM.[18]

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[18]Thus, whenever the term *topics* is used, I refer to the content of ECB speeches as approximated through the STM, whereas usage of the term *lessons* indicates that the argument refers to one of the episodes described by Eichengreen.

Table 3. Summary of Eichengreen's Key "Lessons from the Past" that Influenced Policymakers during the Great Recession

No.	Label	Description	Key Words	Protagonist	Pages in Eichengreen
		First Phase: Global Financial Crisis (2007–09)			
L1	Liquidity	Friedman and Schwartz explain the Great Depression with the Federal Reserve's failure to act as the lender of last resort. Policymakers concluded that the central bank should flood the market with liquidity if a bubble bursts.	bubble, liquidity, macroprudential policy, accommodative stance, lender of last resort, 1929, 1930	Fed, ECB (slower)	63, 119, 176f., 186, 265, 269f., 282, 286f., 305
L2	Preoccupation with Banks	The 1930s crisis centered on the banking system. Influenced by that history, central bankers now looked to the banking system, while many of the most treacherous problems were in the shadow banking system.	(shadow) banking system, securitized mortgages, asset-backed commercial paper, 1930s	Fed, ECB	190f., 381
L3	Fiscal Stimulus	Fiscal policy during the Great Depression made only a limited contribution to recovery because the fiscal initiatives were too small. Obama's $787 billion fiscal stimulus was designed to avoid this mistake. Similarly, the G-20 arranged for expansionary policies.	fiscal stimulus, Obama, G20, private spending, New Deal, 1930s	U.S. government, G-20	297, 330f.
L4	Internat. Cooperation	Another lesson referred to the destruction that could be wrought by inadequate international cooperation. This inspired the effort in 2008–09 to coordinate monetary and fiscal policies and to shun protectionist measures.	protectionism, coordination, cooperation, World Economic Conference, Smoot-Hawley	Fed, ECB, IBS, politicians	122, 186, 236, 340f., 384

Table 3. (Continued)

No.	Label	Description	Key Words	Protagonist	Pages in Eichengreen
		Second Phase: Euro-Zone Crisis (2010–15)			
L5	Fear of Inflation	Based on memories of the 1923 hyperinflation, Germany's fear of inflation translated into European policy. This meant that monetary policy was inadequately supportive of the economy.	hyperinflation, 1929, 1970s, headline inflation, price stability	Fed, ECB, Bundes- bank	8, 40, 59f., 190, 254, 283, 303f., 338f., 383
L6	Austerity	The out-of-control budgets of Weimar, associations with Hitler's rearmament, and lack of Keynesian thought left German economists skeptical of deficit spending. This initiated a premature shift to austerity throughout Europe.	deficit spending, austerity, contract, competition	German govern- ment, ECB, Bundes- bank	9f, 342, 352
L7	Regulatory Reforms	From historical experience, policymakers should have known that the flawed policies that allowed the crisis to develop in the first place should be fixed through comprehensive reforms put in place before the sense of urgency has passed. However, reform attempts came too late and were therefore insufficient.	regulation, reform, Dodd-Frank Act, too-big-to-fail, Volcker Rule, systemically important	Policymakers	247, 378, 386

Source: Eichengreen (2015).
Note: This list is not given by Eichengreen himself but was manually constructed based on close reading of his book.

The narrative constructed by Friedman and Schwartz (1963) in their *Monetary History of the United States* is probably the best-known lesson from the past. They associated the Great Depression with the Federal Reserve's failure to act as the lender of last resort and to provide liquidity to financial markets during the early 1930s banking crises. According to Eichengreen, central banks both in the United States and in Europe acted in line with this lesson by quickly *flooding the market with liquidity* (L1). When interbank rates rose above the ECB's target following the BNP Paribas announcement, the ECB offered to provide unlimited amounts of liquidity: "Even in Frankfurt they had evidently read Friedman and Schwartz" (Eichengreen 2015, p. 177).

