

Overtaking the Masters? Policy Communication of Emerging Market Central Banks

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Introduction and summary

Emerging market (EM) central banks have made major progress in the past two decades in improving their policy frameworks and delivering on their mandates. Recently they may have even outperformed advanced countries in some important respects.

After decades of struggling with high inflation and the underlying failure of various monetary regimes, EM central banks from the mid-2000s increasingly focussed on inflation with variants of the inflation targeting regime used by advanced countries. Their peculiar circumstances and then 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 advanced economies (AE). Apart from outliers such as Turkey and Ukraine, EMs currently record similar inflation rates as AEs, even though their consumption basket contains much higher share of energy and food, key components of global inflation to date. Even when the US Federal Reserve (Fed) and the European Central Bank (ECB) eventually started tightening, capital outflows from EM and pressures on their exchange rates have remained manageable, in sharp

contrast to past tightening cycles. 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 toughest moments of the Covid crisis and in its aftermath, confirming these instruments’ indispensable role in the global financial safety net.

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. We compare their progress with that of the Fed and the ECB, which act as comparators in our analysis. In the process we also gain some insights into these two central banks’ policy and communication record.

Our methodology focuses on quantitative assessments of 20 EM central banks’ monetary policy communication between 2003 and 2023, based on a unique database that we have compiled. We analyse communication along a number of 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..

Key contributions of our paper are the broad dataset of monetary policy statements from 20 EM countries and some novel methods we use to analyse them. The geography of our sample is considerably larger than the ones used in studies on similar topics: 12 EMs countries in Gonzalez and Tadler (2022), 14 EM countries in Laungaram and Wongwachara (2017), 5 Latin American countries in IMF (2018). In addition, our dataset also covers the period between 2020 and 2022 corresponding to the latest global inflation wave. This allows us to compare EM and AE communication in the face of this the emergence of global inflation. We apply language processing techniques to our dataset, including sentiment analysis algorithms and machine learning (ML) tools that, as far as we know, have not been used for analyzing central bank communication.

Our main findings are as follows:

- In general terms, EM central banks have improved in their overall transparency and independence, with some countries having reached levels seen in AE comparators (ECB, Fed, and the Bank of England), though significant divergence exists among EM countries.
- The overall *readability* of central bank statements has been better in EMs than in AEs, requiring lower level of education to achieve comprehension. However, as the Fed and the ECB have made deliberate efforts to improve the accessibility of their communication in recent years, the gap between EM and AE communication readability

has all but disappeared. It still requires more than high school education to understand central bank policy communication.

- *Policy stance and tone* of central banks have naturally evolved during the past two decades. Our analysis offers three noteworthy findings:
 - i. Outside stress/crisis periods (2008/9 GFC, 2011-14 Eurozone crisis, 2020-21 Covid pandemic), the tone of central bank statements (hawkish-dovish) are quite similar, mainly driven by Fed policy with its lead role in the global financial cycle.
 - ii. During crisis, AE-EM policy and tone used to diverge 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, but soon they had to reverse those to defend their exchange rate and fend off inflationary pressures. (Moreover EMs had to also struggle with volatility from “currency wars” as the Fed introduced new waves of QE.) However, 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 liquidity support by the Fed and the ECB.
 - iii. We demonstrate that while all central banks noticed the building-up inflationary pressures from the end of 2020, EMs responded faster and stronger to post-Covid inflation shocks than AEs and communicated their policy clearly. Policy and statement tones have thus diverged, reflecting EM central banks’ overall more appropriate policy stance and communication to combat inflation. In this regard, the students have certainly overtaken the masters.
- Our topic decomposition analysis suggests that:
 - i. During the post-Covid inflation shock, EMs were more focused on inflation and demand/supply imbalances. The Fed was initially mainly concerned with labor market and economic activity; the ECB cared about inflation but still acted with a lag relative to EM central banks.
 - ii. The Fed seems to have accepted a trade-off between its dual mandate in the post-COVID period. Labour market conditions appear to have played a major role in defining the Fed’s monetary stance at the expense of inflation, which in turn was downplayed. We find that the labour market component of the Fed’s sentiment score that we developed is highly correlated with the US unemployment rate.

