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The Great Catch-Up: Comparison of Policy Communication of Emerging Market Central Banks with the Fed and ECB[1]

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Abstract

Emerging market central banks, once laggards of the central banking policy scene, have made remarkable progress in improving their policy frameworks in the past two decades. They adopted many of the principles of advanced economy central banks both in policy conduct and communication, but with modifications that reflect their specific circumstances of capital flow volatility, financial dollarization, and traditionally weaker credibility. EM central banks' transparency has improved dramatically; their statements' readability has overall been better than in advanced countries; their focus on inflation has been sharper; many of them proved to be better inflation-forecaster; and they have used data-shy 'forward guidance' sparingly and flexibly. All this has served them well in the post-Covid period of high inflation. Systemic support by the Federal Reserve and the ECB through currency swaps/repo operations with powerful signaling at times of acute market stress also helped. EMs performed particularly well relative to advanced countries in two critical respects: addressing emerging post-Covid inflationary pressures in a timely manner and, related, avoiding banking sector stress during the monetary policy tightening cycle. EM central banks were also able to start moving towards easing monetary policy, ahead of the Federal Reserve and the ECB. Inflation rates have now been brought down to close to central bank targets in most countries, through challenges of the "last mile" sort prevail. Overall, although the output cost of

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bringing down inflation have been higher in EMs due to their higher exposure to the external shocks and generally still weaker institutional credibility, their improved frameworks and faster policy action helped them to successfully limit these costs. Our paper demonstrates these points through the prism of central bank communication, using the Federal Reserve and the ECB as comparators. We conclude with policy lessons not only for EM central banks, but also for central banks of the advanced world. These include better forecasting and communication of inflation by the majority of central banks; more consistent delivery by EM central banks of communicated policy action; discarding pure 'forward guidance' that hampers data dependency and thus fast policy action particularly at times of rapid change; consistent focus on supply-side factors of inflation; for multiple-goal central banks clear choice of policy priority at times of possible conflict among some of the goals; the importance of keeping currency swap and repo operations of globally systemic central banks available at time of stress; and a more transparent policy communication of coordination with fiscal authorities.

Introduction and summary

After decades of struggling with high inflation and the underlying failure of various monetary regimes, emerging market (EM) central banks from the mid-2000s increasingly focused on inflation with variants of the "inflation targeting" regime used by advanced economy (AE) countries. Their peculiar circumstances and the global financial crisis of 2008/9 tested the EM's evolving frameworks and highlighted still-existing vulnerabilities. By the time of the Covid crisis, most EMs were reasonably well-prepared to recognize and address inflationary pressures. Specifically, EM central banks reacted much earlier – from the spring of 2021 – to the signs of emerging inflation than their advanced country counterparts, and their early action appears to have limited the previously often devastating negative impact of the eventual monetary policy tightening in the US and other AEs. EM's peak of inflation was higher than in AEs, but not excessively and in line with their consumption basket's higher share of energy and food, the two key components of global inflation. Even as the US Federal Reserve (Fed) and the European Central Bank (ECB) eventually started tightening, capital outflows from EMs and associated exchange rate pressures have remained manageable, in sharp contrast to past tightening cycles.[2] Lead emerging markets have also started easing monetary policy earlier than advanced country central banks.

The ambition of our paper is to assess the record of EM central banks in communicating their policy and then delivering commensurate policy action over the past two decades.

Communication is a core element of central bank effectiveness and, ultimately, credibility. Central banks can enhance their policy effectiveness and credibility by communicating their policy in the

[2] The wide availability of currency swaps and repos by globally systemic central banks – the Fed, the ECB, and, to an extent, the People's Bank of China – have also helped EMs to maintain their economic stability during the most challenging moments of the Covid crisis and in its aftermath, confirming these instruments' indispensable role in the modern global financial safety net.

most clear and impactful way. In this paper, we compare EM central bank progress with that of the Fed and the ECB, which act as comparators in our analysis.

Our methodology focuses on quantitative assessments of 27 EM central banks' monetary policy communication between 2003 and early 2025, based on a unique database that we have compiled. We analyze communication along several dimensions: policy sentiment and stance; specific central bank topics and specific EM issues; "see-say-act" analysis; focus on macroprudential regulation and the introduction of "forward guidance" in communication, as well as the overall transparency of central banks and the readability of monetary policy statements. We also look for early signs of communication on banking sector stress – the latest challenge of central banks and governments in several advanced countries.

Our main findings are as follows:

- *EM central banks have adopted many of the principles of advanced economy central banks both in policy conduct and communication, but with appropriate modifications that reflect their different economic circumstances*. Specifically, EM central banks follow, and refer more often to, areas where they have more vulnerability than AEs. These include capital flow volatility, financial dollarization, more frequent economic or political shocks, in the context of overall weaker institutional capacity and policy credibility. In such a setting, EM central banks pay more attention to exchange rate policy even under inflation targeting regimes as well as to supply side factors that can translate quickly into inflationary pressures amid less-anchored inflation expectations. They have been less committal in their "forward guidance" language than AE central banks, in view of their more frequent external and domestic shocks. They also keep an eye on fiscal policy that traditionally carries higher risk of fiscal dominance in their countries.

- In general terms, EM central banks have improved their overall *transparency*, with some countries - Chile, Czech Republic, Hungary, South Korea and South Africa - having reached or even surpassed levels seen in AE comparators. That said, significant divergence exists among EM countries.

- The overall *readability* of central bank statements used to be better in EMs than in AEs, requiring a lower level of education to achieve comprehension. However, thanks to efforts of the Fed and the ECB to improve the accessibility of their communication in recent years, the gap between EM and AE communication readability has disappeared. It still requires more than a high school education to understand central bank policy communication in either EMs or AEs.

- *Policy stance and tone* of central banks have naturally evolved during the past two decades. Our analysis offers several noteworthy findings:

i. Outside stress/crisis periods,[3] the tone of central bank statements (hawkish-dovish) is quite similar among AE and EM central banks, mainly driven by Fed policy, in line with the Fed's lead role in the global financial cycle.

ii. During crises, AE-EM policy and tone had diverged in the past, but this changed during the Covid crisis. In the past, EM central banks had been left to their own devices and to react "alone" in the face of shocks. During the GFC, initial Fed loosening granted some room for EM central banks to cut policy rates too, but soon they had to reverse those to defend their exchange rates and fend off inflationary pressures. In contrast, we find that policy stance during the Covid crisis was credibly synchronized for the first time in economic history, thanks to both EM policy improvements and the wide availability of direct dollar and euro liquidity support from the Fed and the ECB, respectively.

iii. Post-Covid, policy and communication became different again between EMs on the one hand, and the Fed and the ECB on the other hand. We demonstrate that while all central banks noticed the building-up inflationary pressures from the beginning of 2021, EMs responded faster and stronger to post-Covid inflation shocks than AEs and communicated their policy change clearly. Our topic decomposition analysis confirms that during the post-Covid inflation shock, EMs were more focused on inflation, possibly reflecting their historically more recent high-inflation experiences and related policy concerns over less well-anchored inflation expectations. They were also unencumbered with sophisticated models that AE central banks use to analyse new inflationary trends on data that did not contain inflationary periods. The Fed was initially mainly concerned with labor market conditions and economic activity, while the ECB did focus on inflation in its communication but, for one reason or another, still acted with a lag relative to EM central banks.

iv. Earlier tightening has allowed most EM central banks to start policy easing ahead of the Fed and the ECB – another historic first. *The output costs of bringing down inflation have been overall higher in EMs due to their higher exposure to the external shocks and generally still weaker institutional credibility, but their improved frameworks and faster policy action helped them to successfully limit these costs.* .

v. Under its dual mandate, the Fed's seems to have focused on labor market conditions in the immediate post-Covid inflationary period, which may have made its communication convoluted. Our sentiment analysis also finds that the Fed's post-Covid communication has gone both ways: some parts (such as economic activity and continued QE) signaled dovish, while others (like inflation) hawkish sentiment, which could have muddled the overall message for a while. In recent periods we don't find in our sample another central bank where communication sends possibly conflicting messages.

[3] 2008/9 global financial crisis, the 2011-14 Eurozone crisis, and the 2020-21 Covid pandemic.

vi. We find that only the Fed has signaled consistently quantitative tightening (QT) policies as part of its monetary policy tightening message once that had started. Even though ECB has reduced its balance sheet more aggressively to date, its newish QE-type operation from September 2022 in the name of fighting eurozone fragmentation (but effectively supporting such countries such as Italy) may have muddled its QT message.

- We assess how well EMs central banks *indicate policy change*, i.e., how much "heads-up" they give to rate change. Is the link strong between that communication and the actual policy rate change? We find that EMs give reasonable forewarning and have been particularly successful in *indicating policy change* during the post-Covid period, but their policy implementation (actual rate change) often remains uncertain. The link between the signal they send, and the actual rate change they deliver tends to be weaker than in their AE counterparts: on average, the correlation between signaled policy rate and actual rate change is around 40%, in contrast to the Fed's and ECB's 70% or more. This may weaken EM central bank credibility and thus could be an area for improvement for EM central banks. We find that the length of inflation targeting experience helps to improve the link between communication and policy rate action.

- We also assess the *link between central banks communicating their inflation concerns and actual inflation*, which can be seen as a proxy for predicting inflation. We find that, worryingly, most central banks do *not* foresee/predict inflation in their communication and only *react* to the observed inflation with a 1-3 month lag. This finding is particularly strong for the Fed, whose inflation component of the sentiment score is relatively weakly correlated with actual inflation (around 20-50% depending on the approach to sentiment assessment). The ECB is the most focused and consistent in its communication on inflation.

- EM central banks naturally focus more on *exchange rate movements* (even under inflation targeting) than do AE comparators. For small open economies with a history of financial dollarisation that many EMs are, the exchange rate remains important including for its role in the monetary transmission mechanism.

- *Financial stability and macroprudential policy aspects* have been increasingly incorporated in EM central bank statements since the GFC, in line with AE comparators. [4]

- It is critical to maintain the liquidity support facilities of globally systemic central banks – the Federal Reserve, the ECB, and the PBoC – at times of high markets stress to a broad qualifying pool of countries and communicate these to the markets. Such actions during the pandemic helped avoid market meltdown.

[44] In a separate paper, we analyse central bank communication on financial stability and specifically macroprudential policies and compare that with communication on monetary policy (Evdokimova et al 2025, forthcoming).

In sum, EM central banks have come a long way in their policy and communication, adopting many of the principles of leading AE central banks in both the conduct and the communication of policy over the past two decades. In some important respects they have recently performed *better* than their advanced country counterparts. There is, of course, room for improvement in certain areas that we have highlighted above. Yet in the core area of central banking, fighting inflation and maintaining banking sector stability, EM central banks appear to have come ahead of the Fed and the ECB, and communicated their divergent views clearly and confidently in the post-Covid period. Inflation rates have now been brought down close to central bank targets in most countries, through "last mile" type of problems still remain. Overall, the output costs of bringing down inflation have been somewhat higher in EMs due to their higher exposure to the external shocks and generally still weaker institutional credibility, but their improved frameworks and faster policy action helped them to successfully limit these costs.

Policy context

Institutional frameworks often develop in response to crises. This is certainly the case in central banking. Created in the first place to safeguard financial stability and payment systems (Goodhart 2011, Bordo et al. 2017), central banking has evolved to focus on delivering price stability through what (Cœuré and Kotz 2021) call *learning by crises*.

Central banks in advanced economies (AE) tried various frameworks in response to the collapse of the Bretton Woods international monetary system in 1971 and the ensuing high inflation of the 1970s. Their focus turned to inflation targeting in the late 1980s, where the sole (or primary) objective of monetary policy is a numeric target of a chosen price index (Bernanke et al. 2001). Along with this single focus came increased transparency of communication on targets and policies, as well as on central bank independence to permit clear attention to achieving the chosen inflation target (Mishkin 2000).

The evolution of monetary frameworks in emerging markets has been even more of a trial-and-error process. Certain EM characteristics proved to constrain the choice of regime. These included shallow domestic markets; high level of financial dollarization that makes drastic exchange rate movements highly risky for balance sheets and thus economic and financial stability; higher degree of government interference in the economy that is usually accompanied by "fiscal dominance" with risks to central bank independence; and generally weaker institutional capacity. The result was frequent high inflation periods, capital flow volatility and related financial instability, often leading to twin financial market and balance of payments crises.

EMs' quest for a more suitable monetary policy framework turned to the increasing evidence of the success of inflation targeting in advanced countries by the second half of the 1990s. The first EM to adopt a form of inflation targeting was Chile as early as in 1990, though many conditions for it were not really, and not fully, there. Later, an increasing number of EMs adopted inflation targeting in some form ("IT light", "dirty IT") that allowed some exchange rate intervention, which, along with improved central bank independence, transparency and communications, turned out to be

effective even under less-than-perfect conditions. By the eve of the global financial crisis of 2008, 18 EMs had formally adopted IT regime, and many considered their regime as "IT light". Monetary frameworks in advanced countries and lead EMs had become more similar.

The GFC bluntly exposed the major weakness of inflation targeting regimes: its single focus can lead to a "benign neglect" over financial stability – their historic raison d'être. The GFC also prompted some unusual steps by advanced country central banks in the form of "unconventional" monetary policies under which central banks proactively target the longer end of the interest rate curve and engage with their balance sheets to buy assets so that to ease monetary conditions in the context of very low nominal interest rates (at the "effective lower bound" (Bernanke 2020)).

However, emerging markets could *not* mount such counter-cyclical expansionary monetary policies without risking their exchange rate and thus own financial stability at that time. After some initial policy rate cuts in the shadow of the Fed's and ECB's cut actions, they had to react to market pressure through policy tightening, i.e., pro-cyclical policies that tend to exacerbate recessionary pressures (De Leo, Gopinath, and Kalemli-Ozcan, 2022).

EMs used the post-GFC time to strengthen their monetary framework and gain more credibility in the run-up to the Covid crisis (Ribakova et al 2020). And by the time the Covid crisis unfolded, emerging-market central banking had undergone a "quiet revolution (Nagy Mohácsi 2020). Improved domestic monetary frameworks and positive spillovers from advanced countries along with direct and indirect support such as currency swap and repo operations on offer to a wide circle of countries, monetary authorities have enabled EM central banks to mount, for the first time, credible counter-cyclical policies.[5] The Fed and ECB's FX currency swaps and repo operations provided active and widely available support to EMs at critical points of the crisis (Vujčić 2020 and Velasco, 2022). The Fed also became a de facto *international* lender of last resort (Cassetta 2022).

Covid crisis policy responses turned out to have erred on the generous side and continued even as economic recovery got strongly underway. This added to already existing Covid-related demand-supply imbalances with shortages, and, with added supply side shocks from the Russia-Ukraine war, eventually led to the rapid rise of inflation across the globe. High inflation is an area where advanced countries – and their models - had little recent experience, in contrast to EMs that had deep-rooted and painful experiences. As inflation started to surge, advanced countries slipped into a year-long debate about whether inflation was "permanent" or "transitory," while key EM central banks started to tighten policies without too much hesitation[6]. As presented in Table 1, most EM central banks responded to inflationary pressures not later than 6 months after inflation exceeded the target or the upper bound of the targeted band. In most cases inflation deviation was below 3 pp when central banks started tightening. In contrast, the reaction to inflation by AE central banks came with a significant delay.

[5] These included QE, fiscal packages and relaxation of macroprudential policies without putting at risk their exchange rates, capital flows and inflation. While much smaller in size, these policies of EM central banks were similar to those in advanced countries – and sometimes even more effective (IMF 2020).

[6]

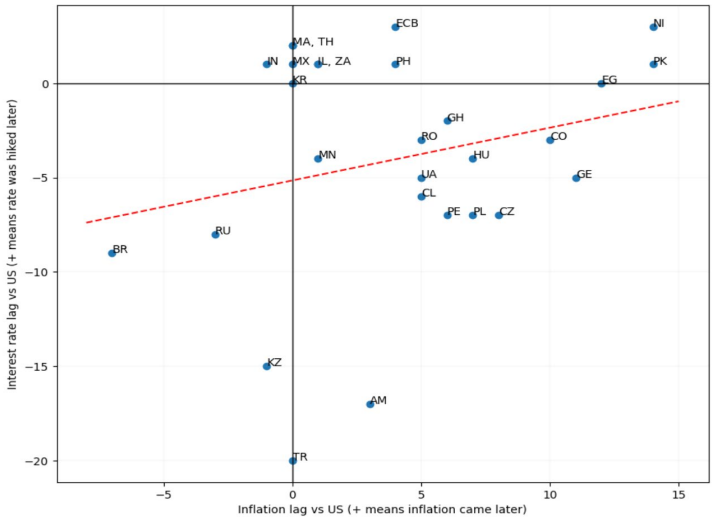
Table 1: Post-Covid tightening cycle timeline

Country	Month of the first rate hike	Months above target / upper bound at the time of the hike	Deviation of inflation from target at the time of the hike, percentage points
Brazil	March 2021	0	(1.1)
Armenia	February 2021	1	0.1
Egypt	March 2022	1	1.3
Kazakhstan	March 2021	1	1.3
Philippines	May 2022	2	1.4
Colombia	October 2021	3	0.6
Hungary	June 2021	3	1.5
Peru	August 2021	3	1.9
Chile	July 2021	4	1.6
Czechia	June 2021	4	0.7
Ukraine	March 2021	4	3.5
Ghana	November 2021	4	3.0
Israel	April 2022	4	0.9
Mexico	June 2021	4	1.8
Korea	August 2021	5	0.5
India	May 2022	5	1.0
Romania	October 2021	6	4.4
Russia	March 2021	6	1.7
Mongolia	January 2022	6	7.1
Poland	October 2021	7	3.6
South Africa	November 2021	8	0.9
Thailand	August 2022	11	5.8
US	March 2022	13	6.5
Euro area	July 2022	13	6.9
Türkiye	March 2021	15	8.9
Georgia	July 2021	19	5.3

Source: Authors' calculations

It is sometimes argued that EMs' swift hawkishness was driven by the fact that inflation shocks hit EMs earlier than AEs. However, this was not the case. The US was in fact one of the first to experience inflationary pressures in 2021. In Chart 1 we plot lags and leads in inflation and interest rates in EMs relative to US. We identify these lags and leads by measuring correlation between timeseries for EMs and US and finding the lag/lead in months at which this correlation is highest. We observe that most countries are concentrated in lower-right quadrant, which corresponds to a *later* start of inflation compared to US, yet a *faster* policy tightening as compared to the Fed.