However, unlike the Great Depression, the 2007 crisis did not center on commercial banks, but on the shadow banking system of hedge funds, money market mutual funds, and commercial paper issuers. Standard central bank interventions were thus less effective. According to Eichengreen, the central banks' erroneous *targeting of the banking sector* (L2) was based on historical experiences. As he notes regarding the Fed: "The 1930s crisis centred on the banking system. Influenced by that history, it was to the banking system that the Fed now looked" (Eichengreen 2015, p. 190f.).

Besides central banks' reactions, active fiscal policy was needed to counter the crisis. For instance, the Obama administration designed a $787 billion *fiscal stimulus bill* (L3) that, according to Eichengreen, was informed by the impression that both the Hoover and Roosevelt administrations had done too little to offset the decline in private spending during the 1930s. Christina Romer, Obama's economic advisor, had argued that during the Great Depression, fiscal policy had been of little consequence because fiscal stimuli were too small (Romer 1992). Now, politicians both in the United States and in Europe aimed to "prevent the repetition of this mistake" (Eichengreen 2015, p. 297).

During the Great Depression, central banks had been slow to coordinate their actions to enable the functioning of the gold standard. Eichengreen argues that this historic lesson inspired *international cooperation* in 2008–09 (L4). Major central banks coordinated interest rate cuts in October 2008 and set up foreign exchange swap lines, while governments coordinated financial bailouts and fiscal stimuli (Duca 2017, p. 59). Eichengreen (2015, p. 122) argues that

the "ritual invocation" of the Smoot-Hawley tariff helped policymakers to resist protectionism and that British Prime Minister Gordon Brown reminded G-20 leaders how the failure of the 1933 World Economic Conference "had foreshadowed all the other terrible events of that decade and the one to follow" (Eichengreen 2015, p. 340).

According to Eichengreen's account, the emphasis of policymakers shifted after this first phase of the crisis. From 2010 onwards, new lessons about the danger of inflation and the necessity of balanced budgets prevailed, especially in Europe, while banking reforms came too late: "This shift occurred despite the fact that the recovery continued to disappoint," Eichengreen complains. "Rather than avoiding the mistakes of the 1930s, policy makers almost seemed intent on repeating them" (Eichengreen 2015, p. 284). If Eichengreen's hypothesis is true, one should therefore observe a change in argumentation over time, with lessons L1–L4 becoming less prominent and lessons L5–L7 increasing their respective proportions in ECB speeches.

Germany's *fear of inflation* (L5), based on memories of the 1923 hyperinflation, translated into European policy because of the ECB's Bundesbank-like structure and "the desire of its French president, Jean-Claude Trichet, to demonstrate that he was as dedicated an inflation fighter as any German" (Eichengreen 2015, p. 8). According to Eichengreen (2015, p. 254), the German public was "traumatized by inflation" and those fears of inflation "informed and inhibited policy in other countries." Consequently, monetary policy was not supportive enough.

Similarly, the idea that fiscal stimuli could facilitate the recovery was dismissed by the German public, who associated deficit spending with historical episodes of out-of-control budgets and Hitler's rearmament, as well as with more recent experiences of fiscal profligacy and high inflation in Southern European countries in the 1970s and 1980s. Keynesian theory had never gained traction in Germany (Allen 1989). German economists therefore argued that the government should focus on strengthening contract enforcement and fostering competition. Overall, this mix of peculiar German experiences is said to have encouraged an *early shift to austerity* (L6).

Finally, policymakers were aware that the flawed policies and institutional structures that had enabled the crisis needed to be fixed through *comprehensive reforms* (L7). Banks are now subject

to higher capital and liquidity requirements. However, historical experience suggests that to be effective, such reforms have to be put in place "before the sense of urgency has passed" (Eichengreen 2015, p. 378). According to Eichengreen (2015, p. 386), the fact that "another Great Depression was avoided weakened the argument for more radical changes." He argues that policymakers prioritized recovery over reform during the first phase, implying that efforts to develop banking reforms came too late.