- iii. In contrast, EM central banks and the ECB remained focused on inflation in their communication, though the latter acted later. The ECB had to dedicate considerable attention to its increasing number/complexity of its specific QE operations.
 - iv. EMs in contrast remained almost single-mindedly focussed on inflation, in line with their mandate, possibly also reflecting their historically more recent high-inflation experiences and related less well-anchored inflation expectations.
- Our machine learning (ML) analysis confirms our findings from the more conventional dictionary-based algorithm analysis, but also produces a few additional insights: (i) the Fed's focus on inflation was so weak in the initial post-Covid period that ML does not even pick it up; (ii) a major part of the ECB's initial post-Covid communication was on economic activity; and (iii) EM central banks drop the notion of "inflation is high" when a crisis hits (2008, 2020), but then quickly return to their inflation-focus.
 - How well do EMs central banks fare with regards to indicating a 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 good in this regard during the post-COVID period, but then their policy implementation (actual rate change) remains uncertain. The link between the signal they send and the actual rate change is weak and almost random: on average, EMs deliver a signalled policy rate change about 50% of the time, in contrast to the Fed's 80%. This may weaken credibility and thus an area for improvement for EM central banks in the final leg of their "see-say-act" nexus. We find that the length of inflation targeting experience helps to improve the link between communication and inflation.
 - What is the link between central banks communicating their inflation concerns and actual inflation, which can be seen as proxy for predicting inflation? We find that, worryingly, central banks in general do *not* foresee/predict inflation in their communication. The finding is particularly strong for the Fed, whose inflation-sentiment/forewarning is very weakly correlated with actual inflation (less than 40%). The ECB is the most focussed and consistent in its communication on inflation.
 - We investigate the use of the term "exchange rate" by EMs. For small/medium size open economies that most inflation targeters are and where financial dollarisation exists, exchange rate used to be in central policy focus. It is no longer: consistent with the inflation targeting regime, EM central bank communications have reduced

reference to exchange rate movements, even though related vulnerabilities have not disappeared.

- We find, intriguingly, that EM central banks speak much more openly about supply side factors of inflation than do the Fed and the ECB. This can be part of EM central banking more heightened vigilance over any factor of inflation, given possible higher second-round effects in weaker institutional settings. AE central banks may also hold the view that this is not an area of policy action for them.
- Macroprudential aspects have been increasingly incorporated in EM central bank statements since the GFC, in line with AE comparators.
- Finally, EM central banks introduced some language of *forward audience* particularly during the Covid crisis, but, unlike their AE counterparts, the language remained, in our view wisely, imprecise. While the basic point of forward guidance is to provide additional assurances to markets about policy direction and timing particularly in acute crisis, its potential lack of decoupling from data can be problematic. Forward guidance is now out of fashion because of the surge in inflation that AEs missed, and EM central banks have benefitted from using it in a more sensible, less committal fashion.

In sum, EM central banks have come a long way in their policy and communication, catching up with lead advanced economy central banks over the past two decades in some important respects with of course room for improvement in certain areas that we have highlighted. They are also a diverse group. Yet in the core area of central banking, fighting inflation, EM central banks have come well ahead of the ECB and the Fed, and communicated their divergent views on global inflation clearly and confidently. In this critical area of central banking, emerging markets may have overtaken the masters.

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 and Bordo 2017), central banking has evolved to focus on delivering price stability through what Coure and Katz (2021) call *learning by crises*.