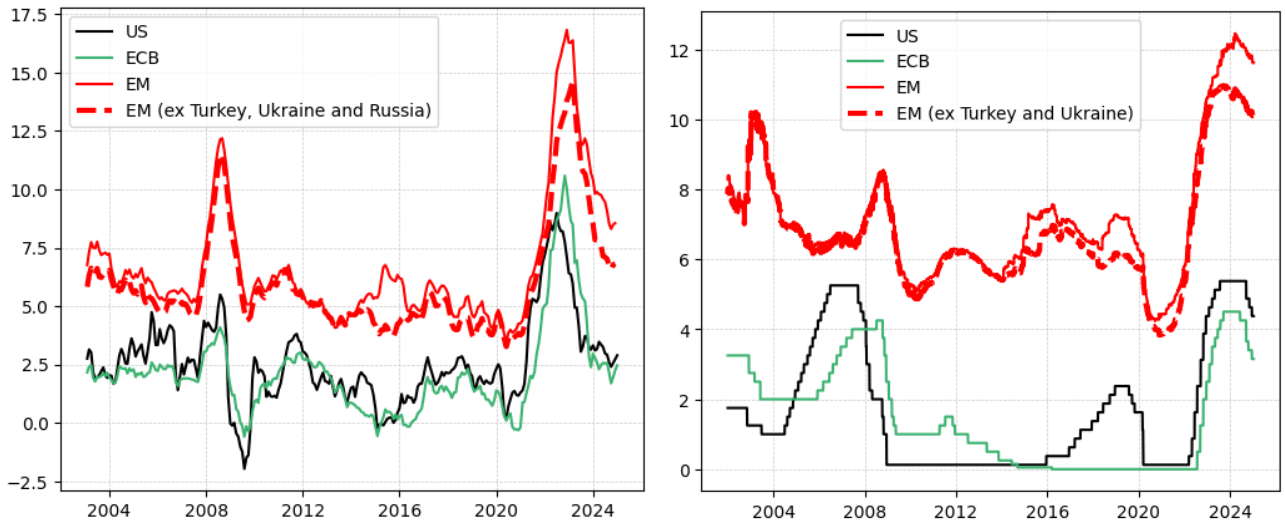
Chart 1: Inflation and interest rate timelines in EMs relative to US



Source: Authors' calculations

In sum, EM central banks were more receptive to the dangers of inflation (and the ensuing impact on capital flows and economic growth) than their advanced country counterparts (Chart 2). Though EM inflation rates peaked higher than in AE due to a higher share of food and energy in the consumer price basket and some exchange rate depreciation, as well as weaker institutional credibility, EMs have *not* seen unmanageable capital outflows and exchange rate pressures which in the past used to be typical at times of stress. Overall, EM central banks' initial reaction to surging inflation was more appropriate than in AE, and their monetary policy has performed better than in the past in dealing with the fallout from the eventual global financial tightening. Moreover, earlier and thus more gradual interest rate increases in EMs might have helped avert banking sector stress we have seen with the failure of Silicon Valley Bank and others in the US and the UK, and of Credit Suisse in Switzerland.

Chart 2: Inflation and central bank policy rates in US, Eurozone and EM



Source: Haver, FRED

Review of communication literature

Central bank communication has received increasing attention from researchers as a tool of policymaking. Studies have analyzed trends, relationships between communication and markets, and communication as a precursor of policy decisions and a driver of market influence. However, despite its significant progress, the evolution of EM central banks' communication has remained a relatively less studied area.

We build upon the earlier literature to analyze EM central bank communication and how it compares to the AE central banks.

(Gonzalez and Tadle 2022) present the most comprehensive sample of 18 countries (6 AEs and 12 EMs) and investigate the use of sentiment analysis in predicting monetary policy changes. The study employs sentiment analysis, relying on custom dictionaries. For a significant majority of the inflation-targeting countries, the sentiment score provides additional information that helps predict monetary policy rate movements. Sentiment across countries tended to co-move during the 2008 crisis and following Fed's sentiment surprises.

The analysis of the length and readability of the statements for 5 Latin American central banks in (IMF 2018) found that more readable press releases were associated with lower policy forecast error when using the statement tone index.

(Armelius et al. 2019) ran a study on 23, mostly AE, central banks to understand how central banks influence each other's communication across borders, with the Fed's communication being at the center. Co-movement in sentiment across central banks was partially explained by trade or financial flow exposures. However, the reasons for communication spillovers are not limited to these factors.

(Laungaram and Wongwachara 2017) focused on readability of statements of 22 central banks, including EMs. Statements were found to have become longer over time, but the average number of words per sentence was declining. Readability tended to fall when central banks lowered their policy interest rates. Among the six communication topics analyzed using Latent Dirichlet Allocation, it was the net tone of inflation and growth topics that were found to be most strongly correlated with the interest rate path.

(Tadle 2022) showed a statistically significant strengthening of the US dollar following the publication of hawkish Fed minutes, but no significant response from the stock markets. The analysis also finds a positive correlation between minutes sentiment and policy rate, peaking around 12 to 15 months ahead of meeting releases. The paper also analyzes the communication strategy and content of monetary policy statements of the Fed, ECB, and Central Bank of Türkiye from 2002-2015, observing a change in tone towards greater transparency and measuring the extent of optimism and certainty in the statements before and after the crisis.

In country-specific research, (Carvalho et al. 2013) decomposed the effect of Brazil's COPOM's statements on the term structure of interest rates. The authors measured the hawkishness or

dovishness of the statements using Google search and sentiment analysis, showing that a one standard deviation shift in the hawkish direction increased 4-month to 2-year yields by 2 to 5 basis points.

Similarly, (Iglesias et al. 2017), in their study of Türkiye aimed to identify latent topics in central bank statements and analyzed their evolution over time using neural networks. The study measured central bank sentiment and used a high-frequency event study to analyze the market rates' response to the central bank monetary policy statements through the yield curve. The study found that the market rates increased in response to a more hawkish central bank tone and decreased in response to a more dovish tone.

In a similar vein, (Hansen et al. 2019) examined the effect of the Bank of England's Inflation Report on the yield curve. (Kawamura et al. 2019) also use Latent Dirichlet Analysis (LDA) to analyze the ambiguity of sentences of the Bank of Japan's communication and found a correlation between obfuscation and negative signals. (Hendry and Madeley 2010) use latent semantic analysis to check whether Bank of Canada statements affect returns and volatility of interest rate markets over the 2002-2008 period. (Apel and Grimaldi 2014) used a custom dictionary as well as LDA to analyze the information content of Riksbank's monetary policy minutes. (Tobback et al. 2017) constructed an index that measured the tone perceived by the media of the ECB press conferences.

Although the body of the literature is vast, to our knowledge there are only three papers looking into the evolution of EM communication over time and no paper focuses on comparing EMs to AEs that cover a long period as well as the post-Covid inflation shock to date.

Our dataset

We assess the evolution of EM central bank communication by analyzing monetary policy statements of 27 EM central banks over the last two decades: Armenia, Brazil, Chile, Colombia, Czech Republic, Egypt, Ghana, Georgia, Hungary, India, Israel, Kazakhstan, Korea, Malaysia, Mexico, Mongolia, Nigeria, Pakistan, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, and Ukraine.[7] We have collected the texts of the statements from the central banks' websites.[8]

We collected the published statements in English, and not in the native language of the central banks. One of the key methodological questions in cross-country comparative language studies is whether to use single (typically English) or multi language text input. The first approach is easier to implement since it does not require setting up language-specific dictionaries or using more advanced multilingual text processing techniques. Its caveat though is that translation always

[7] Given the long time period, some of the countries included here have become advanced economies, such as Israel and Korea. We have run our analyses also excluding them, but the results we present here do not change materially. Most of the countries in the sample (with the exception of Egypt, Nigeria, Pakistan and Malaysia) have an inflation targeting framework, according to the IMF Annual Report on Exchange Arrangements and Exchange Restrictions. Rerunning our analysis on the sub-sample limited to inflation targeters does not significantly alter the results.

[8] The full database of statements broken down into separate sentences is available in the online Annexes to this paper.

carries the risk of not conveying in full the original message, and some central banks include a disclaimer that the native language version prevails in case of a conflict. Similar to the majority of cross-country studies on central bank communication (Gonzalez and Tadle 2022; Laungaram and Wongwachara 2017; Armelius et al. 2019)[9] we decide to use English versions of the monetary policy statements published by the central banks. We explain below why we view this pragmatic approach as appropriate.

- The review by (Nur Atiqah and Nur Ida 2021) of recent publications relying on multilingual analysis techniques highlights that a typical initial step of such analysis (used in around a half of surveyed studies) is a machine translation of multilingual text input into a single target language, most frequently English. Machine translation is a more affordable but less precise alternative to a human translation, which remains the gold standard (Lucas et al. 2015). From this perspective official translation is a high quality input for the analysis.
- There is some empirical evidence (Rada Mihalcea and Wiebe 2010), (Dashtipour et al. 2016) that multilingual analysis tools can improve the accuracy of sentiment analysis (for example, the precision of algorithms classifying sentences as objective or subjective). However, (Mabokela et al. 2023) show that multilingual tools are particularly popular and in the analysis of colloquial unofficial texts (product/service reviews, social media posts and comments, newspaper headlines, etc.). In case of these subjective texts, language specific grammar, sentence structure, lexicon, idioms can significantly affect the results of the analysis justifying the need for more sophisticated multilingual techniques. The content of the formal and technical monetary policy statements is primarily conveyed via the use of specific terminology and concepts for which information loss due to translation is relatively low. The readability analysis is directly affected by the choice of the input text language since the metrics typically include such subcomponents as word and sentence length. These are highly language specific. The advantage of using single language text input is that it allows apples-to-apples comparison of monetary policy communication.

The dataset from the collected statements is quite rich and starts before the global financial crisis for most of the countries in the sample, in or around 2003 and thus covers the past two decades. A few countries (Armenia, Czech Republic, Brazil, Colombia, Georgia, Mexico, Mongolia, Russia, and Ukraine) have a shorter archive of statements. In some cases, the statements were not available in English and hence were not included in the analysis. In other cases, central banks used unconventional formats for monetary policy statements such as presentations with charts and not so much text. This, of course can make the analysis more challenging.

We also collected monetary policy statements from the Federal Reserve and ECB (since 2002 and 2000, respectively), which we use as comparators for policy communication by EM central banks. In the case of the ECB, we use the introductory statements of the ECB President at press conferences instead of the ECB's statements, because the format and content of the ECB introductory

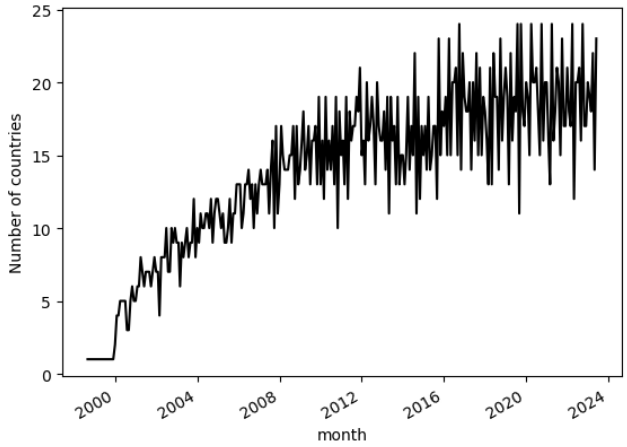
[9] Native language statements are typically used in papers that focus on individual countries or regions with a common native language (IMF, 2018, Vega and Lahura (2018)).

statements is much closer to that of statements issued by other central banks and give more detailed reasoning behind the ECB Governing Council's decisions.

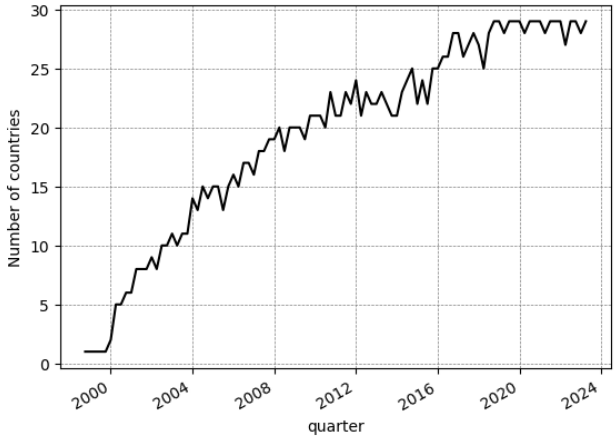
On average, we have around 170 statements per country from the history of 20 years. Starting from 2003, we have between 5 and 24 monetary policy statements per month for the analysis.

Chart 3: Number of statements

Number of countries with statements, by month



Number of countries with statements, by quarter



We also use the following additional data for our analysis: monthly CPI index and central banks' key policy rate dynamics. These data come from Haver and central bank websites.

Approach to analyzing monetary policy communication

To assess the quality of monetary policy communication in EMs we looked at monetary policy statements across nine dimensions in the following order:

1. Sentiment analysis
2. Topic decomposition
3. "See-say-act" analysis
4. EM-specific communication
5. Use of macroprudential language by the central banks
6. Use of forward guidance
7. Reference to fiscal policy
8. Readability
9. Central bank transparency.

We compare the evolution of EM and AE central banks communication along these metrics to assess progress; uncover whether the EM central banks have converged or not with AE central

banks on these parameters; and see if their communication and the underlying policy have become better equipped to respond to macroeconomic/inflationary shocks.

1. Sentiment analysis

Our sentiment analysis aims to assess the tone of central banks' monetary policy communication and the extent to which it reflects their policy actions. To this end we analyze the *degree of hawkishness/dovishness* of central banks' monetary policy statements and compare the evolution of the resulting metric with the trajectory of their key policy rates and inflation. To construct our monetary policy sentiment metric, we largely followed the approach used by (Gonzalez and Tadle 2022).[10]

Using thematic dictionaries, we classify each sentence of the monetary policy statement as "hawkish", "dovish" or "neutral" (assigning to them a score of 1, -1 and 0, respectively). To achieve higher precision, we break down compound sentences into parts and score them separately. We then calculate an average sentiment score for each statement. A positive score reflects a more hawkish tone of the central bank, a negative score means more dovish tone. The detailed methodology for classifying sentences into dovish, hawkish and neutral is described in Annex 1.

We summarize below the key developments in monetary policy stance of the Fed, the ECB and EM central banks. Overall, historically EM central banks used to have, by-and-large, to react to the policies of the Federal Reserve, in line with the dollar's lead role in the global financial cycle (Rey 2013, Akinci et al. 2022). Traditionally this meant that EM central banks often needed to tighten policies in the face of shocks, particularly when the US was not affected by that shock.

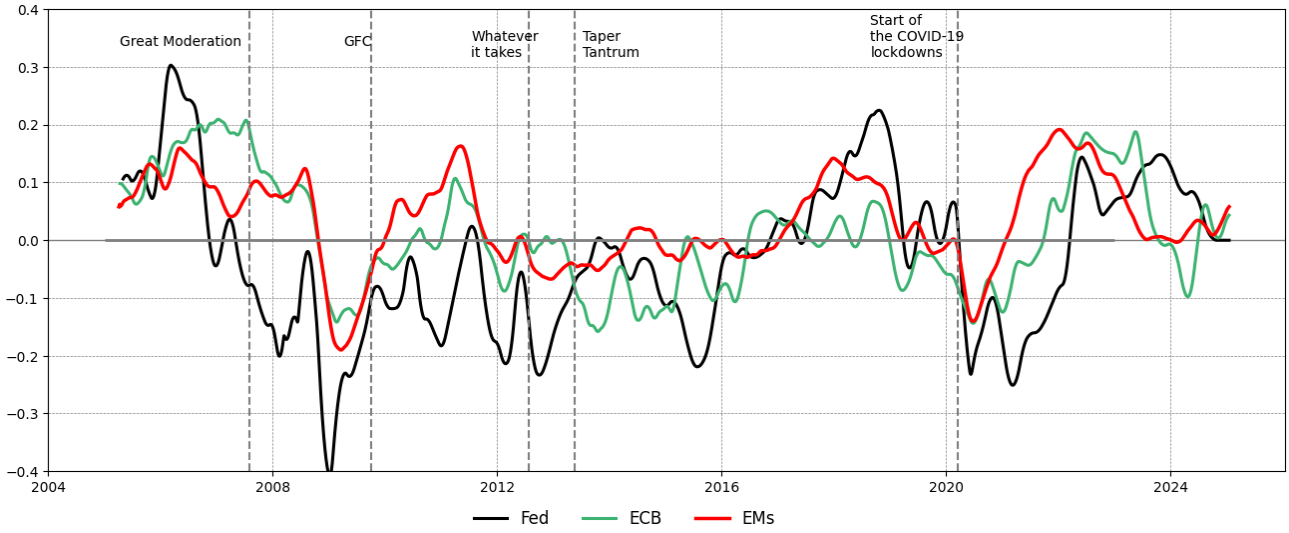
However, we see a certain degree of convergence of policy stance prior to the Covid crisis. Monetary frameworks were converging with EMs successfully adopting inflation targeting, and policy stances became more similar in the run-up to the Covid crisis amid increasing degree of synchronization in economic cycles globally. The nature of shocks has also changed in the past 15 years or so. In the past, EMs were often responsible for their crises because of domestic vulnerabilities even when external shocks hit them. More recently, however, advanced countries appear to be the source of financial stress both with regards to the Global Financial Crisis and more recently with banking sector stress. And, of course, the Covid crisis impacted EMs and advanced economies alike.

In such context, we observe a *synchronization of policy stance* during the first phases of the Covid crisis. This was helped by positive policy spillovers and specific liquidity support by the Fed and the ECB to virtually all emerging markets. EM central banks were able to introduce, for the first time in their economic history, credible counter-cyclical policies with interest rates cuts and many introducing QE just like the Fed and the ECB.

[10] We have introduced some enhancements to the Gonzales-Tadle approach as described in Annex 1.

EM central banks reacted to post-Covid inflationary pressures faster and more aggressively from mid-2021, becoming more hawkish than their AE counterparts. Only a year later did the Fed and the ECB catch-up in the fight against inflation.