Eichengreen's narrative provides anecdotal evidence but no systematic evaluation of how exactly these historical lessons have been applied in decisionmaking. A typical example for the type of evidence given by Eichengreen (2015, p. 170) is a remark addressed by Bernanke to Professor Friedman in 2002: "Regarding the Great Depression. You're right, we did it. We're very sorry. But thanks to you, we won't do it again." In his book review, Hansen (2015, p. 562) critically notes that "this case is the only explicit example where Eichengreen substantiates empirically how decision makers understood the crisis through the lens or frame of the 1930s." Consequently, the goal of the remainder of this paper is to empirically test Eichengreen's hypothesis about the influence of historical lessons as defined above (L1–L7), using the corpus of ECB speeches as a case study.

5.   Tracing "Lessons from the Past"

Proceeding in three stages, this final section analyzes the usage of historical analogies in ECB communication as captured in the corpus of ECB speeches. First, the impact of Eichengreen's seven historical lessons can be compared with the semantic shift in ECB speeches as measured by the STM with its estimated topics. Next, it is possible to search the corpus directly for both key terms and key dates that could refer to these lessons. Finally, a qualitative analysis of historical analogies based on all ECB speeches given between 2007 and 2015 is conducted. Although all three approaches for capturing historical lessons indicate that the latter played an increased role in ECB communication at the height of the Great Recession (in line with net sentiment shown above), the qualitative analysis suggests that this role was rather marginal and less substantive than suggested by economic historians.

To begin with, one can compare Eichengreen's historical lessons with the topics estimated by the STM. In cases where one (or several) historical lessons are represented by an estimated topic, one receives an upper-bound estimate for the prevalence of the respective lesson in the ECB's communication. Note that this is only a first approximation, given that the estimated topics span more than 20 years and are therefore much broader than the very specific lessons described above. Although these proportions are thus upward-biased estimates, they still give valuable indications of the lessons' potential occurrence and their significance in ECB communication *relative* to each other.

First of all, one needs to clarify which topics could approximate the different historical lessons. Most importantly, one could draw a link between ECB Board members' discussions about inflation (T8) with the historic fear of (hyper)inflation (L5), not least because the politically neutral ECB was structurally modeled on the basis of the German Bundesbank with its sole emphasis on price stability (e.g., Bibow 2013; for a discussion, see Feld, Köhler, and Nientiedt 2015). As Berghahn and Young (2013, p. 776) put it, "Both the Maastricht Agreement and the accompanying Stability and Growth Treaty bear the handwriting of the Germans." In addition, it is plausible to assume that there is a certain relationship between discussions of the need for more competitiveness and productivity (T1) and Northern Europeans' demands for structural reforms (L6), between the ECB's liquidity measures (T3) and the Friedman and Schwartz story (L1), and between the banking regulation topic (T6) and the allegedly history-driven focus on banks (L2) as well as the need to regulate them quickly (L7).

By contrast, the estimated topics do not refer to the need for fiscal stimulus packages (L3) and international cooperation (L4). The absence of L3 supports the hypothesis that the prevailing discourse on "austerity" as a solution for the sovereign debt crisis excluded the issue of fiscal stimulus. Still, it could also reflect the fact that fiscal stimulus packages are the responsibility of national governments, and not the ECB. The absence of L4 in turn could be partly explained by the fact that cooperation between euro-area countries had been already institutionalized under the Stability and Growth Pact. Assuming that there is a link between some of the historical *lessons* and ECB *topics* in the way outlined above, are the dynamics of these topics in line with Eichengreen's narrative?

To begin with, European central bankers' sensitivity to inflation (L5) is captured by the continued presence of the inflation topic (T8), accompanied by the topic describing the price stability objective (T10), even in the most dramatic months. To a certain extent, this simply reflects the fact that price stability is the explicit mandate of the ECB, so one would naturally expect that it is always mentioned in ECB speeches. Particularly from 2012 onwards, however, discussions about inflation (T8) assumed ever larger proportions in ECB speeches, supporting Eichengreen's (2015, p. 304) notion that the "mandate to pursue low inflation . . . continued to guide and constrain policy." According to Eichengreen (2015, p. 284), the analogy with the Great Depression "was foremost in the minds of policy makers" during "a brief period in 2008-09," but afterwards, "the emphasis shifted" towards balanced budgets. His timing of this premature shift to austerity (L6) is confirmed by the STM, which records a steady increase of discussions about competitiveness, productivity, and structural reforms (T1) from 2010 onwards.[19]