Central banks in advanced economies (AE) have tried various frameworks in response to the collapse of the Bretton Woods international monetary system in 1971 and ensuing high inflation of the 1970s. First, applying *monetary aggregate* targeting (M0, M1, etc, see for example Germany's Bundesbank and many other advanced country central banks), then targeting the *exchange rate* (United Kingdom before it was ultimately forced out of the European Monetary System in 1992). Running out of options, 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. Along with this single focus came increased transparency of communication on targets and policies, as well as on central bank independence to permit focus on achieving the chosen inflation target (Mishkin 2000).¹

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

EMs’ quest for a more suitable monetary policy framework started turned to the increasing evidence of 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 and shape (“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 adapted IT regime and many considered their regime as “IT light” (IMF 2008). Monetary frameworks in advanced countries and leading EMs had become more similar than in the past.

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 as to ease monetary conditions in the context of very low nominal interest rates (at the “effective lower band” (Bernanke 2020). Through this they entered and “saved” financial market segments, and then some: several central banks – though not the Fed at the time - expanded asset purchases beyond the financial sector to corporate bonds and even equities

¹¹ The U.K., though not the first to adopt inflation targeting (it was New Zealand in 1990), became the main proponent and world-leader of the inflation targeting theory and framework, along with granting formal independence to its central bank the Bank of England in 1997.¹ The primary objective of the ECB, established in 1998, has also been price stability, even though it does not call its framework “inflation targeting”.

(Bank of Japan). Central banks thus became not only a lender of last resort, but market maker of last resort.

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

EMs used the post-GFC time to strengthen their monetary framework and gain more credibility in the run up to the Covid crisis. And by the time Covid crisis unfolded, emerging-market central banking had undergone a "quiet revolution" (Nagy-Mohacsi 2020). Improved domestic monetary frameworks and positive spillovers from advanced countries along with direct and indirect support and such as currency swap and repo operations on offer to a wide circle of country monetary authorities have enabled EM central banks to mount, for the first time, credible counter-cyclical policies that 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 were similar to those in advanced countries – and sometimes even more effective (IMF 2020). The Fed and ECB generous FX currency swaps and repo operations provided active and widely available support to EMs at critical points of the crisis such as in March – April 2020; (Vujcic, 2021).

On the side of the Fed, "spill-back" arguments for these operations helped overcome concerns over nation-anchored mandates. All this signaled a remarkable convergence of policy stance and frameworks between AEs and EMs and, importantly, their central banks' cooperation in the new era of strong global financial connectedness and similar monetary frameworks. The Fed became a de facto international lender of last resort (Cassetta, 2022).

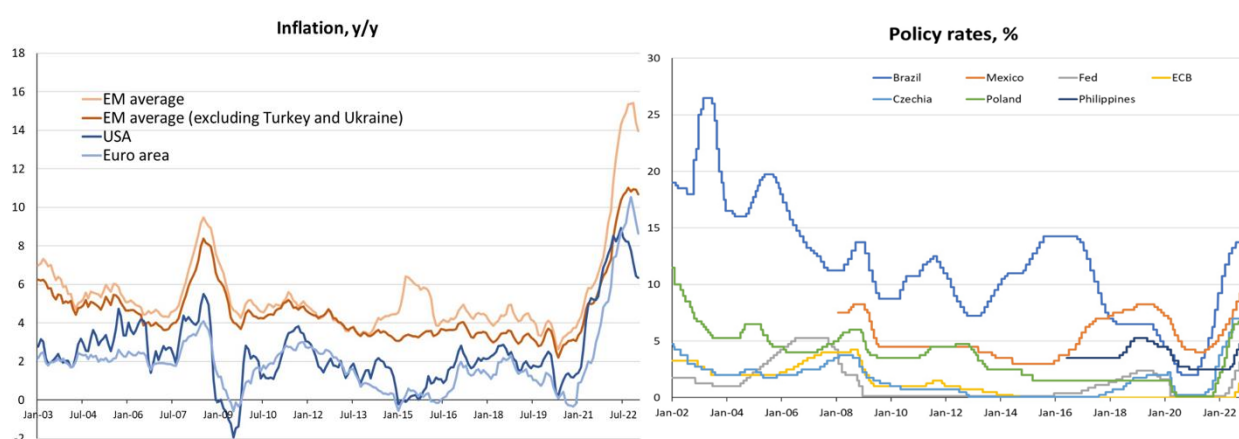
Covid crisis policy responses erred on the generous and politically safe side, and continued even as economic recovery got underway. This added to already existing Covid-related demand-supply imbalances with shortages, and eventually led to the rapid rise of inflation. High inflation is an area where advanced countries had little recent experience, in contrast to EMs that had deep-rooted painful experiences and remained alert to price pressures. As inflation started to surge, advanced countries slipped into a year-long debate whether inflation was "permanent" or only "transitory" – while key EM central banks started to tighten policies without too much hesitation (Velasco 2022).