Chart 4: Sentiment score of the monetary policy statements (higher = more hawkish, lower = more dovish)



Sentiment score on the chart corresponds to the average hawkish/neutral/dovish score of the sentences belonging to each monetary policy statement. The scores are smoothed over a 3-month rolling period.

Source: Authors' calculations

Specifically, we observe the following trends:

Prior to the global financial crisis (GFC), **EM central bank** communication was generally slightly cautious/hawkish, particularly in the run-up to the GFC. The **Fed** tightened and turned hawkish around 2006, but as the GFC neared and signs of financial instability emerged, the Fed turned dovish already from 2007. The **ECB**, in contrast, was building up its hawkishness pre-GFC and remained hawkish amid the first signs of the financial crisis. The ECB hiked the policy rate in the middle of 2008, diverging from the Fed. This monetary policy stance was reversed very quickly towards the end of 2008.

During the GFC the **Fed's** loosening policy with dovish language led the crisis response and communication. Initially **EM** central banks tightened and remained hawkish to avoid capital flight. As the crisis spread and global sentiment worsened, major advanced country central banks loosened policy with a strong dovish stance, which then EM central banks tried to mimic for a short period of time, only to turn hawkish and tighten sharply from 2010 to stem capital outflows and pressures on exchange rates.

Post-GFC, **EM central banks** remained vigilant with a neutral or hawkish stance between the GFC and the Covid crisis, given their weaker credibility, less-anchored inflation expectations and occasional pressure on domestic currencies. For most of the period between the GFC and Covid the

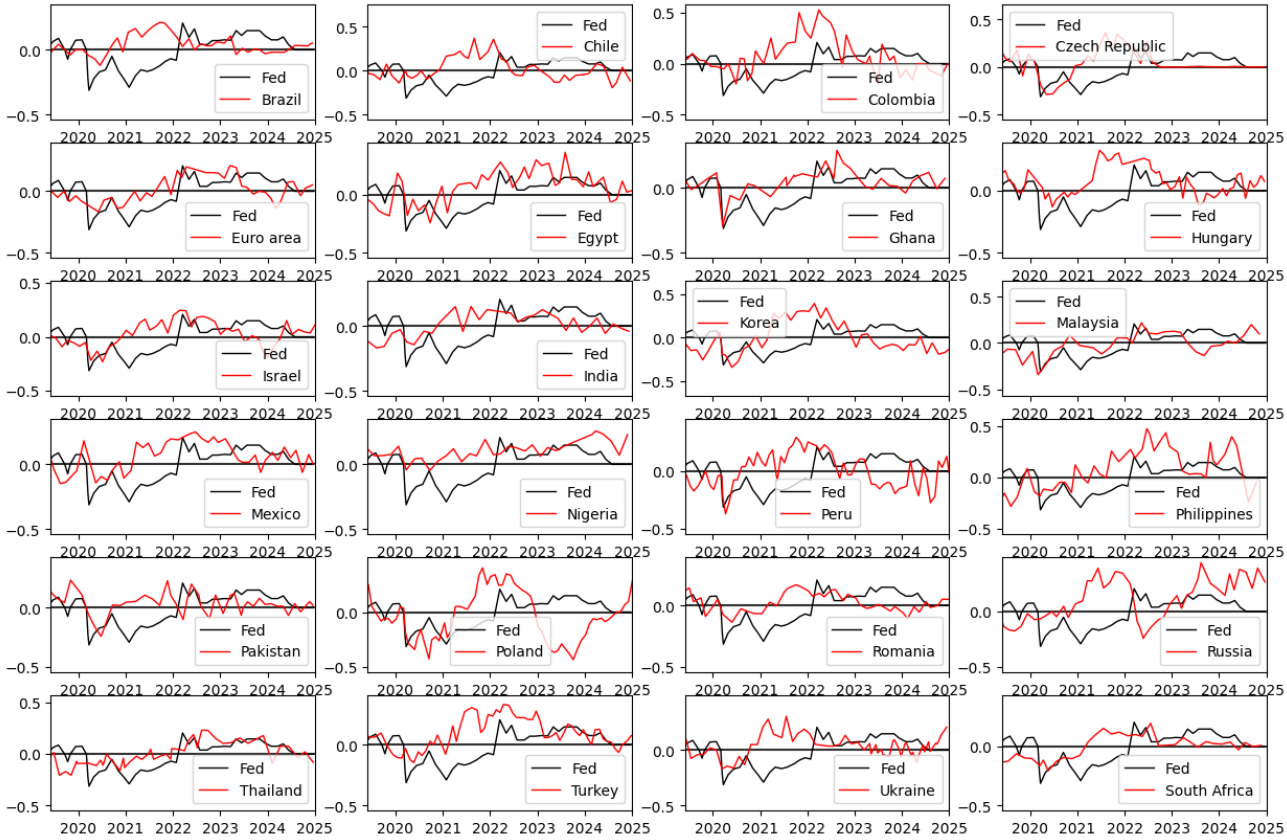
Fed and the ECB remained more dovish than EM central banks. Several major EM central banks (Chile, Brazil, India, Peru, Thailand, Korea) were hiking rates in 2010-2012 to lessen capital flow volatility. The period was further complicated with occasional "currency war" episodes when Fed policy was still loose under quantitative easing (QE), leading to "search-for yield" and associated upward pressures on EM currencies. The **ECB's** communication may have reflected a somewhat confused policy mindset but also "growing pains" to become a full-fledged central bank to manage shocks. It attempted to exit from its accommodative monetary policy stance ahead of the Fed with episodes of tightening/hawkishness in 2011 before Draghi's "Whatever It Takes" speech in July 2012. The eurozone sovereign debt crisis of 2011-2014 and significant disinflation turned the ECB towards a more dovish mode where it broadly remained until Covid, due to concerns about the fragility of the recovery. The **Fed** became much more hawkish as it started a tightening cycle in late 2015, followed by some (limited) quantitative tightening (QT).

During Covid, we see a convergence of **EM** and the two **AE central banks** towards a neutral stance just before the Covid crisis and then a hitherto unseen synchronization in monetary policy communication of the Fed, the ECB and EM central banks in the face of the truly global health and economic shock. As already mentioned, it also reflected a high degree of collaboration among central banks with the Fed and the ECB making available expanded FX swap and repo operations to many EM central banks in 2020-21.

Post-Covid, however, that synchronization broke down initially when **EM central banks** had started to react to rising inflationary pressures about a year earlier than did the Fed and the ECB. EM central bank communication became markedly more hawkish/inflation alert than advanced country comparators from mid-2021. They started interest rate increases earlier and ceased, where practiced, central bank asset purchase programs. The Fed and the ECB have clearly lagged the EM central banks in tightening their policy amid inflation spikes in 2021 onwards. As inflation was being brought down closer to targets, central banks again moved in tandem to easing and by late 2024 sentiment scores have broadly converged to neutral (with some volatility naturally).. Historically, EMs have been generally more hawkish than advanced country counterparts. During the post-Covid inflation pressure EM central banks started to tighten their rhetoric well ahead of the Fed and ECB. The recent sentiment convergence is in clear evidence.

Chart 5 shows the communication sentiment metric for each EM central bank in our sample as well as the ECB relative to that of the Fed around the Covid pandemic. The vast majority of EM central banks shifted to more hawkish communication significantly earlier than did the Fed, and the few which did not – Malaysia and Thailand – had a smaller inflation shock than other EMs.

Chart 5: The tone of monetary policy statements: Fed vs other central banks



Source: Authors' calculations

2. Topic decomposition

We decompose monetary policy statements' tone into specific drivers reflective of central banks' hawkishness/dovishness.

We consider five main components: (i) inflation; (ii) economic activity; (iii) labor market; (iv) quantitative easing, and (v) forward guidance. This allows us to find contributions of each factor to the overall monetary policy statement sentiment. We use two approaches for this: a dictionary-based sentiment calculation and machine-learning (ML) modeling. The results of each approach are discussed in the sections below, with details on the methodology in Annex 1.

Dictionary approach

One way to achieve topic decomposition is to narrow down the dictionaries used in Section (1) above to more specific topics. The overall sentiment score is the sum of its components, reflecting the drivers of the monetary policy stance. The residual between the overall score and components (corresponding to grey areas on the charts in this section) mostly covers central banks' discussions of financial conditions (assessment of credit dynamics, market performance and interest rates).

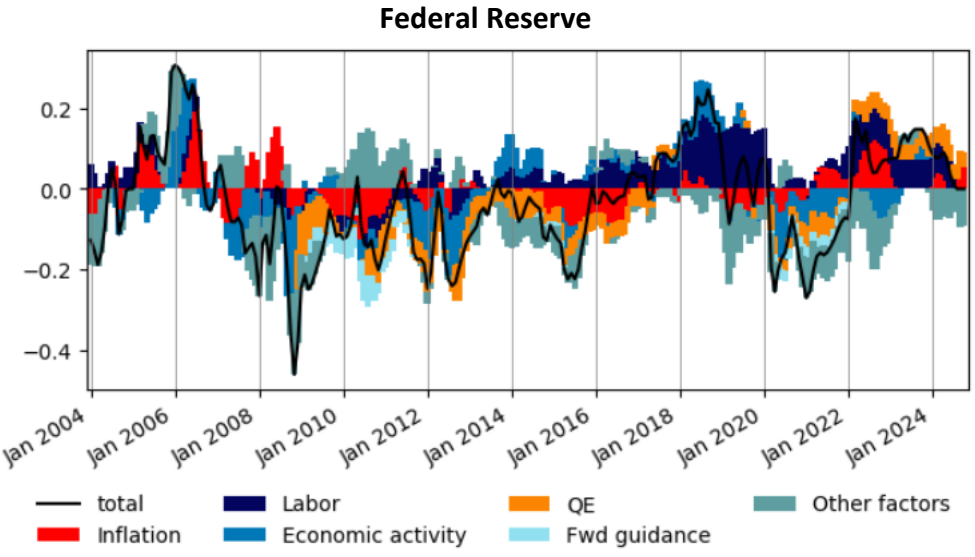
In broad terms, the decomposition confirms that historically the Fed pays high attention to the labor market and economic activity, while the ECB and EM central banks focus more on the price/inflation objective, along with attention to economic activity. Another distinguishing feature of EMs' communication is their focus on fewer topics compared to AE (chart 5), specifically very limited use of forward guidance and QE.

In the Covid period, it appears that both EM and AE central banks *noticed the rising inflation simultaneously in early 2021*. However, AE central banks kept referring to inflationary pressures as transitory or temporary till July 2021. EM central banks, on the contrary, were quick to voice concerns about more persistent nature of inflation (as early as in Q1 of 2021 in case of Brazil, and Q2 2021 in case of Czech Republic, Hungary, Poland and Russia).

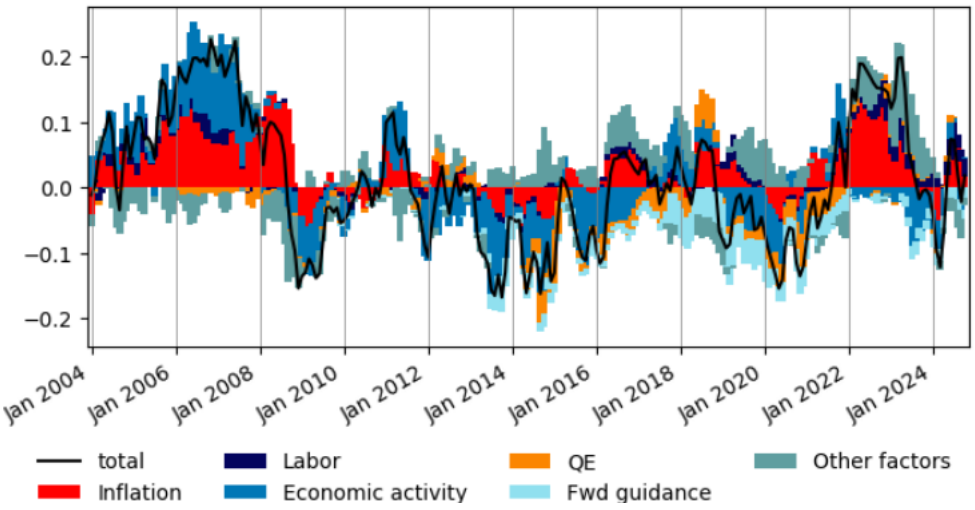
In addition, AE central banks appeared to have been more concerned about the sustainability of the nascent post-pandemic economic recovery and were sticking for some time to dovish policies with no monetary tightening and continued dovish forward guidance and quantitative easing. This led to conflicting signals. For example, in the case of the Fed, the contribution of the inflation component to the overall hawkishness metric became positive around the end of 2020, in sync with many other central banks of the world, but it was still offset by the negative contribution of the economic activity, continued dovish forward guidance component and communication about QE stimulus until the end of 2021.

EM concerns about inflation were not counterbalanced by fears over the sustainability of the economic recovery, and their communication was less constrained by sticking to dovish forward guidance. As a result, EMs' overall sentiment metric was pushed into the hawkish territory much faster than the that of the Fed or the ECB. The notable difference between the ECB and EMs is the *rate* at which they ramped up their inflation conversations: EMs shifted the stance of their regime almost instantaneously, whereas ECB responded to its concerns more gradually and also dedicated a lot of attention to forward guidance and QE in its communication.

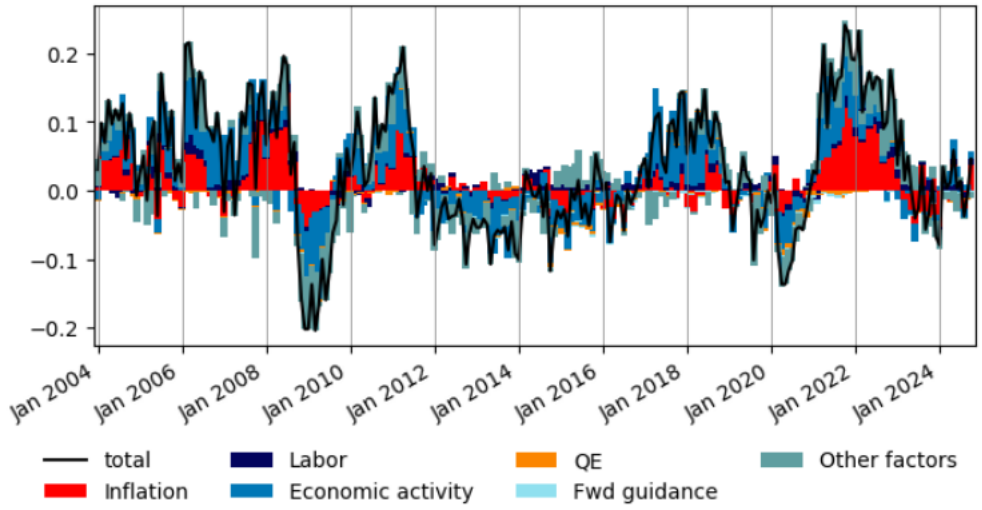
Chart 6: Decomposition of overall sentiment score of monetary policy statements
(Solid line represents the overall score)



ECB



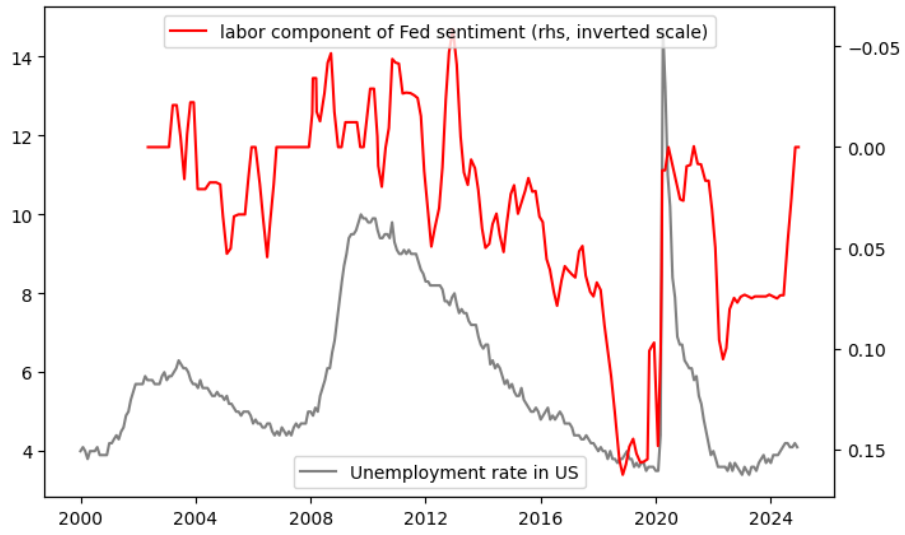
Emerging Markets



Source: Authors' calculations

The decomposition clearly illustrates the dual mandate of the **Fed** with a focus on maximum employment and price stability, as well as its overall initial assessment that inflation was a temporary phenomenon that did not require policy action. Labor market conditions play a critical role in defining the Fed's monetary policy stance, with the labor market component of the sentiment score bringing a significant contribution to the overall score. Note that the labor market component of the Fed sentiment score follows the path of the US unemployment rate, except in 2024 when despite low unemployment the Fed has shifted towards more neutral communication on the labour market (Chart 7).