Similarly, the central banks' "readiness to provide not just liquidity but unlimited amounts of liquidity" (Eichengreen 2015, pp. 176f.) that was informed by economic history (L1) is mirrored by the liquidity topic (T3), which rises rapidly between 2007 and 2009 and peaks in 2010. Thereafter, T3 declines in line with the ECB's first "phasing-out." The extent to which liquidity measures were discussed in ECB speeches continued to decline in later years. This is again in line with Eichengreen's argument that in the European context, the analogy with the Great Depression was particularly influential in the first years of the crisis, but not afterwards. This is further supported by the trajectory of T9, which fits well with the argument for fiscal stimulus (L3) but reaches a low point in 2008 and only increases after the peak of the crisis, probably in tandem with the Greek bailout packages.

Eichengreen (2015, p. 381) also notes that central banks' policies were targeted at banks (L2) due to a "historically informed vision of the risks" and given T6's continued presence, this preoccupation with banks is visible in ECB speeches. However, given that
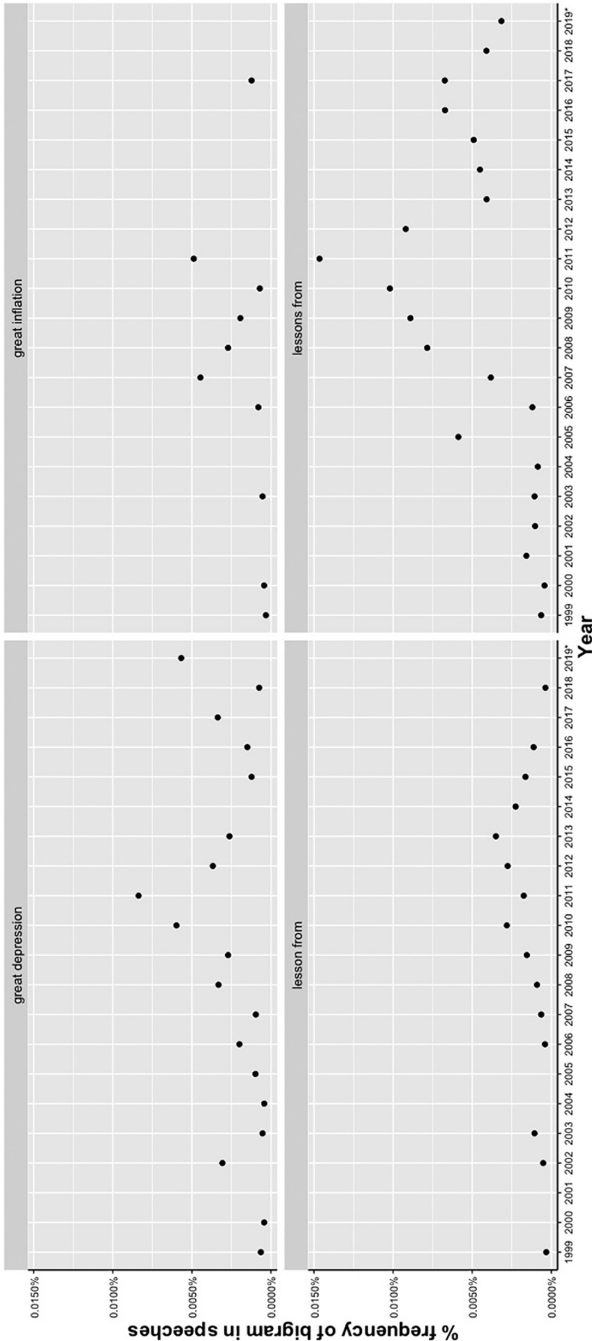
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[19]Interestingly, T1 is also prominent before the crisis, but the main point for the argument put forward here is that it is recovering quickly from its low point in 2010.

the shadow banking system is significantly smaller and less relevant in Europe than in the United States (Shambaugh 2012, p. 162), this historical lesson of focusing on the banking system suits well the structural characteristics of the European financial system. Additionally, the evolution of T6, which contains proposals for banking reforms, supports Eichengreen's notion that banking reforms were initiated too late (L7), as T6's proportion is especially large from 2010 onwards but rather small when the financial crisis spread from the United States to Europe. Still, it should be noted that the characteristics of the EU legislation process make agreements on reforms of banking regulations complex and time-consuming (cf. Sum 2016).