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 1). While inflation rates now are similar in both groups of countries as inflation became global and advanced country central banks had started an aggressive tightening

cycle, EMs have not seen unmanageable capital outflows and exchange rate pressures. We argue that EM central banks' initial reaction to surging inflation was considerably more appropriate than in AEs, and their monetary policy and communications have performed much better than in the past dealing with the fallout from the global financial tightening.

Have the students overtaken the masters? - we wonder. Our paper seeks to assess evidence in this regard through analyzing EM central bank policy communications.

Chart 1: Inflation and central bank policy rates in US, Eurozone and EMs



Source: Haver

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 driver of market influence. However, despite significant progress in this area, emerging markets and particularly the evolution of their communication has remained a relatively less covered area.

We build upon the earlier literature to analyze emerging market central bank communication and how it compares to the advanced economy central banks.

Gonzalez and Tadler (2022) presents 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 involves sentiment analysis, relying on custom dictionaries. Only a few countries were found to have a link between statements and the future monetary rates, unless there was a surprise element in the communication. Sentiment across countries tended to co-move during the 2008 crisis and following Fed's sentiment surprises.

The IMF (2018) analyzed the length and readability of the statements for 5 LatAm central banks and found that more readable press releases were associated with lower policy forecast error when using the statement tone index. We conclude that, in general, more readable statements would be more palatable to algorithmic processing and signal extraction.

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 in the center. Co-movement in sentiment across central banks was partially explained by trade or financial flow exposures.

Luangaram et al (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. The readability tended to fall when central banks lowered their policy interest rates. Among the six communication topics, 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 meetings 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 sentiment analysis and showed 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 (2014) 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 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. Swedish Central Bank, Apel and Grimaldi (2014) used a custom dictionary as well as LDA to analyze the information content of the monetary policy minutes. Nardelli 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 not many papers looking into the evolution of EM communication over time and particularly comparing them to AEs and covering the post-Covid inflation shock to date.

Our dataset

We assess the evolution of EM central bank communication by analyzing monetary policy statements of 20 EM central banks over the last two decades: Brazil, Chile, Colombia, Czechia, Hungary, India, Israel, Korea, Malaysia, Mexico, Nigeria, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, and Ukraine.² We have collected the texts of the statements from the central banks' websites.³ To the best of our knowledge, this is one of the broadest samples of EM monetary policy statements analyzed in the economic literature to date. Existing papers on monetary policy communication in EM were based on fewer EM countries (6 AEs and 12 EMs in Gonzalez and Tadler (2022), 23 countries mostly AEs in Armelius et al. (2020), 9 AEs and 13 EMs in Luangaram and Wongwachara (2017)).

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 (Czechia, Mexico, South Africa, and Ukraine) have a shorter archive of statements. In some cases, the statements were not available in English, in other cases central banks used unconventional formats for monetary policy statements such as presentations with charts and not so much text, which makes the analysis more challenging. On average, we have around 170 statements per country from the history of 20 years. Starting from 2003, we have between 5 and 10 monetary policy statements per month for the analysis.