Chart 7: Unemployment rate and labor market component of Fed sentiment score

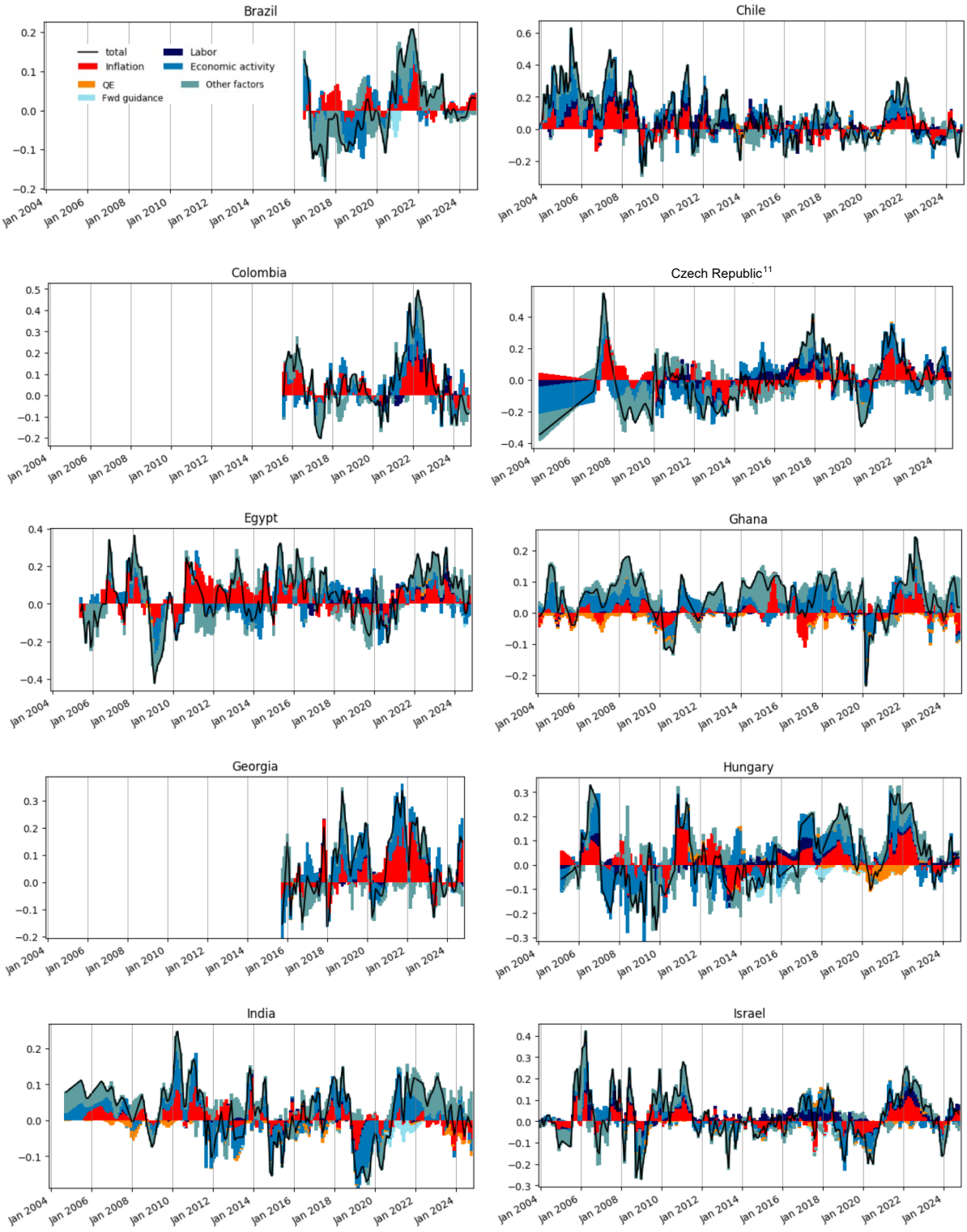


Sources: FRED, authors' calculations

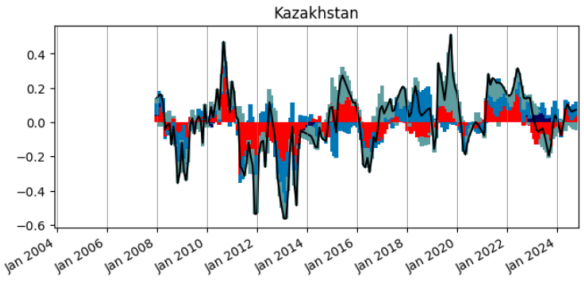
In the case of the **ECB**, historically the focus on inflation has been relatively strong, in line with its primary mandate on price stability. After the GFC, the ECB's concern was mostly about inflation being persistently below the ECB target (which is below, but close to, 2%). In the years before the pandemic the focus on inflation was still present but it became of a more structural nature, linking labor market, inflation and the flattening of the Phillips curve. The ECB also dedicated considerable attention in its press releases to the increasing number of – and more complex – unconventional monetary policy tools. This part of communication together with supporting forward guidance is captured by respectively orange and light blue areas on Chart 6 that became particularly sizeable in 2017-2019. Against this backdrop, increasingly strong conviction that "inflation is dead" might have decreased the ECB's vigilance towards inflation risks ahead of post-Covid inflation wave.

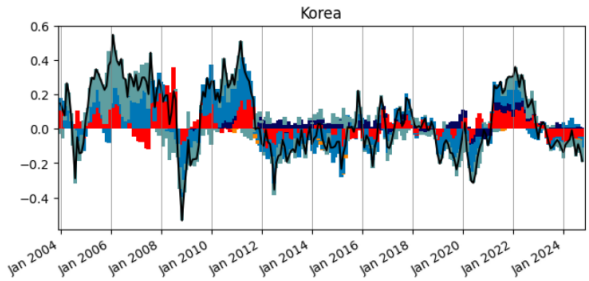
In the case of **EMs**, inflation is the key factor (depicted in red), while labor market focus is limited. Since 2021, the role of inflation in the overall sentiment became *dominant*, especially for Brazil, the Czech Republic, Hungary, South Korea, Mexico, Peru, Philippines, Poland, Romania, Russia, South Africa, Turkey and Ukraine. The strong focus of EM central banks on inflation is likely to reflect this group's relatively recent high inflation experiences and still weakly anchored inflation expectations. Overall components of the EMs' monetary policy sentiment tend to be pointing in the same direction. More hawkish/dovish communication tends to be driven by most components simultaneously, while in case of the Fed and the ECB different components often point in different directions complicating the communication.

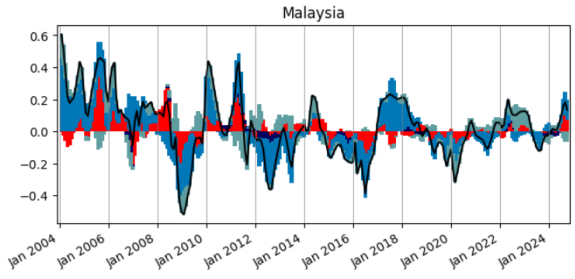
Chart 8: Decomposition of overall monetary policy sentiment score in EM counties

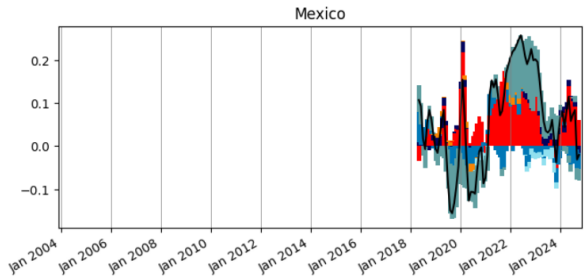


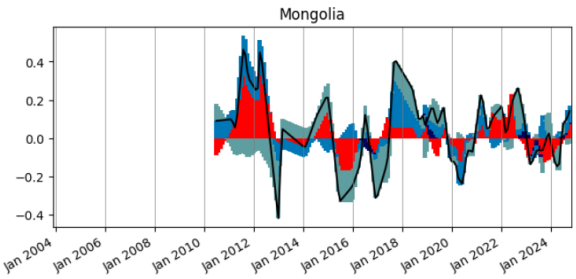
[11] The statements for 2004-2007 are not available on the CNB website.

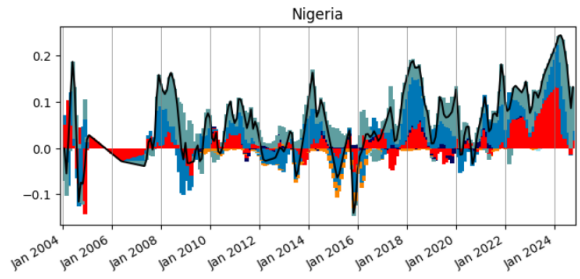

Kazakhstan

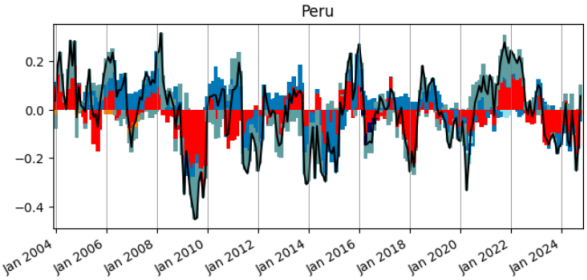

Korea

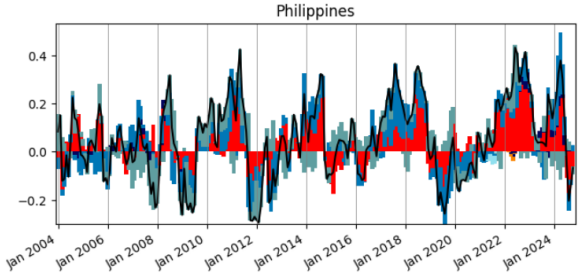

Malaysia

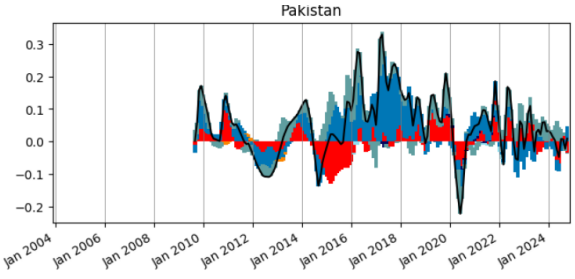

Mexico

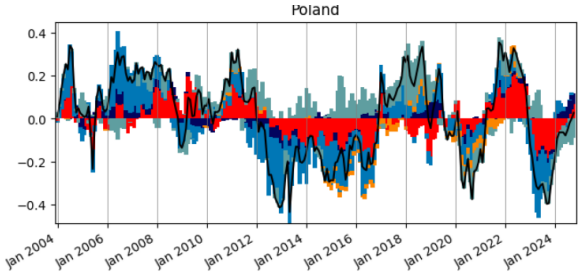

Mongolia

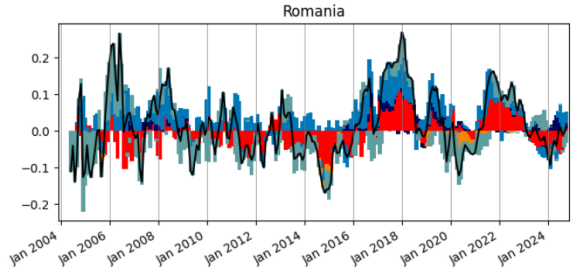

Nigeria

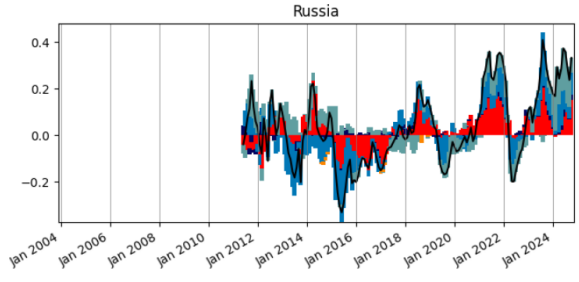

Peru

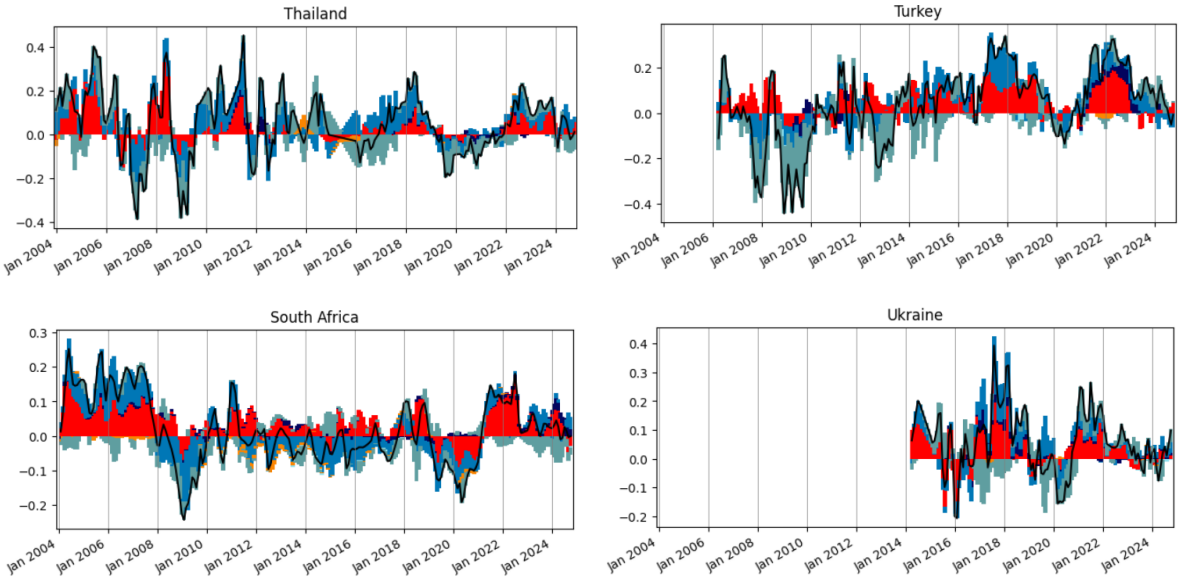

Philippines


Pakistan


Poland


Romania


Russia



Source: Authors' calculations

Machine learning approach

We also apply machine learning methods that rely on large language models using Artificial Intelligence (AI) to support our analysis of central bank communication. We use pre-trained state-of-the-art models; for details see Annex 1.

Our analysis aims to achieve several objectives:

- Expand the literature around machine learning (ML) applications to central bank communication;
- Compare the ML results to the more trialed method of dictionary-based analysis; and
- Identify some caveats around using ML models.

Modern ML allows calculating thematic similarity, thus lending itself to the topic decomposition analysis. The approach involves embeddings, or numeric vector representation of text in high-dimensional space by the state-of-the-art (SoTA) models. We rely on two models: Google's BERT (2018) and Open AI's Ada (end-2022). Two sentences are "correlated" if the dot product of the respective embeddings is high.

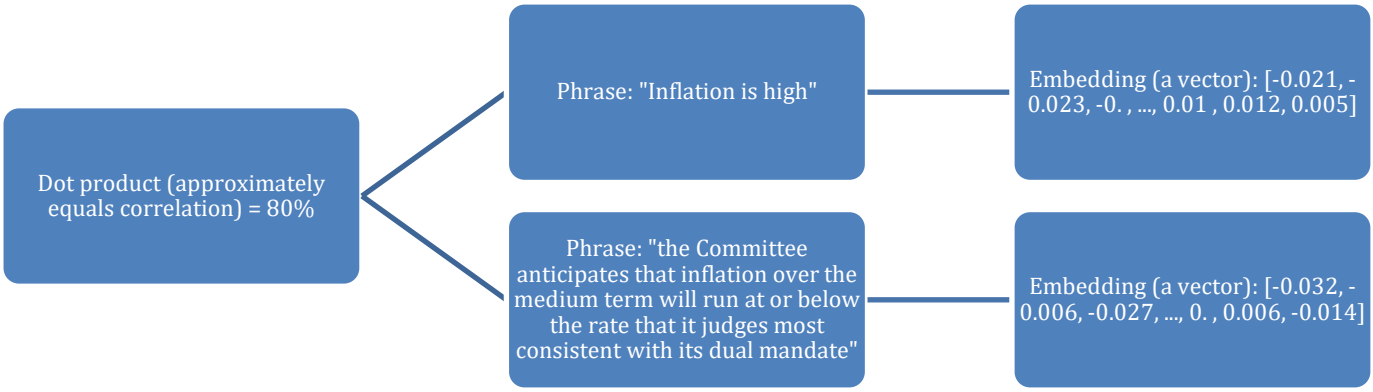
To capture main themes, we use pre-defined "base" phrases: "Inflation is high" and "Labor market is strong"[12]. We limit our ML topic decomposition analysis to these two factors, due to their defining roles in central banks' monetary policy mandates. Both can be clearly defined using a brief phrase – unlike for example "economic activity" which includes GDP, consumption, investments.

It is important to note that the ML analysis does not produce hawkishness/dovishness metrics. Instead, it captures thematic similarity between communication and given phrases, and having

[12] The choice between British and American spelling of the word "labor" does not significantly affect the results. The similarity between the phrases "Labor market is strong " and "Labour market is strong" is close to 90%.

similar sentiment may strengthen similarity, but primarily it stems from topic (unemployment, inflation). The advantage of the ML method is its flexibility. Unlike ML, the dictionary method relies on keeping the dictionary up-to-date and in line with the central bank communication style. ML methods can pick up on synonyms and natural variability in formulations. The main disadvantage of the used ML method is its thematic rather than sentiment focus: e.g., we identify that a central bank emphasizes inflation, but we would be less certain whether this is due to inflation being high or being low (see Diagram 1). The second limitation of the ML method is its sensitivity to the chosen "base phrase".