Finally, although not related to Eichengreen's lessons, the payments topic (T5) closely follows the SEPA initiative's actual development, peaking in 2008 when SEPA pan-European payment instruments became operational and declining after SEPA payments had successfully replaced national payments in 2011. Overall, the estimated topics show that at the beginning of the crisis the focus was almost exclusively on monetary policy and, in particular, the provision of liquidity. Fiscal policy and banking reforms were postponed for the time being and when they were discussed again a few years later, after the crisis had bottomed out, the focus of the discussion had already shifted to the threat of inflation and austerity.

A more direct approach for identifying lessons from the past is to search the corpus for key terms such as "history," "lessons," or "past." However, manual search quickly makes clear that taken on their own, these multifunctional words are often unrelated to actual lessons from the past. For instance, the term "history" is frequently evoked at the beginning of a speech, when the respective ECB Board member briefly reviews the history of the location that forms the context for her or his speech. One gets a more precise picture by tokenizing the ECB corpus into consecutive sequences of words. When tracing the Great Depression analogy, it makes sense to examine pairs of two consecutive words, called "bigrams" (Figure 9). The resulting diagrams underline that there was indeed a sharp increase in references to the "Great Depression" in 2010 and 2011, and more generally to "lesson(s) from" the past. As a comparison, references to the "Great Inflation" in the wake of the 1970s oil-price shocks occurred less frequently, but even here we detect an increase in references at the height of the Great Recession. Taken together, in all

Figure 9. Relative Frequency of Key Bigrams Related to Lessons from the Past

four panels of Figure 9, a strong increase in relative bigram fre-
quencies can be seen in the second half of the observation period,
i.e., during the Great Recession. These results are in line with the
sentiment analysis presented earlier, and the hypothesis that his-
toric lessons are especially prevalent in times of crises that can be
captured through negative net sentiment.

In addition to bigrams, specific dates might be a precise proxy
for tracing historical lessons. A good example is a 2008 speech given
by Smaghi, who reflected on "what the errors of the past could
teach us," asking particularly "what was done in earlier crises, in
1929, 1974–75, 1992–93 and in 2001–2002?" (Smaghi: May 15, 2008).
Smaghi identified four distinctive lessons from the past. First, he
emphasized the importance of price stability (L5) and demanded
that any "rise in headline inflation must remain temporary." This
supports Eichengreen's accusation that the ECB's "extraordinar-
ily destructive" decision to raise its main policy rate by 25 basis
points to 4.25 percent in July 2008 (two months after Smaghi's
speech) was grounded in a mistaken focus on headline inflation,
which in turn resulted from inflation aversion in Germany, where
"the distinction between headline and core inflation was dismissed
out of hand" (Eichengreen 2015, p. 339). Secondly, Smaghi referred
to the "experience of Germany" to denounce potential Keynesian
countermeasures to the crisis as "illusions," echoing German econo-
mists' skepticism regarding deficit spending (L6). Thirdly, he argued
that the 1929 crisis showed that policymakers should not "put up
protectionist barriers" in response to a financial crisis, and, echo-
ing Eichengreen (2015, p. 122), invoked Smoot-Hawley as a nega-
tive example (L4). Finally, Smaghi noted that all support measures
for distressed financial institutions should support "market liquid-
ity" but not relieve investors from "solvency risks." This peculiar
combination of the classic Friedman-Schwartz-liquidity lesson (L1)
with moral hazard concerns could again signal the influence of Ger-
man economists, who stressed the importance of liability and disci-
plining behavior throughout the crisis (Guiso, Herrera, and Morelli
2016, p. 111).