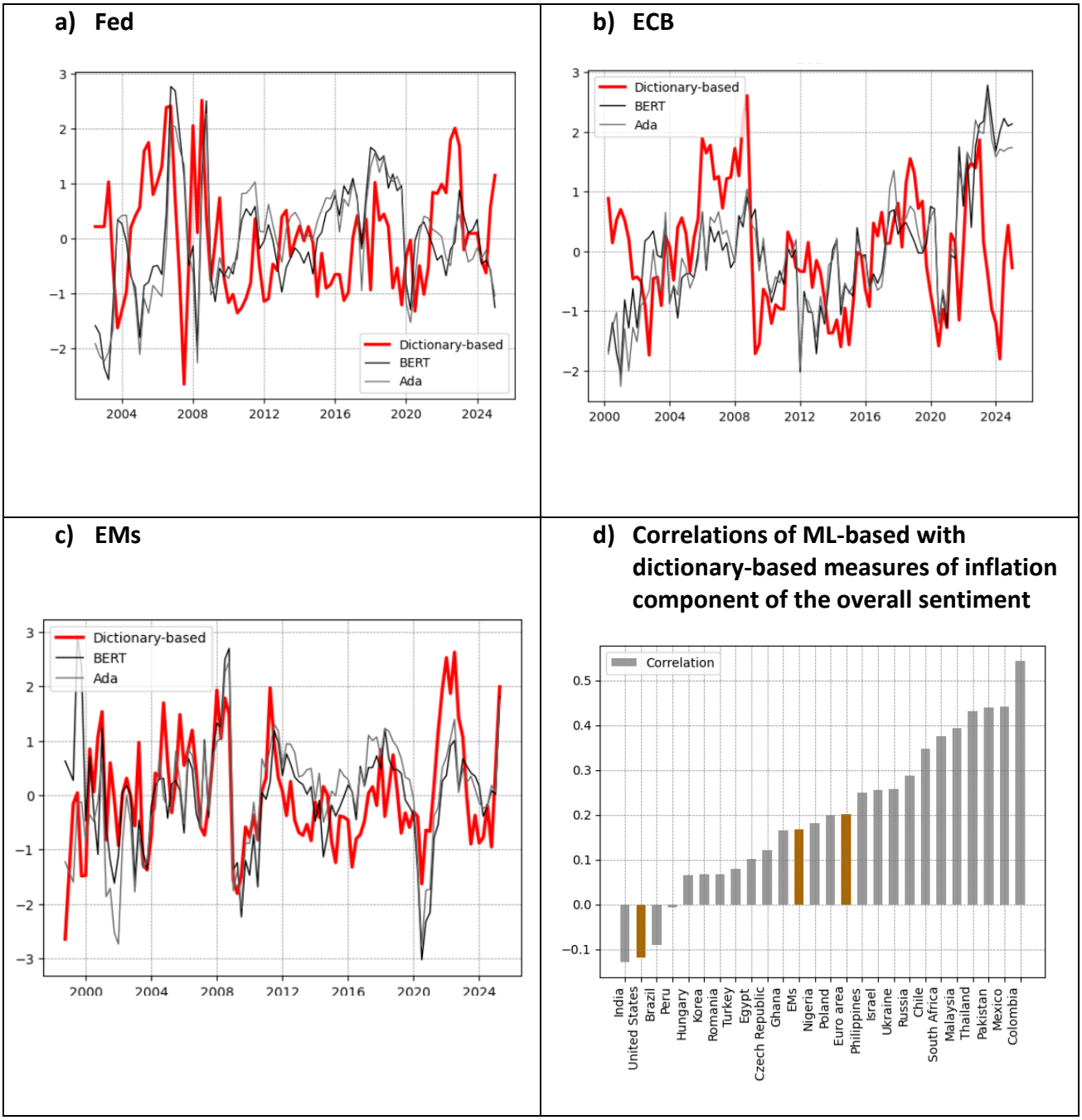
Diagram 1: Correlation of sentences using embeddings, illustrated



We start our analysis by comparing inflation communication as quantified by the two approaches: dictionary-based and ML. While two ML models (BERT and Ada) produce almost identical results, they often deviate from the dictionary-based approach[13] (Chart 9). The **Fed**'s case is notable with correlation between ML and dictionary measures of inflation sentiment being negative (Chart 9d). In 2020-2022, this correlation stood above 50% for almost all countries with the exception of Turkey, Egypt and India – and the Fed. In other words, during this period all the methods quantified communication in a very similar way. This indicates that communication of most central banks was unambiguously focused on inflation, while the Fed remained an outlier with a negative correlation. We attribute this to several factors: (i) inflation, in contrast to employment, being less central in Fed's communication, and thus harder to identify as a topic; (ii) worse readability of Fed's statements compared to other countries, which makes it harder for an ML algorithm trained on generic text (Wikipedia and Brown Corpus) to "understand" the statements.

[13] Context embeddings may struggle with distinguishing negations, which could play a role in quantifying sentiment, leading to this divergence.

Chart 9: Inflation component of the sentiment: comparing dictionary and machine learning methods (Series are normalized)



Source: Authors' calculations

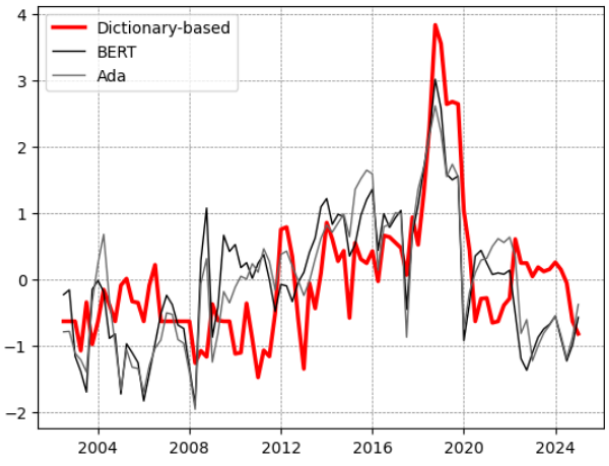
In contrast to the Fed, **EM central banks** started voicing alarm around inflation early, as illustrated by all three measures utilized. The co-movement of the metrics for the **ECB** also appear strong, except for the later part of our sample where only the dictionary-based metric started identifying some dovishness. **EM central banks** also drop the 'inflation is high' sentiment when a crisis hit (both in 2008 and 2020), but then quickly return to inflation focus afterwards.

Judging by Chart 9d, the ECB is in between the FED and a number of EMs in terms of clarity of communication about inflation.

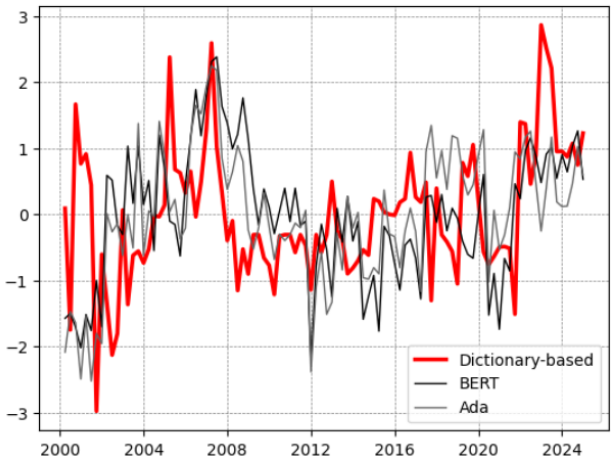
Due to Fed's focus on unemployment, we also run a similar analysis on labor market sentiment (Chart 10). Perhaps not surprisingly, the **Fed** appears to have the strongest correlation between ML and dictionary metrics, which confirms clear and unambiguous communication around this topic (Chart 10d). For the majority of **EM** countries, but also the **ECB**, labor communication does not have strong significance, resulting in low correlations.

Chart 10: Labor market component of the sentiment: comparing dictionary and machine learning methods (Series are normalized)

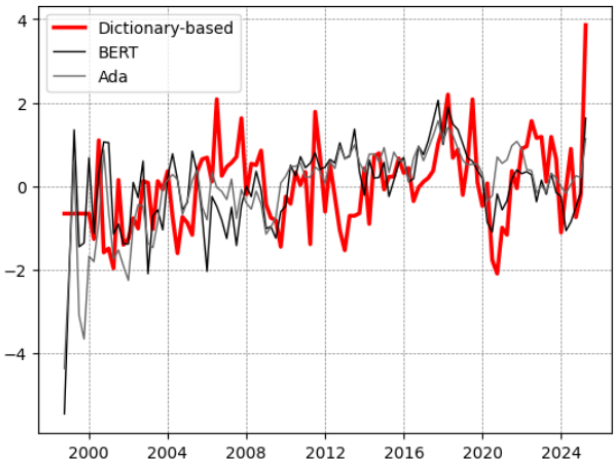
a) Fed



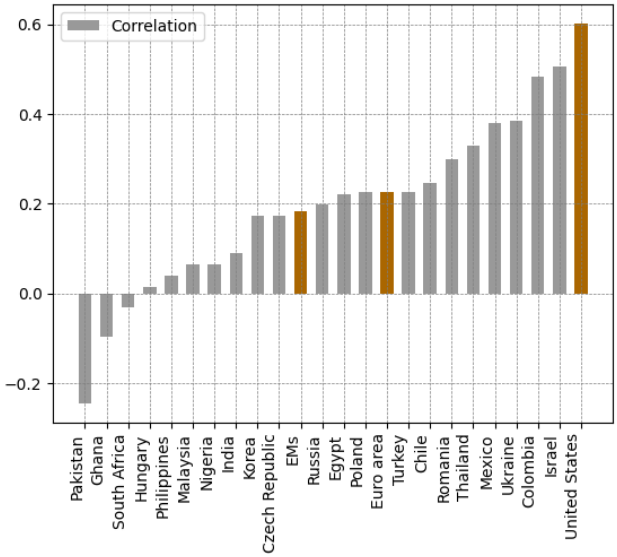
b) ECB



c) EM



d) Correlations of ML-based with dictionary-based measures of labor component of the overall sentiment



Source: Authors' calculations

3. "See-say-act"

So far, we covered sentiment and topics. We now turn to analyzing how central banks' communication relates to reality. First, we check if communication is indicative of the future policy rates moves. Second, we investigate how inflation relates to communication: Do central banks foresee it? Do they react or do they ignore it?

i. Communication and policy rates

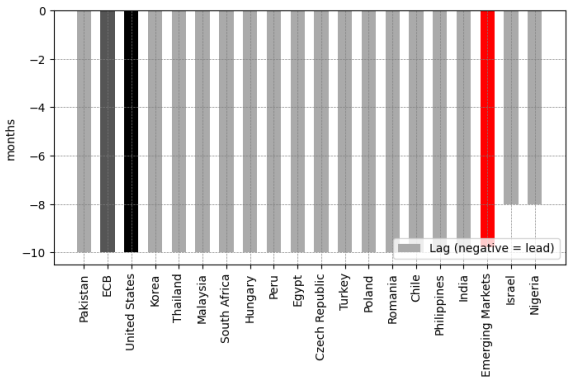
The key objective is to check the extent to which central banks follow the signal sent by the monetary policy statement with the actual key rate moves. We try to find the lag at which communication tone is most correlated with interest rate changes. Ideally, we expect to see communication *foreshadowing* rate moves with sufficient notice. We calculate correlations during the whole period under considerations and we also find a lag of the sentiment score relative to the policy rate that would yield maximum correlation between the two (we constrain the lag analysis with at most 10 months' warning time from communication to policy rate action).

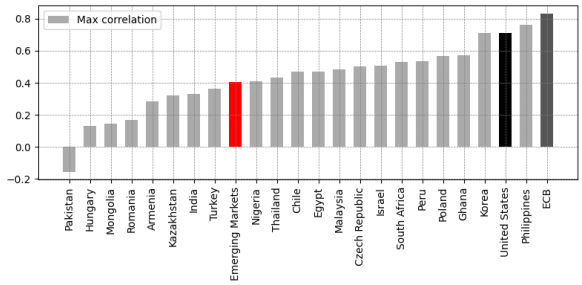
We find that in **EM** the sentiment score *leads* the policy rate moves by at least 8 months (Chart 11a), which means that EM central banks typically start preparing markets and economic agents about their future moves well in advance.

Chart 11: Correlation and lags between overall sentiment score and policy rate*

a) Lag at which correlation is max (negative lag=lead; lead means central banks gives notice before changing rates)

b) Max correlation between communication and policy rate (higher=stronger relationship





Note: using 6-month moving average of the indicators

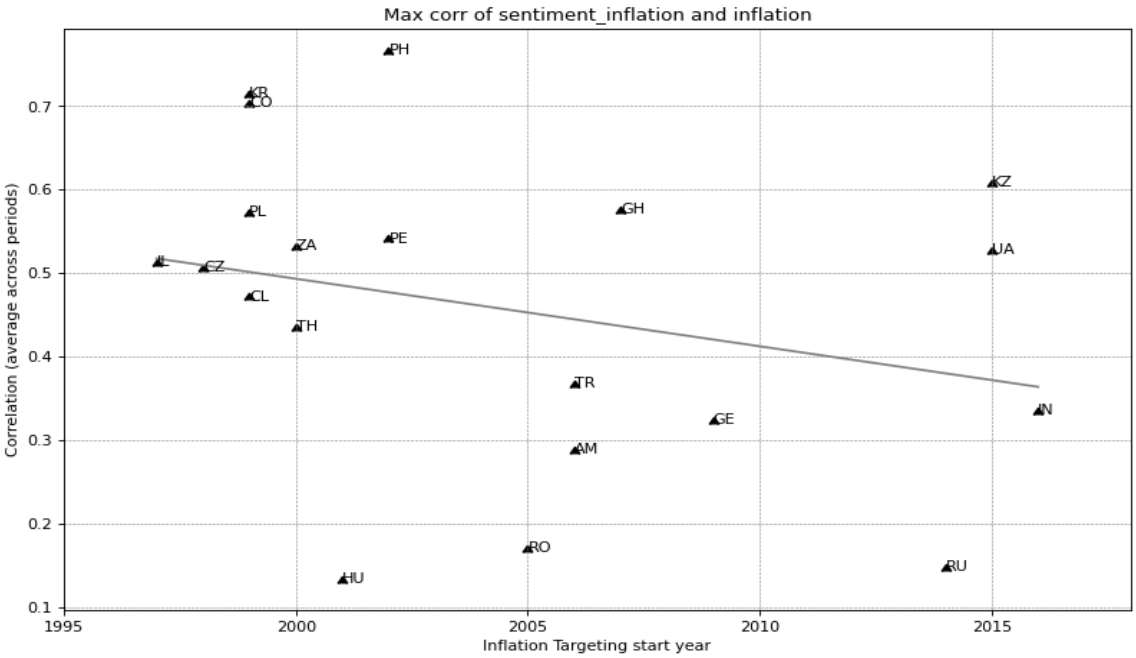
Source: Authors' calculations

We find that in the case of the **Fed and ECB,** the communication and the actual policy rate changes are very closely linked. The correlation between the overall sentiment score and the policy rate is around 70% and above 80%, respectively (Chart 11b)[14]. High correlations indicate that the Fed and ECB do what they say.

The **EM central banks** typically have a *weaker link* between the signal sent by their monetary policy statement and the actual policy rate change. Even though they signal the rate change 8-10 months in advance (see above), the actual rate change traces communication less precisely than for the AE. Average correlation for EM is below 40% implying some room for further improvement in consistency between communication and actual policy rate changes[15]. We note, however, that EMs are more vulnerable to shocks, so that the observed lower correlation might be linked to more frequent need to adapt to changing circumstances, be it from abroad or domestically induced. The former includes spillovers from the AE central bank actions.

We explore if inflation targeting experience matters when it comes to communication. We find some evidence that it does: for countries that started inflation targeting earlier, communication correlates more strongly with policy decisions (Chart 12).

Chart 12. Correlation between tone of monetary policy statements and policy rates versus the time of adopting inflation targeting*



**Note that Mexico and Brazil are excluded because of short time series*

Source: Authors' calculations

[14] For robustness check we have run a similar analysis using shadow interest rates of the Fed estimated by Wu-Xia and Doh-Choi. Correlations between overall sentiment score and shadow federal funds rate is very close to the results obtained with the actual rate (67% when using Wu-Xia proxy and 69% when using Doh-Choi proxy).

[15] Poland, Chile, Philippines and South Korea are notable exceptions with correlations close to AE levels.

ii. Communication and inflation

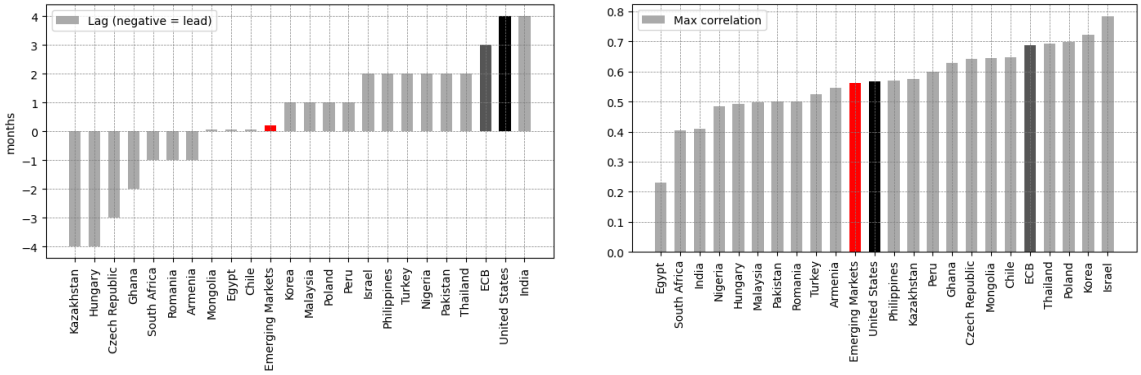
We also look at the correlation between the inflation component of the sentiment and actual inflation in countries from our sample, using both the dictionary-based approach and the ML approach. This is a proxy to measure if central banks are able to forewarn about inflation. For inflation, we use month-on-month seasonally adjusted inflation[16].

Chart 13: Correlation and lags between (a) inflation sentiment score and inflation (dictionary-based metric); and (b) ML "Inflation is high" metric and inflation

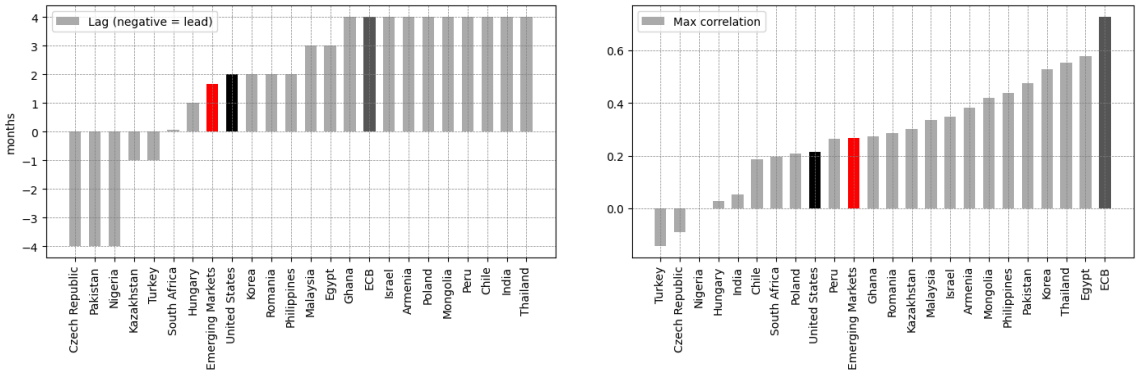
a) Lag at which correlation is max (negative lag=lead; lead means central bank foresees inflation)

b) Max correlation between communication and inflation (higher=stronger relationship)

(a) Dictionary-based metric



(b) ML-based metric (Ada)



Note: Using 6-month moving average of the indicators

Source: Authors' calculations

[16] We use month-to month change in price level as it reflects current inflation trends much better than year-on-year change. The latter is greatly affected by base effects which are less relevant for forward-looking monetary policy.

Central banks both from advanced and emerging countries appear to have *limited ability* to foresee inflation in advance and start communicating on it. The left panels of Chart 13 show that the lag between the inflation component of the sentiment and inflation itself is mostly positive, meaning that central banks first notice the actual inflation and then start communicating on it with a 1-4 month lag. This is a surprising result.

Using the dictionary-based metric, we find that compared to ECB and a few EM central banks (Chile, Czech Republic, Thailand, Korea, Poland, Israel), the **Fed**'s inflation component of the sentiments is *less* correlated with inflation. The correlation is not far from 50%, perhaps linked to the Fed's dual mandate. In case of the **ECB**, which has a firmer focus on price stability, the correlation is higher (around 70%). These findings are broadly confirmed with results based on ML metrics (ECB exhibits the highest correlation of communication about inflation with actual inflation trends, EMs have medium correlation, while the Fed is performing much poorer compared to dictionary-based metrics).

Box 1. Using ChatGPT to parse Fed statements[17]

We identified a shortcoming of ML-based methods in parsing Fed statements when it comes to discerning inflation sentiment (recall negative correlation between ML-based and dictionary-based metrics of communication about inflation). So we ask a question: Can more ML help us?

For this we deploy ChatGPT, one of the latest SoTa models, also referred to as "generative Large Language Model" (LLM). ChatGPT works as a bot, whereby users may ask questions and receive answers based on what the LLM internalized as its knowledge base. The question is often referred to as "prompt".

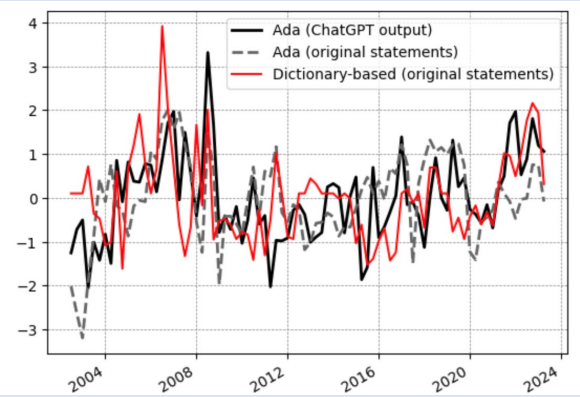
Current understanding of LLM indicates that prompts matter, and there is a separate field of "prompts engineering" aiming to optimize prompts for the best answers. Current recommendations involve assigning a role to the AI agent (e.g., personal assistant, school math teacher, expert in central bank communication, financial analyst, etc.) and asking ChatGPT to reason about the answer. Therefore, instead of asking "Is the central bank hawkish in this statement?", we gave the following prompt to the algorithm:

"*You are a researcher of central bank communication and monetary policy. The text below contains a monetary policy statement issued by a central bank. In your view, does the central bank here believe that inflation is high or increasing, which in turn could warrant an interest rate action? Or do you think that inflation is subsiding, thus warranting a rate cut?*"

[17] The analysis was carried out in August 2023. OpenAI versions are constantly changing complicating the full replicability of this part of the analysis.

Chart: Inflation sentiment using various approaches

Inflation sentiment metrics (normalized)



We then feed this prompt together with one statement. The output is a paragraph of text generated by ChatGPT. We then run this paragraph of text through the ML methods we utilized on the full statements. The results are promising, as the correlation of the embeddings-based method with the dictionary-based metric on original statements (grey dotted line and red line) went from 13% (almost indistinguishable from noise) to 41% (black line and red line). We can therefore conclude that more ML can help.

These results suggest that poor ability of ML to read Fed's statements is partly linked to the complexity of Fed's language. Once the statement goes through Chat GPT and is rephrased in a clearer communication style, ML-based metrics becomes more correlated with dictionary-based suggesting improving readability.

4. Adaptation of EM-specific topics

We investigate the importance of selected key words in the EM monetary policy statements. We look at the exchange rate and supply side constraints. Both topics highlight EMs' vulnerability to external shocks.

Exchange rate

EMs can be conflicted about exchange rate policy, particularly when it comes to inflation-targeting central banks. In our sample central banks still mention exchange rate in their monetary policy statements relatively more frequently than central banks in advanced economies. In case of EM central banks on average 5-7% of sentences in the statements make a reference to the exchange rate (Chart 14). This share almost never falls below 3%. This is in contrast with the ECB, where attention to exchange rate is sporadic, and with Fed, where the references to the exchange rate are

virtually non-existent[18]. Compared to EMs' attention to inflation, their reference to exchange rate looks marginal and does not challenge the priority of inflation targets (Char 15).

These results, however, should not be over-interpreted. Even though EM central banks appear to devote only limited attention to exchange rates in their communication, some of them still occasionally intervene into the foreign exchange market. Such attention to the exchange rate can be fully justified given the EM import price-inflation channel and that many EMs have financial dollarization (Huertas 2022). For small open economies with the heavy legacy of financial dollarization that most EMs are, the exchange rate remains a non-negligible factor (Velasco 2023).

Chart 14. Share of sentences in MP statements containing reference to exchange rate

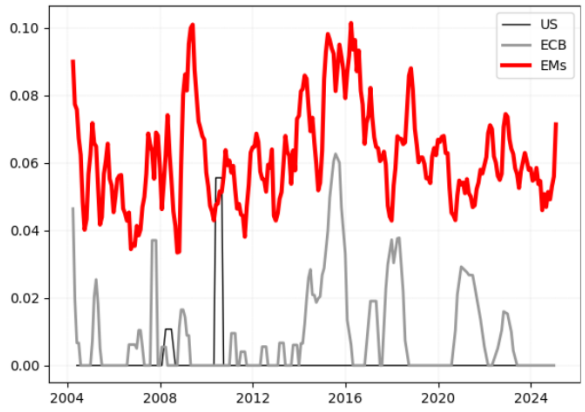
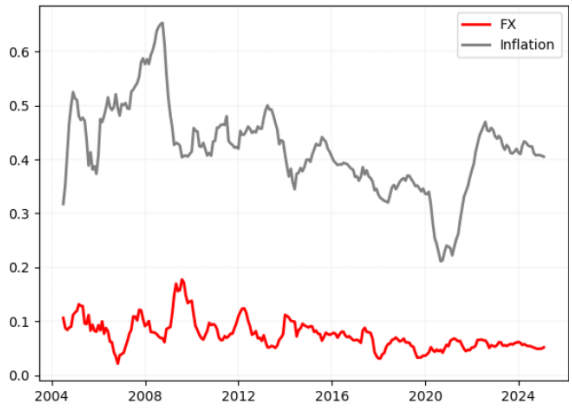


Chart 15. Share of sentences in MP statements of EM central banks containing reference to exchange rate and inflation



Source: Authors' calculations

Supply side factors of inflation

We explore in more detail how central banks discuss inflation. Both AE and EM central banks refer to supply-side factors of inflation, but EMs do so more frequently.[19] They mention supply-side drivers of inflation on average in more than 5% of sentences in the statement (compared to 3% on average in case of the ECB and highly volatile patterns in case of the Fed (Chart 16a)). However, the supply-side factors present in the ECB's and the Fed's communication are primarily energy and food prices. Other supply-related factors (like supply shortages/constraints/shocks or supply-demand imbalances) were almost never mentioned in AE central banks' communication prior to Covid (Chart 16b, 16c). This relatively higher importance of supply-side factors for EM central banks may be linked to higher risks of second-round effects in countries with less well-anchored inflation expectations. The Fed and ECB, in their turn, refrained from more actively discussing supply-side inflation factors, possibly due to their view that monetary policy has limited ability to address them.

[18] The spike in 2011 is linked to the discussion of currency swap lines between Fed and central banks of other advanced economies to ensure the availability of sufficient liquidity. In this case the reference to exchange rate does not imply the change in the monetary policy.

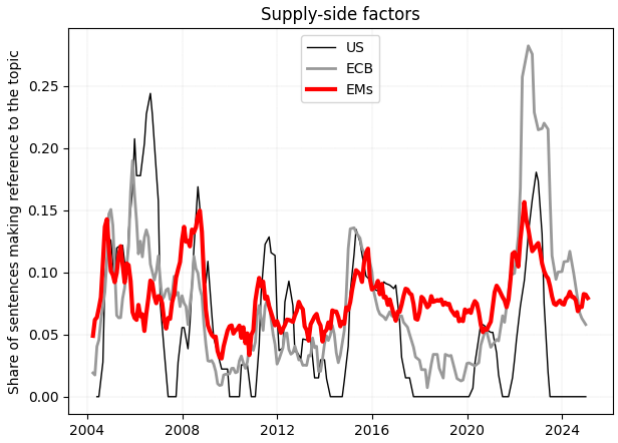
[19] We use a separate dictionary for this part of the analysis (see Annex 1 for the list of the words).

The Fed has also focused only on the unemployment rate instead of an indicator that is more reflective of labor market demand-supply conditions (Bernanke and Blanchard, 2023[20]). We note however that this attitude may be changing, as reflected in the Governor of the Bank of England's recent speech titled *Supply Matters*[21] (Bailey 2023).

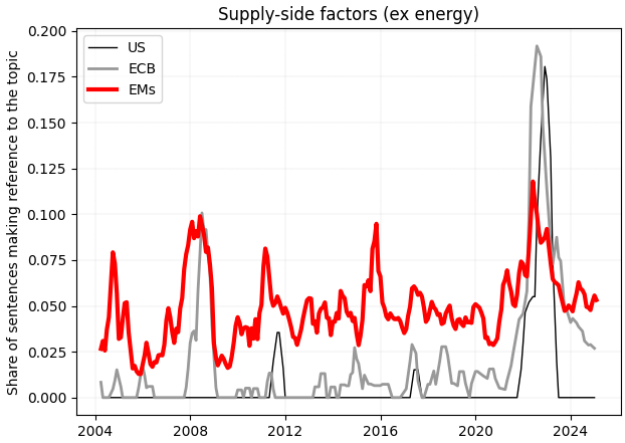
Accordingly, in the latest inflation wave EM central banks seem to have been ahead of the Fed and ECB in drawing attention to supply bottlenecks. The frequency of this topic in their statements started to pick up in the first quarter of 2021 while the ECB and the Fed followed suit only in June and September of 2021 respectively. More recently, EM central banks are also reducing their attention to supply-side factors earlier than AE counterparts.

Chart 16: Supply-side factors in central bank communication

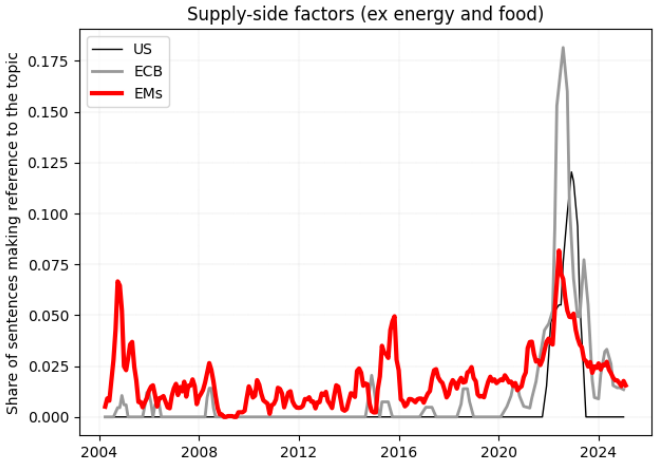
a) Full dictionary



b) Dictionary without "energy"



c) Dictionary without reference to "food" and "energy"



Source: Author's calculations

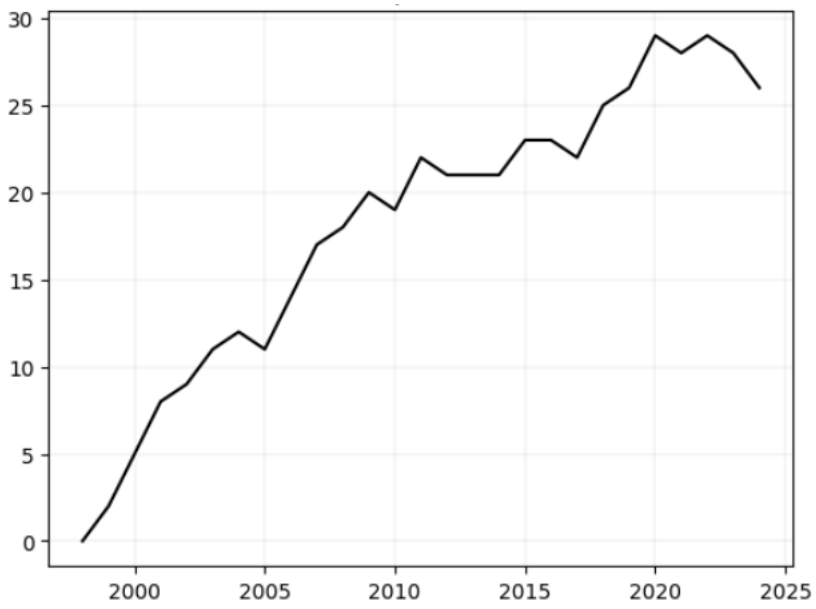
[20] Bernanke and Blanchard use the vacancy-to-unemployment ratio.

5. Financial stability/macroprudential policy language

We also check the extent to which EM central banks pay attention to financial stability and macroprudential topics in their monetary policy statements.[22] The importance of macroprudential tools in addressing systemic financial risks and safeguarding financial stability was recognized by the monetary authorities at the time of the Global Financial Crisis of 2008-09. Central banks around the world started to gradually introduce macroprudential policies in their toolkit, and EM economies were no exception (Chart 17). The number of EM central banks frequently referring to financial stability issues in monetary policy statements has more than doubled between 2005 and 2010 and never dropped back to pre-GFC levels. We view these developments as another sign of policymakers' appropriate adaptation and focus of their communication.

In this section we focus purely on how *frequently* financial stability terms appear in the statements. Here we disregard the direction of the macroprudential measures (their loosening vs tightening). Our goal is only to assess the trends in the use of this language in monetary policy statements.

Chart 17: Number of EM countries in our sample using words from financial stability vocabulary at least 5 times per year



Source: Author's calculations

Note, however, that in a few countries financial stability, and/or communication on macroprudential policy may be deliberately separated from monetary policy. In that case, macroprudential measures would typically be announced in thematic press-releases, reports or acts. Hence, sparse financial stability language in monetary policy press-releases is not necessarily equivalent to lack of focus on this area of policymaking. Therefore, our analysis that is based solely on monetary policy statements should be interpreted with caution.

[22] We conduct a text analysis of monetary policy statements using the vocabulary of macroprudential terms. The full list of the terms can be found in the Annex.

Thanks to considerable progress achieved since the Global Financial Crisis in developing macroprudential policy toolkit, EM central banks were relatively well-equipped to address financial stability risks at the time of Covid-19 shock and post-pandemic recovery. By that time most of them have been explicitly including financial stability topics in their monetary policy statements for a number of years reflecting their more comprehensive monetary policy frameworks.

In communicating their policy response to inflation pressures of 2021-2022, many EM central banks stressed that their policy actions are guided both by their price stability mandate and financial stability considerations (see some examples below). The ECB started to actively refer to financial stability issues and interlinkages between monetary policy and financial stability only in March 2022.

Dec 2021	Philippines	The BSP stands ready to respond to potential second-round effects arising from supply-side pressures, in line with its price and **financial stability objectives.**
Sep 2020	Brazil	The Copom believes that the current economic conditions continue to recommend an unusually strong monetary stimulus but it recognizes that, **due to prudential and financial stability reasons**, the remaining space for monetary policy stimulus, if it exists, should be small.
Jan 2021	Chile	The Board reiterates that any future changes in monetary policy or additional measures will depend on the evolution of the macroeconomic outlook, the proper functioning of financial markets and the fulfillment of the Bank's **objectives regarding inflation and financial stability.**
Jan 2021 – Dec 2022	Korea	The Board will continue to conduct monetary policy in order to support the economy and stabilize consumer price inflation at the target level over a medium-term horizon, **while paying attention to financial stability.**
Jul – Dec 2022	Korea	The Board will determine the size and pace of further increases of the Base Rate while thoroughly assessing the degree of persistence of high inflation, the pace of growth, monetary policy changes in major countries, **financial stability conditions**, and geopolitical risks.
March 2021	Romania	The NBR Board decisions aim to preserve price stability over the medium term in line with the 2.5 percent ±1 percentage point flat inflation target, in a manner supportive of the recovery of economic activity in the context of fiscal consolidation, **while safeguarding financial stability.**
March 2022	ECB	We will take whatever action is needed to fulfil the ECB's mandate to pursue price stability and to **safeguard financial stability.**

In a forthcoming paper, we specifically analyse central bank communication on financial stability and macroprudential policy and compare it with that on monetary policy (Evdokimova et al 2025).

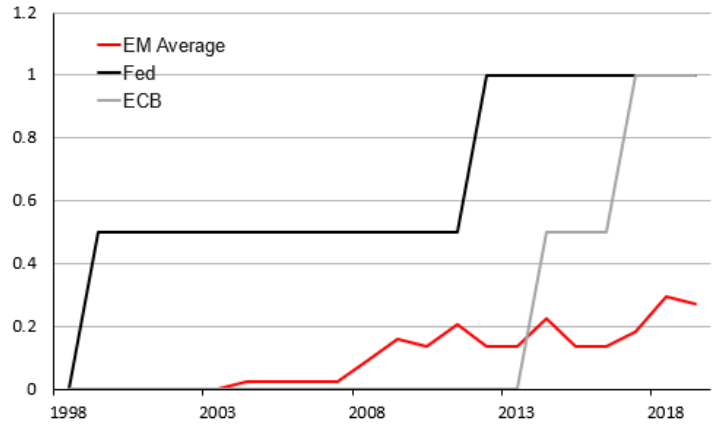
6. Forward guidance

Another change in EM's central bank communication is the increasing use of forward guidance, which was introduced not long ago by AE central banks as they confronted the problem of zero lower bound, where the effectiveness of traditional policy tools weakens. Of course, in case of EMs the use of forward guidance was not so much motivated by the lack of monetary policy space, but

rather by the desire to improve the signal sent to market participants regarding the direction and timeline of future monetary policy action and as to better influence longer term interest rates.