Smaghi's remarks suggest that searching the corpus for the dates
of the 20th century's main economic crises and visualizing how their
occurrence changed over time is an efficient strategy for capturing
historical lessons within ECB speeches (Figure 10). In line with the

Figure 10. Relative Frequency of Key Dates Related to Lessons from the Interwar Period (hyperinflation and Great Depression)

sentiment analysis and the key bigrams shown earlier, the resulting figure reveals that Board members referred increasingly to "1929" and "1930s" during the Great Recession, with a potential peak between 2009 and 2011. Such bell-shaped patterns are typical phenomena in the field of narrative economics and have been found for the spread of intellectual innovations such as the IS-LM model, the multiplier-accelerator model, and the real business cycle model (Shiller 2017; also Hansson 2021). This implies that during a crisis, the narrative recourse to historical lessons follows the typical innovation cycle of adoption, peak, and decline. By contrast, recourses to the "1923" hyperinflation were less frequent and did not occur at all once the crisis dispersed, whereas references to "1930" as a single year increased only lately.

At this point, the higher prevalence of historical analogies during the Great Recession compared to previous years should be firmly established. Turning from the quantitative to the qualitative, the follow-up question is therefore which specific lessons were utilized during this time of crisis. To get an impression of this, a subset of the corpus covering all ECB speeches during the Great Recession (2007–15) is searched for references to the German hyperinflation ("hyperinflation," "1923") and for the dates commonly associated with the Great Depression ("1929," "1930," "1930s").[20] Within this subset, these five search terms can be found in 90 speeches (8.92 percent). The comparatively smaller number of speeches allows for a detailed close reading, on the basis of which each speech can be manually classified according to the specific historical lesson evoked by the speaker. In particular, it is determined if the speaker used the respective term only in a loose, comparative way (like "The world is hit by a severe crisis, the deepest since the beginning of the Great Depression in 1929") or if she or he outlined one of the historical lessons (L1–7) in more detail. Naturally, this procedure is more subjective than counting words or estimating a topic model, but it is

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[20]In addition to the dates, the term "hyperinflation" is specifically searched for, since close reading of the ECB speeches shows that it is used almost exclusively with respect to the German hyperinflation of the interwar period. By contrast, references to the "Great Depression" usually referred to the historical episode only in a loose, general way that did not suggest the intentional utilization of a "historical lesson."

**Table 4. Tracing Lessons from the Past in
ECB Speeches between 2007 and 2015**

Lesson	1923	1929	1930	1930s	Hyperinflation	SUM
Price Stability (L5)	1	0	0	5	7	13
Cooperation (L4)	0	1	2	8	0	11
Liquidity (L1)	0	5	0	5	0	10
Austerity (L6)	0	0	0	5	1	6
Regulation (L7)	0	2	0	4	0	6
Bank Focus (L2)	0	0	0	4	0	4
Fiscal Stimulus (L3)	0	0	0	0	0	0
No Lesson	3	6	2	25	4	40
Sum	4	14	4	56	12	90

Note: The results refer to a manual classification procedure, as described in the main text. The specific lessons L1–L7 are defined in Table 3. Each time a speech used a certain historical analogy only in a loose, comparative way (e.g., "The world is hit by a severe crisis, the deepest since the beginning of the Great Depression in 1929") without further elaboration, it was classified as "No lesson."

still likely to capture the *relative* importance of individual lessons. Typical excerpts from speeches classified in this way are given below.

Three findings emerge from this exercise (Table 4). First, almost half of the identified references are only rhetorical means that are unrelated to the usage of actual historical lessons, shrinking the latter's proportion in the subset of speeches to roughly 5 percent (overall corpus: 2.34 percent). It is therefore questionable if historical lessons constituted a significant pattern, given their quantitatively minor role.

Secondly, we can identify a division of labor with respect to the way that specific historic experiences are remembered. The German experience of a "hyperinflation" in "1923" is typically mentioned when the speaker aims to emphasize the economic and social importance of rigorous price stability, while "1929" immediately leads to associations of insufficient liquidity. By contrast, references to the "1930s" period in general can form the background to various, even conflicting, lessons, but their most frequent purpose is to illustrate the need for cooperation.