Prior to the post-Covid inflation surge, most EM central banks in our sample had some embryonic form of forward guidance in their statements. The number of EM central banks that adopted this communication tool has considerably increased after the GFC (Chart 18). AE central banks have been publishing their forecasts for some time and some EM central banks in our sample also started to publish the forecast of the key rate trajectory, such as the Czech National Bank in 2008, South Africa Reserve bank and the Bank of Russia in 2021.

Chart 18: Forward guidance component of Dincer&Eichengreen policy transparency index (0-1)[23]



Source: Based on Dincer and Eichengreen (2022)

That said, we find that EM central banks use a different language to formulate their forward guidance. In most cases their signal to the markets remains imprecise, allowing for ample flexibility for central banks in the face of a rapidly changing external environment. They use forward guidance to give more clarity to specific timing and conditions. In this way central banks seek, at the same time of giving the guidance, to avoid over-commitment to a predefined monetary policy path that could potentially clash with new data and endanger their credibility (Kganyago 2023). This approach seems particularly reasonable given the history of relatively low correlation between policy rate moves and communication sentiment in EM that we show in Section 3. Even with this ambiguity, EM central bank statements seem to have become more forward-looking in nature. The below table highlights some EM central bank typical language.

[23] Based on the central bank's scores in response to the following question: "Does the central bank disclose an explicit policy inclination after every policy meeting or an explicit indication of likely future policy actions (at least quarterly)?"

Peru	6/11/2020	The Board considers it appropriate **to maintain a strong expansionary monetary stance for an extended period** and while the negative effects of the pandemic on inflation and its determinants persist
Hungary	23/06/2020	The Council continues to consider the government securities purchase programme as a safety net, **which it intends to use in case of necessary and to the extent necessary.**
Russia	6/19/2020	If the situation develops in line with the baseline forecast, the Bank of Russia will **consider the necessity of further key rate reduction at its upcoming meetings**
South Africa	21/05/2020	**The implied path of policy rates over the forecast period generated by the Quarterly Projection Model indicates two repo rate cuts of 25 basis points in the next two quarters of 2020**. As usual, the repo rate projection from the QPM remains a broad policy guide, changing from meeting to meeting in response to new data and risks.
Turkey	25/06/2020	Keeping the disinflation process in track with the targeted path requires **the continuation of a cautious monetary stance.**
Brazil	6/16/2020	The Copom believes that the current state of affairs **continues to recommend an unusually strong monetary stimulus**, but it recognizes that **the remaining space for monetary policy stimulus is uncertain and should be small.**
India	5/22/2020	**The MPC also decided to continue with the accommodative stance as long as it is necessary to revive growth** and mitigate the impact of COVID-19 on the economy, while ensuring that inflation remains within the target.
South Korea	7/16/2020	As economic growth is expected to be sluggish and inflationary pressures on the demand-side are forecast to remain weak due to the COVID19 pandemic, **the Board will maintain its accommodative monetary policy stance**
Chile	6/5/2020	The Board's decision to keep the MPR at its technical minimum of 0.5% is **consistent with the need for monetary policy to remain in this highly expansionary stance for an extended period of time**, in order to ensure the convergence of inflation to the 3% target over a two-year horizon.
Czech Republic	7/5/2020	**The new forecast implies significantly lower interest rates this year and the next** and a weaker koruna-euro exchange rate than the previous outlook.
Philippines	30/09/2020	Given these considerations, the Monetary Board is of the view that a **continued pause** will allow prior measures by the BSP to further work their way through the economy.
Ukraine	11/6/2020	A decrease in the key policy rate below its neutral level indicates **the end of the cycle of rapid monetary policy easing.**

7. Reference to fiscal policy

We also look at the frequency of references to fiscal policy in the monetary policy statements to assess the attention that central banks pay to (i) the overall macro policy mix that is in place; and (ii) referencing policy coordination with the fiscal authority. To this end we use a special dictionary of fiscal terms that is available in the online version of Annex 1.

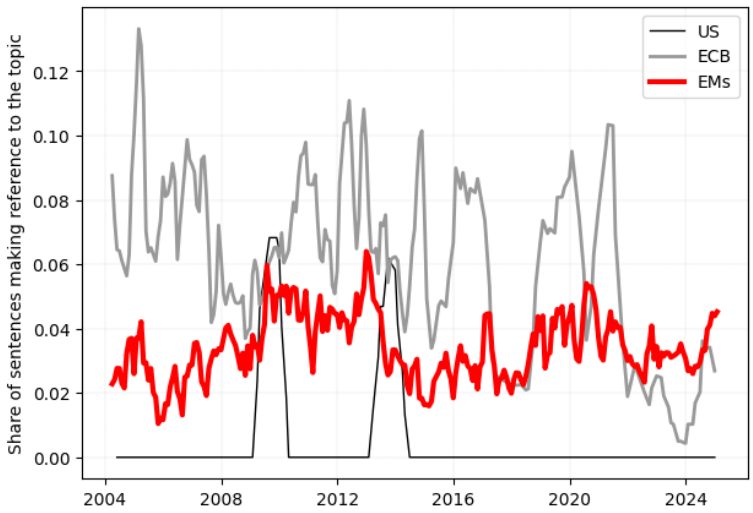
We find that the fiscal topic is essentially absent from the Fed's monetary policy statements (except for two occasions post GFC). However, this could be in part explained by the very concise format of

the Fed's statements, rather than by its complete disregard of the fiscal context. Fiscal policy developments are often discussed during the Fed's chair press conferences. However, given the importance of fiscal measures during Covid-19 and associated monetary and fiscal policy coordination, as well as the contribution that fiscal stimulus brought to the post-Covid recovery and possibly some overheating of US economy and elsewhere, fiscal policy contexts should warrant at least some focus in monetary policy statements.

The ECB refers to fiscal policy more frequently than other central banks. On average 7% of the sentences in introductory statements contain some fiscal policy related terms (Chart 18). Not surprisingly, particular attention to the topic was paid during the Euro area sovereign debt crisis and during the pandemic. Quite often the communication signals the need for a differentiated approach to fiscal policy of Euro area countries depending on their debt sustainability. (Examples: "Regarding fiscal policies, the Governing Council reiterates the need for rebuilding fiscal buffers. This is particularly important in countries where government debt is high and for which full adherence to the Stability and Growth Pact is critical for safeguarding sound fiscal positions.") The ECB's higher attention to fiscal policies compared to the Fed may also reflect the lack of a central fiscal authority in the eurozone and thus the ECB's high level of political independence (but also a Goodhart-type higher "democratic deficit", see (Blinder et al. 2001)).

EM central banks do refer to fiscal policies but less than the ECB. The need for coordinated policy response to the pandemic increased attention to fiscal measures in monetary policy communication. There is, however, quite a lot of heterogeneity across countries. Central banks of Thailand, Mexico, Hungary, Brazil, and Romania refer noticeably more frequently to fiscal policy topics, while Turkey, Poland, Korea, Chile, Czech Republic and Peru show the lowest level of reference.

Chart 19. Share of sentences in MP statements containing reference to fiscal policy



Source: Authors' calculations

8. Readability

We compare the readability of EM and AE monetary policy statements using Flesch and Flesch-Kinkaid indices. The index looks at average sentence length and average word length in syllables. The lower the index the less education is needed to understand central bank communication, helping access for wider audiences. We carry out this analysis based on the English translation of central bank statements. As discussed in the Data section, the choice of the national languages for text input would have likely yielded a somewhat different output of the analysis. Our results are relevant for assessing statements readability among international investors and less applicable to communication between a central bank and the domestic general public.

We find the following (Chart 20):

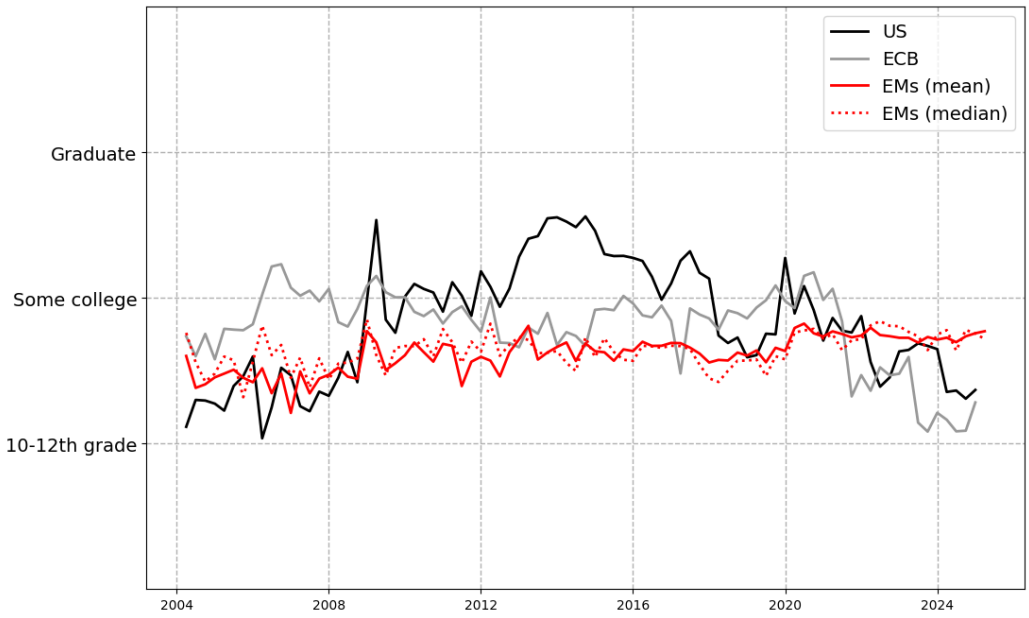
- The readability of EM monetary policy statements appears to have been *better* than that of AEs until recently. Understanding the statements still requires either high school education or some college degree in EMs and even higher in AEs until recently. Thanks to specific efforts by AE central banks discussed below, the ECB's readability index is now better than other central banks.

- Recently AE central banks have been making a clear effort to simplify their communication. The Fed's communication seems to have struggled around the "taper tantrum" of 2013/14 as it tried to signal its desire to exit its QE policy. Only people with graduate degrees were able to discern what the policy was supposed to be. Since that fiasco the Fed's communication has clearly improved. The ECB has similarly been making efforts to simplify its communication in line with the recommendations of its recent Strategy Review (ECB 2021). The improvements in ECB communication quality were dramatic and almost immediate.

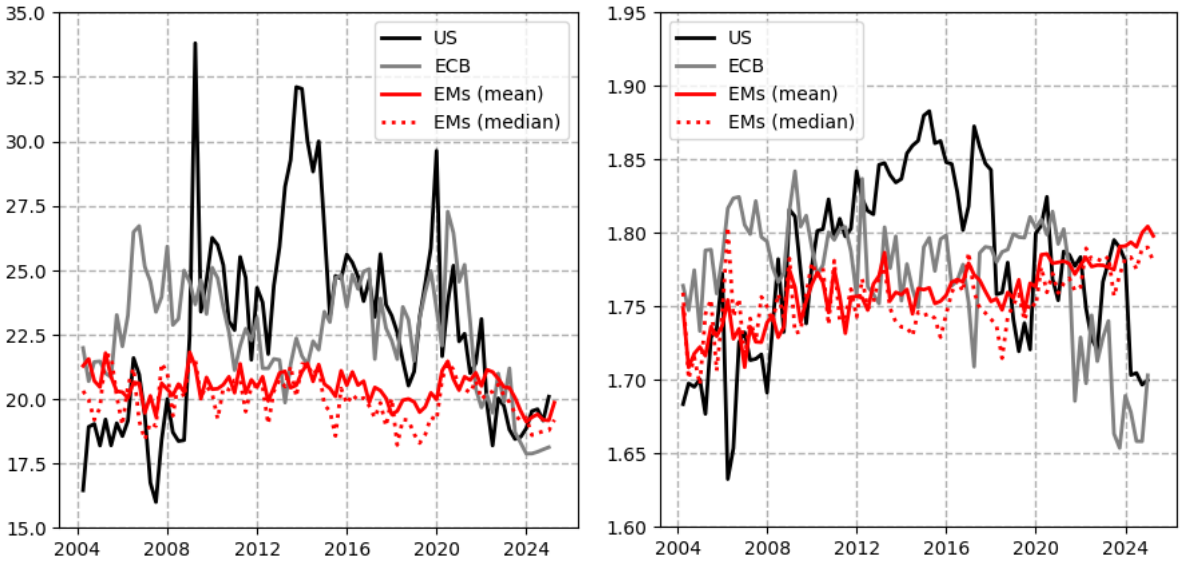
- Better communication by the Fed and the ECB has been achieved with a combination of cutting the sentence length and word length. It is possible that the communication of QE policies with large asset purchases by advanced country central banks but recently also by EM central banks may have complicated communication strategy. The readability metric for EM central banks slightly worsens around Q1 2020 when many of them launched asset purchases programs. However, we have not managed to establish a rigorous link here. The change in the readability could also coincide with the central banks' need to communicate about previously unseen developments linked to the pandemic.

Chart 20: Flesh-Kincaid readability index*

(Number of years of education required to understand the text. Higher = poorer readability, lower = better readability)



Average sentence length (words) **Average word length (syllables)**

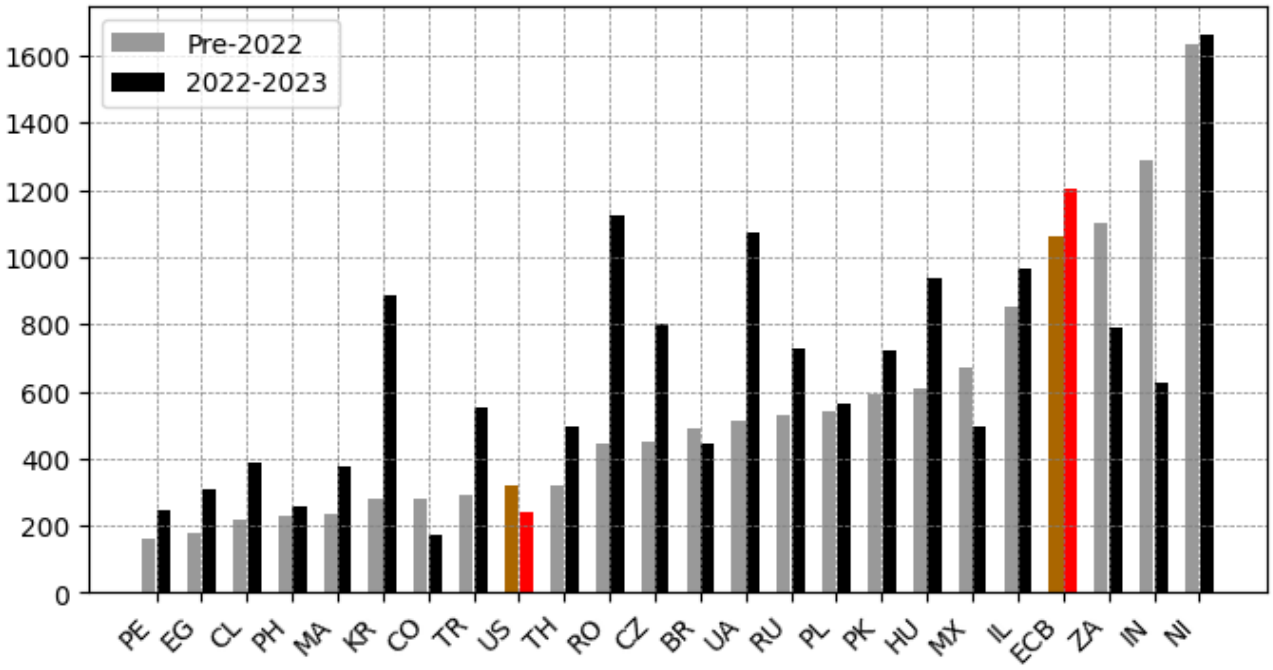


Note that Mexico is excluded as data only starts in 2018.

Source: Authors' calculations

Most central banks have relatively concise statements that do not exceed 1000 words on average for the period under consideration. The length of the statements has increased lately (Chart 21). The Fed, conversely, has gone in the opposite direction and currently has shorter statements than most EM central banks in our sample. Laconic format of statements is often compensated by press conferences, publication of detailed minutes of the meetings and monetary policy reports (Shchadilova and Evstigneeva 2023).

Chart 21: Length of monetary policy statements (average number of words per statement)



Source: Authors' calculations

9. Transparency

We use the transparency metric developed by (Dincer, Eichengreen and Geraats 2022) to assess progress in transparency and independence of EM central banks over time against the three AE comparators: the Fed, the ECB and the Bank of England.

Among advanced economies, the Transparency Index is the highest for the Bank of England (close to 14 out of the maximum of 15). The Fed, and particularly the ECB had started from a lower base but have broadly caught up with the Bank of England by 2019 (Charts 22 and 23).

Most EM central banks have made massive progress since 1998, more than doubling their index score. Some EM central banks have managed to completely close their gap to advanced country comparators (Czech Republic, Chile, Hungary, Korea, South Africa).