Thirdly, if we understand Eichengreen's seven lessons as a pool of lessons readily available when a speaker decides on the speech's content, the aggregate ranking of lessons as actually used reveals

the Board members' preferences. Price stability, cooperation, and liquidity seem to have been their main priorities, and the respective lessons invoked in their favor recall Eichengreen's narrative. Speaking in Munich, Trichet recalled the German hyperinflation, which "has left deep scars in the collective memory of both Germany and Europe" and demonstrated "how painful deviations from price stability can be." According to Trichet, "these lessons of history were shared all over Europe" and with the creation of the ECB, Germany's stability culture had been fully "europeanized" (Trichet: July 13, 2009). ECB Board members regarded the post-WWI hyperinflations as one of the few "natural experiments" offered by economic history whose lessons were "deeply entrenched into the collective psyche of many European peoples" (Stark: June 11, 2008). Lessons about liquidity were likewise in line with Eichengreen's analysis in that they frequently mentioned Friedman and Schwartz. How to conduct monetary policy during a downturn had been "shown by Milton Friedman and Anna Schwartz already long ago" (Smaghi: November 25, 2008). Their "seminal analysis" had "taught" the central bankers that the Federal Reserve's failure to "provide enough liquidity to the financial system" had amplified the Great Depression: "This time we made sure we avoided a similar scenario" (Tumpel-Gugerell: May 3, 2011). Interestingly, Praet acknowledges that while Friedman and Schwartz's analysis provided "inspiration," it did not offer an "off-the-shelf recipe" since it only stated a "general rule without a detailed prescription" (Praet: November 26, 2012). This suggests that historical lessons provide a convenient analytical starting point in a crisis situation but are not sufficient to design the technical implementation of the necessary policies. Finally, it is remarkable that even in a non-U.S. context, lessons about cooperation included hortatory reminders of Smoot-Hawley (Smaghi: May 15, 2008), thereby giving credibility to Eichengreen's claim that its "ritual invocation" helped policymakers resist protectionism.

Next, lessons about austerity, regulation, and the role of banks form a second group of lessons that were occasionally mentioned. The moral hazard concerns expounded in favor of early austerity measures signal again a proximity to German priorities. While Stark (February 25, 2010) admitted that "discretionary government intervention has been key in forestalling a repeat of a 1930s-style depression," he criticised the "policy hyper-activism" of some countries

and demanded a stability-oriented policy framework to ensure that fiscal authorities "withdraw stimulus to safeguard public solvency." The fact that several speeches referred to lessons about the banking sector and its potential regulation supports Eichengreen's lessons L2 and L7, but it should be noted that the ECB was nevertheless aware of the systemic risk arising from the shadow banking sector (Constâncio: February 13, 2015). Finally, just as the topics estimated by the STM, the identified historical lessons omit the positive role played by fiscal stimuli during times of recession (L3).

The observation that price stability has been the lesson most evoked by ECB Board members even aggregates this apparent contrast with the developments in the United States. Not least, this has institutional reasons, namely the fact that unlike the Fed with its dual mandate, the ECB's statute defined the responsibility for price-level stability as single priority. Still, once the primary objective is fulfilled, the ECB also supports the general economic policies in the European Union (Driffill and Rotondi 2004). These so-called secondary objectives include, for example, balanced economic growth, full employment, and social progress. One can trace the importance of these secondary objectives vis-à-vis the price stability goal by searching the ECB corpus for the corresponding bigrams (Figure 11). While price stability was and remains by far the most frequently cited objective in ECB speeches, one can identify a constant decline in the term's usage, both in relative and in absolute terms. Figure 11 reports only the relative frequency, i.e., how often the bigram was used in relation to the whole number of spoken words in a given year. While the term "price stability" was used more than 1,000 times in 1999, it has been used less than 250 times per year since 2014. The decline in absolute frequencies suggest that this trend cannot be explained with the increasing number and length of speeches.