The improvements took place across-the-board over five dimensions (political, economic, procedural, operational and policy transparency). The biggest improvement was recorded in *policy transparency* (with the introduction of quantified official monetary policy targets) and economic transparency (better disclosure of macroeconomic policy models and numerical macroeconomic forecasts).

z **Chart 22: Central bank transparency (Max score = 15)**

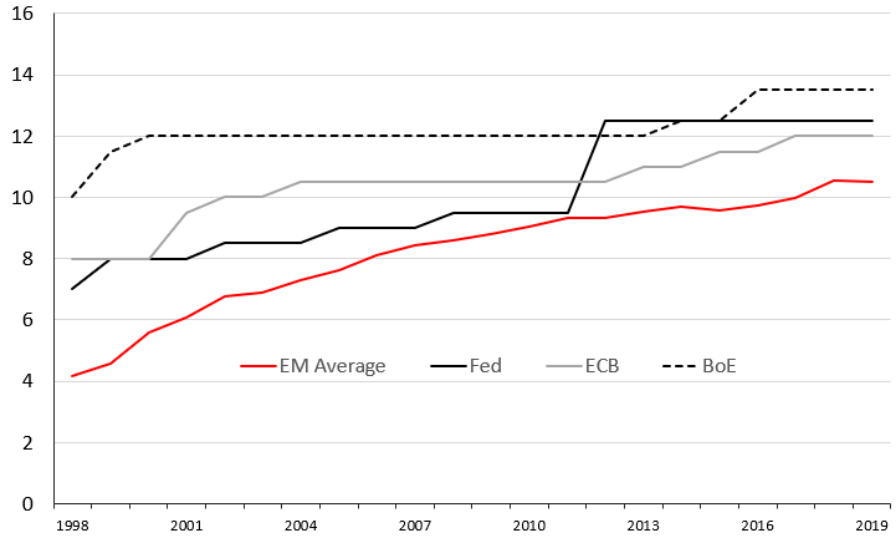
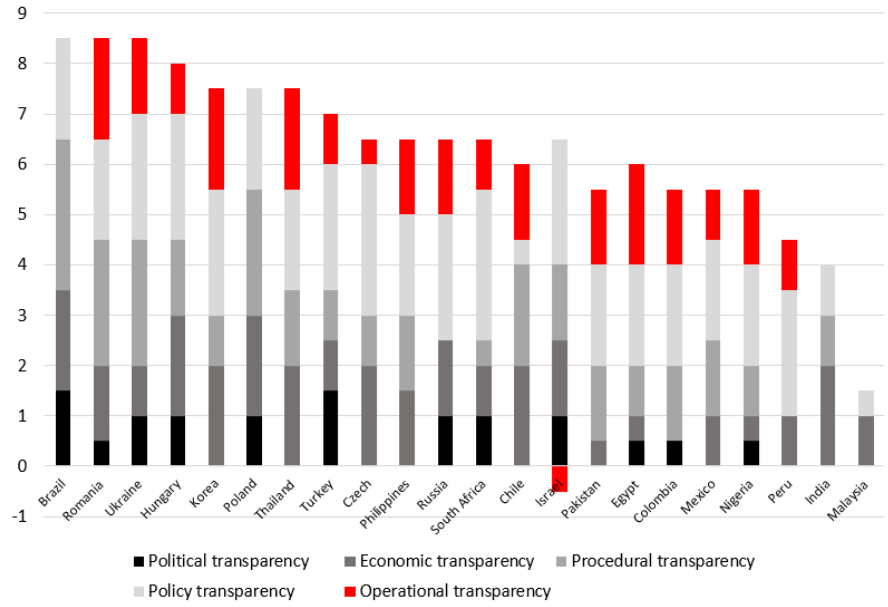


Chart 23: Decomposition of improvement in transparency score over 1998-2019



Source: Authors' calculations based on (Dincer, Eichengreen and Geraats 2022)

A recent IMF paper (Unsal et al. 2022) that assessed monetary policy frameworks (MPF) across countries and over time also confirms strong progress accomplished by EMs during the decade following the GFC. The EMs have particularly improved their scores for the two pillars of the index: policy transparency and operational strategy. Specifically, these two scores of 17 EMs from our sample for which the MPF index is available have increased by 59% and 34% between 2007 and 2018 (respectively for policy transparency and operational strategy), compared to 20% and 21% for AEs respectively, narrowing the gap between the two country groups.

Policy lessons

Central bank policy and communication has undergone major shifts – if not a revolution - in the past two decades. Our paper has covered and compared the record of 22 EM central banks with those of the Federal Reserve and the European Central Bank in this regard. We offer a few policy lessons both for policy and communication, including for advanced countries:

- *Both AE and EM central banks need to improve their inflation projection tools and willingness to recognize price pressures in their communication.* Our analysis finds limited ability of central banks (AE and EM alike) to forecast inflation in advance, suggesting ample room for improvement on this front.

- *EM central banks need to be better at "walking the talk".* EM central banks appear to follow-up on their signaled policy change much less consistently than AE counterparts. While some of this communication-policy action gap maybe explained by more frequent shocks in EMs, this can weaken central bank credibility over the longer term.

- *Forward guidance can be detrimental at a time of rapid change.* Forward guidance, introduced in the wake of the global financial crisis in the context of deflationary pressures, was intended to provide additional assurance by central banks on their monetary policy stance. Views on whether it served its original purpose can differ. Here we note that it has de facto weakened monetary policy's data dependence, which in turn has proven, in our view, detrimental at a time of rapid economic change. We have shown that EM central banks have generally used forward guidance in a less committal and more vague way, which has served them well at the time of rapidly changing inflation data and dynamics.

- *Multiple central bank mandates that require multiple policy tools need a particularly clear communication strategy to identify the primary focus at a time of stress and potential conflicts among policy goals*. Many central banks have dual - or even triple or quadruple - mandates. In addition to their price stability goal, financial stability, employment and, more recently, climate change become part of their mandate. The well-established policy rule of one goal-one instrument, underscores the critical importance of a more nuanced but clear central bank communication strategy in this regard. In addition, at times of stress or rapid change, there can be conflict – at least in the short run – between some of the goals. At such times, central bank communication should explain which goal gets priority. In our view, in 2021-early 2022 the Fed struggled in its communication between its dual mandate on maximum employment and price stability. We also wonder, along with others, if the Fed's recently adapted average inflation targeting (AIT) regime has not also contributed to its belated inflation policy action.

- *The distinction between first and second round effects of inflation gets blurred when inflation rises rapidly.* EM central banks did not waste time and acted fast when inflation started to rise in early 2021. They knew that inflation expectations can quickly de-anchor

when prices rise rapidly, and hence the distinction between “first” and “second” round effects blurs. AE central banks need to internalize this policy lesson going forward.

- *It is important to monitor and communicate supply-side factors behind demand-supply imbalances.* AE central banks have typically focused on the macroeconomic (demand) side of inflation pressures, whereas EMs appear to have always had supply side factors on their policy radar screen as well, which served them well in the post-Covid inflationary period. Advanced country central banks have started to internalise this lesson..

- *EMs have successfully adapted their communication policy to their specific economic circumstances.* Yet their reduced communication on the exchange rate to conform with the inflation targeting framework can raise questions given their vulnerability to exchange rate shocks. EMs continue to do FX intervention when market stress requires and can increasingly rely on currency swaps or repo operations that the Fed and the ECB offer. EM central banks could examine if their policy effectiveness would benefit from clearer communication on exchange rate policy actions. Coordinated communication with the Fed and the ECB at times of currency swaps/repos would help EMs in this regard.

- Finally, *both advanced country and emerging market central banks should reconsider their communication particularly with regards to coordination with their fiscal authorities* and policy interactions between monetary and fiscal policy. This would help the transparency and credibility of both the monetary and fiscal authorities

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Annex 1

Methodology

Dictionary approach

In our dictionary-based algorithm measuring the degree of monetary policy statements' hawkishness/dovishness we broadly follow the methodology used by (Gonzalez and Tadle 2022). We start with their vocabulary of keywords – nouns that indicate the economic subject of a sentence, for example, inflation, consumption, credit. We also have a vocabulary of modifiers – mostly verbs or adjectives describing the evolution of the keywords, like accelerate, high, reduce, deteriorate. Both initial vocabularies provided by (Gonzalez and Tadle 2022) were expanded with additional relevant words typically used in monetary statements of the central banks in our sample. The lists can be found at the end of this section.

Each modifier is categorized as either positive (conveying a meaning of improvement, increase or strength) or negative (reflecting a worsening, decline or weakness). The keywords in their turn can be either direct or reverse. A positive modifier applied to a direct keyword would signal a potential need for monetary tightening. The following examples illustrate this case: buoyant economic activity, increasing inflationary pressures. A positive modifier combined with a reverse keyword, on the contrary, would describe economic conditions increasing likelihood of more expansionary monetary policy stance (for example: higher unemployment, increased uncertainty).

We use keywords and modifiers to classify each sentence in the monetary policy statements of the EM central banks as dovish, neutral or hawkish. As in (Gonzalez and Tadle 2022), a sentence in which a direct keyword is accompanied by more positive than negative modifiers is given a score of "+1", i.e. considered hawkish (or rather containing information that increases likelihood of monetary tightening). A sentence with a direct key word in combination with more negative than positive modifiers gets a score of "-1", i.e. considered dovish. The algorithm works in the opposite way for the sentences with reverse key words. Sentences with no keywords, equal number of direct and reverse keywords or with equal number of positive and negative modifiers are classified as neutral with a score of 0.

Sentences containing standard forward guidance language (see section "Forward guidance" in the table below) are classified as dovish based on practice. Sentences referring to quantitative easing with the words from "QE dictionary" section in the table below are viewed as dovish. If accompanied with words from "QE modifiers" list the sentences are considered hawkish. The degree of hawkishness/dovishness of each monetary policy statement is measured by an average score of all the sentences in the statement.

The overall score can be decomposed into specific drivers of hawkishness/dovishness. Specifically, we focus on five components: **inflation**, *labor market* and economic activity, forward guidance and quantitative easing/tightening. The keywords used to produce these metrics are highlighted accordingly in the dictionaries used for the overall sentiment. The methodology for calculating each of the first three components is identical to the overall approach described above but is implemented using narrower dictionaries. The calculations of the last two components rely on separate corresponding dictionaries of key words with specific modifiers in case of QE (as described above). The difference between the overall sentiment score and the sum of the five components corresponds to the contribution of other drivers of the monetary policy stance. These other drivers are reflected by the keywords that are not included in either of the three components or

QE/forward guidance dictionaries. The preprocessing of the text involves splitting of the sentences into smaller parts mostly based on punctuation. Additional steps include lowercasing and stemming.

Even though we broadly follow the procedures by (Gonzalez and Tadle 2022), we have introduced several improvements in the algorithm.

Firstly, instead of applying it to complete sentences, we split them into parts by punctuation marks and conjunctions. Despite the efforts to simplify their language, central bankers still more often than not use complex sentences that can hardly be properly classified with unsophisticated methods described above. Complex sentences may often contain both direct and reverse keywords, which would be hard to connect to specific modifiers. The chances to correctly categorize the sentiment are much higher when the algorithm is applied to simpler parts of the sentences. Admittedly, the breakdown of sentences into simpler parts also comes with a cost. Sometimes the parts of the sentences become less comprehensive when separated from the rest of the sentence. Nevertheless, selectively examined results proved to be more plausible when the algorithm was applied to parts of the sentences.

Second, our algorithm checks for the presence of negation words (no, not, never, without, prevent) in the sentences. The original sentence score is multiplied by -1 if these words are found in the sentence. In the absence of this step, sentences similar to the following would have been classified incorrectly: “There are no broad-based price pressures on consumer prices over the near term”.Third, we have added QE-related vocabulary in our algorithm, as non-conventional monetary policy instruments are becoming increasingly actively used among the EM countries since the pandemic. To assess the impact of this factor on the overall tone of EM central banks' communication, we drop all the sentences containing a reference to one or several central banks from advanced economies that very actively recur to QE in recent years. When sentences about QE contain words signaling its tapering (for example, withdraw, reduce), we classify them as hawkish. All the other sentences related to QE are classified as dovish.

Fourth, we have added a separate dictionary for forward guidance that was actively used after the GFC by AE central banks but more recently was also adopted in EM countries.

Finally, as mentioned above, we use longer keywords and modifiers dictionaries, which allows us to automatically capture more content of the statements.

As with any automatic algorithm, it is next to impossible to achieve correct categorization of 100% of sentences. A few caveats should be kept in mind. In particular, the algorithm is focused on the linguistics of the statements and mostly disregards the numbers mentioned by the central banks. Hence the sentiment of the statements can not be differentiated by the size of key rate changes, or the extent of key economic indicators moves. In addition, the language about non-conventional monetary policy tools and emergency instruments (like activation of swap lines) is harder to read. Even when the specific words are captured by the algorithm, the significance of the move and the associated degree of dovishness/hawkishness is often underestimated.

We search in monetary policy statements for the words from our macroprudential vocabulary when assessing the role of macroprudential considerations in the policy mix.

Dictionaries

Dictionary name	Words
Direct keywords	activity, balance, competitiveness, condition, confidence, construction, consumption, **cost**, **CPI**, credit, creditworthiness, demand, economy, *employment*, expenditure, exports, flow, GDP, growth, income, indicator, **inflation**, interest, investment, *job*, *labor*, *labour*, loan, manufacturing, market, outlook, output, performance, policy, **PPI**, pressure, **price**, production, rate, **rent**, repo, sales, sectors, sentiment, turnover, *wage*, **HICP**
Reverse keywords	caution, deficit, **disinflation**, holdings, purchases, recession, risk, uncertainty, *unemployment*, supply
Positive modifiers	above, accelerate, added, alleviate, augment, benign, best, better, biggest, boost, brighter, buoy, buoyant, calm, climb, depreciate, dynamic, elevate, encouraging, escalate, exceed, expand, expansionary, expansive, fast, faster, fastest, favorable, favourable, firmer, gain, good, great, greater, greatest, grew, grow, grown, healthier, high, higher, highest, hike, improve, impulse, increase, inflationary, jump, large, larger, largest, loose, loosen, looser, mitigate, mount, optimistic, outperform, overheating, peak, persistent, pick, positive, prevail, proceed, raise, ramp, rapid, rebound, recover, reinforce, restore, resume, resumption, rise, risen, rose, satisfactory, skyrocket, spike, spur, steady, stimulate, stimulatory, strengthen, strong, stronger, strongest, successful, surge, sustained, swifter, tight, tighten, tighter, unanchored, up, upper, upside, upswing, upswinging, upswung, uptrend, upturn, upward, vigorous, widen, wider
Negative modifiers	adverse, accommodative, aggravate, anti-inflationary, appreciate, appreciatory, bad, bottlenecks, bottom, challenge, concern, conservative, constrain, constraint, contract, contractionary, cooling, cut, dampen, decelerate, decline, decrease, deepen, deflationary, descend, destabilizing, deteriorate, difficult, difficulty, diminish, disappointing, disinflationary, disrupt, dovish, down, downside, downsize, downturn, downward, drop, ease, erode, fade, fail, fall, fallen, fell, fewer, flatten, fluctuate, fragile, halt, hamper, harm, inconsistent, jeopardise, jeopardize, lackluster, less, low, lower, lowest, mild, minimal, minimum, minor, moderate, modest, muted, negative, patient, pessimistic, poor, recessionary, reduce, reduction, restrictive, restriction, riskier, risky, sank, severe, shortage, shorten, shrink, shrunk, shrunken, sink, slack, slow, slowdown, slower, slowest, sluggish, small, smaller, smallest, soften, speculate, stress, stringent, subdued, subprime, suffer, sunk, support, suppress, threaten, tougher, turbulent, uncertain, unclear, undermine, unfavorable, unfavourable, unstable, vulnerable, wane, weak, weaken, weaker, weakest, weigh, worse, worsen, worst

Financial stability keywords	Asset prices, banking system, bankruptcy, Basel, bubble, capital adequacy, capital buffer, capital shortfall, capital standard, collateral, corporate bond, credit risk, creditors, debt restructuring, debt serviceability, equity, financial and economic stability, financial conditions, financial crisis, financial instability, financial institutions, financial market, financial risk, financial stability, financial sector, financial stress, financial system, financial vulnerabilities, funding markets, housing market, impairment, indebtedness, investors, leverage, liquidity, loan loss, loan provision, macro prudential, macro-financial, macro-prudential, macroprudential, market depth, market participants, market volatility, nonperforming loan, non-performing loan, portfolio allocation, prudential measures, real estate, regulation, regulatory, resolution, risk management, search-for-yield behavior, safety net, speculative bubble, stress test, stress-test, supervision, systemic, systemic risk, systemic stress, systemically important
QE dictionary	purchase programme, purchase government securities, purchase government bonds, securities purchase, purchase leu-denominated government securities, asset purchase, purchases, balance sheet, holdings
QE modifiers	withdraw, reduce, reduction, adjust, moderate, normalization, normalize, slow, end, revise, conclude, lower, remunerate, endpoint, decline
Supply-side factors dictionary	unbalances between demand and supply, supply-related, supply side, supply-side, supply restrictions, supply shock, supply shortage, supply constraints, supply disruptions, supply bottlenecks, supply-sided shocks, value chain, Ukraine, war, gas, food, energy
Forward guidance	for an extended period of time, as long as necessary, forward guidance, until at least, for an extended period, for some time, below, for some time, warrant, to maintain this target range until, levels that are expected to prevail in the longer run

Machine learning approach

The machine learning approach to parsing central banks' communications relies on sentence embeddings. Sentence embeddings are the internal representations of words, sentences, or chunks of texts inside the deep learning transformer models.

Transformer models

In our analysis we rely on BERT model, and specifically its "MiniLM" distilled version that achieves 99% accuracy (https://arxiv.org/abs/2002.10957, https://arxiv.org/abs/2012.15828) while being significantly faster and requiring less powerful machines to run.

BERT language model uses the popular transformer architecture to achieve superior text processing abilities by supporting varying-length inputs, sequential data, and contextual understanding among other break-throughs. As of the time of the writing, transformer architecture is the predominantly used one for the state-of-the-art models for language processing.

BERT is a pre-trained language model, meaning that it was trained on millions of natural language examples. Training language models is a costly exercise, and large companies (like Google in BERT's case) make these pre-trained models available open-source for use.

Since BERT is trained on general language, it is possible to "fine-tune" the model by providing it with more domain-specific examples, or use other available fine-tuned models. For this exercise we wanted to analyze how a generically-trained model processes central bank communication. We believe that whereas communiques are domain-specific (finance, economics, policy-making), they should be, at least to some extent, understandable by the general audience. The readability analysis indicated that Central bank statements should be understood by people with some college degrees.

Embeddings

Pre-trained transformer models produce a vector representation of any input they receive. Typically such vectors have length of 512, and the position of the vector encodes the meaning of the input received (word, sentence, paragraph).

In the simplest form, a word embedding would be a simple mapping from the words in English language onto the integer line. Usually only stems of words are considered, and therefore a basic embedding could use the sequence numbers of the words in a dictionary as an embedding. Since, however, sentences and paragraphs are more complex than this, multi-dimensional vectors are preferred.

Using embeddings for similarity analysis

Since embeddings are vectors, similarity between them can be calculated using correlations or dot products.

To quantify central banks' choice of topics, we correlate individual sentences in the statements to the "base phrases". To capture inflation, labor market, and economic activity, we use the following phrases:

- "Inflation is high",
- "Labor market is strong".

How to interpret embedding similarity

It is important to note that similarity measures broad thematic relatedness between inputs. However, this also means that the model typically struggles with negation. For example, "Unemployment is high" is much closer to "Unemployment is low" than it is to "The grass is green".

When similarity between inputs declines, it may mean one of two things:

- Topics change,
- Topic remains the same, but the meaning changes.