This finding is also in line with the fact that the STM estimated a topic on the basis of price stability terms (T10) whose proportion in ECB speeches declined significant throughout the Great Recession. Despite the fact that ECB speeches continue to address the inflation topic (T8) in great proportion, the hypothesis put forward by Eichengreen and others that Germany's inflation aversion has biased ECB policy too much during the Great Recession is difficult to square with this decline in "price stability" references. For reasons of space, this interesting aspect cannot be discussed further, but it

Figure 11. Relative Frequency of Key Bigrams Related to Primary and Secondary Objectives of the ECB

Source: ECB corpus; see description in the main text.
Note: Frequency is given as percentage of the respective objective's occurrence in all words spoken in a given year. Since 1997, 1998, and 2019 feature only partial observations, they are not directly comparable and thus marked with an asterisk.

forms a worthwhile field for future research, not least in light of the ECB's recently concluded strategy review.

In sum, although most of Eichengreen's lessons can be substantiated with content from ECB speeches, this finding is, to a certain extent, qualified by the small proportion of speeches that actually describe these lessons. This ambiguity can be detected even in the case of price stability, an institutionally enshrined objective of the ECB that was historically informed by German interwar experiences: While the STM was able to show that there is a continued presence of the inflation and price stability topics in ECB speeches throughout the Great Recession, this has nevertheless been accompanied by a declining frequency with which the actual term is used.

6. Conclusion

This paper employed text mining methods such as structural topic modeling to examine all 2,135 speeches by ECB Executive Board members between February 1997 and October 2019. It thereby identified and analyzed the significant semantic change that occurred in ECB communication in the transition from the Great Moderation to the Great Recession. The methodology also allowed for a structured and empirical assessment of the hypothesis that central bankers increasingly referred to "lessons from the past" during the crisis. Three main findings arise from this analysis.

Firstly, explanatory analysis of the ECB corpus via descriptive statistics and text mining methods revealed a decisive break in ECB communication between the pre- and the post-crisis period: the number of ECB speeches increased significantly, their semantic content changed considerably, and their general tone became more negative. This was also substantiated through the STM that distilled the key 10 topics underlying ECB speeches and showed how their respective proportions changed particularly during the Great Recession.

Turning to the question of whether this semantic change was accompanied by an increased usage of lessons from the past, this paper found empirical evidence for some of Eichengreen's (2015) lessons that went beyond the occasional anecdote à la Bernanke. Frequency analysis of key bigrams and dates related to the Great

Depression confirmed that there was indeed an increase in historical analogies, particularly between 2009 and 2011. Interestingly, ECB speeches kept referring to the inflation topic (L5) throughout the Great Recession, while liquidity measures (L1) were only discussed briefly. The temporal dimension of this evidence, as measured by the STM, corresponds to Eichengreen's narrative and confirms a shift in policy priorities from 2010 onwards. This is also in line with the development of net sentiment, as measured for the ECB corpus, suggesting that sentiment analysis can help identify times of crises that are likely to lead to an increase in historical analogies.

Finally, the speeches that actually described these historical lessons in more detail, as opposed to merely including comparisons with the Great Depression as a rhetorical device, constituted only 5 percent of all speeches given between 2007 and 2015. While this still reflects an interesting and persistent rhetorical pattern, its marginal quantitative size qualifies the claim about a dominant, all-encompassing influence of historical lessons during the Great Recession.

By discussing the corpus of ECB speeches in detail and by introducing methods such as structural topic modeling that so far have been overlooked in the analysis of ECB communication, this paper contributes to the rapidly growing literature that aims to quantitatively investigate central bank communication through means of natural language processing. In doing so, the paper also advances an understanding of the ECB's communication process during the Great Recession by tracing and analyzing the historical analogies contained in ECB speeches. Future research could expand on these findings by clarifying how these historical analogies relate to macroeconomic parameters, to rhetorical legitimation strategies in front of different national audiences, or to investors' confidence. This would help to better understand the role of economic narratives (in the sense of Shiller 2017) in central bank communication (Hansson 2021). In particular, the findings presented in this paper raise the question of the extent to which complex and often ambiguous references to "lessons from the past" constitute, in a technical sense, "noise" in central bank communication that ultimately reduces the latter's predictability, effectiveness, but also general accessibility (Haldane and McMahon 2018).

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