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 press releases, because the format and

² 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.

³ The full database of statements broken down into separate sentences is available in the online Annex to this paper.

content of the ECB introductory statements is much closer to that of press releases issued by other central banks, giving more detailed reasoning behind the ECB Governing Council's decisions.

We also use the following additional data for our analysis: monthly CPI index, monthly money market as well as central banks' key policy rate dynamics. These data come from Harvey Analytics and central bank websites.

Approach to analysing monetary policy communication

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

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. Readability; and
8. Statement 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 has become better equipped to respond to macroeconomic/inflationary shocks.

1. Sentiment analysis

Our sentiment analysis aims to assess the tone of central bank's 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, money market rates, and inflation. To construct our monetary policy sentiment metric, we largely follow the approach used by Gonzalez and Tadle (2022).⁴

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). We

⁴ We have introduced some enhancements to the Gonzales-Tadle approach as described in Annex 1.

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 the 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 had, 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.

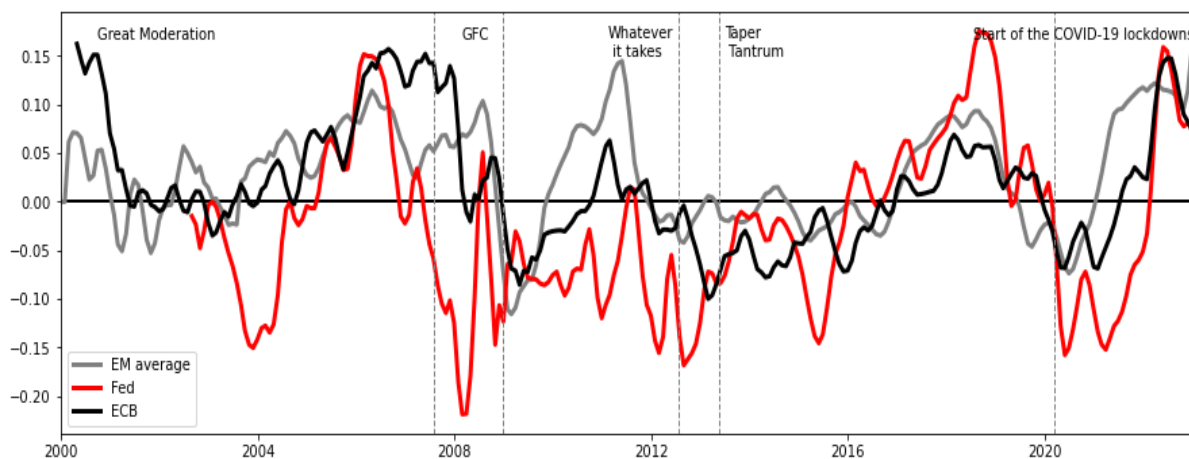
However, we see a certain degree of convergence of policy stance prior to the Covid crisis. Monetary frameworks were converging with EMs successfully adopting inflation targeting, and policy stances became more similar in the run-up to the Covid crisis. We can also add that the nature of shocks have also changed in the past 15 years or so: the US was the source of the Global Financial Crisis; and 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.

However, 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 2: Sentiment score of the monetary policy statements

(higher = more hawkish, lower = more dovish)



Specifically, we observe the following trends:

Prior to the global financial crisis (GFC):

- **EM central bank** communication was generally neutral or slightly cautious/hawkish, particularly in the run-up to the GFC.
- After a period of dovishness through 2004, the **Fed** tightened and turned hawkish, but as the GFC neared and signs of financial instability emerged, the Fed turned dovish already from 2007.
- The **ECB**, in contrast, remained hawkish amid the first signs of the financial crisis and 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.

GFC:

- The **Fed's** loosening policy with dovish language led the crisis response. 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 significantly 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 yields” and associated upward pressures on EM currencies.

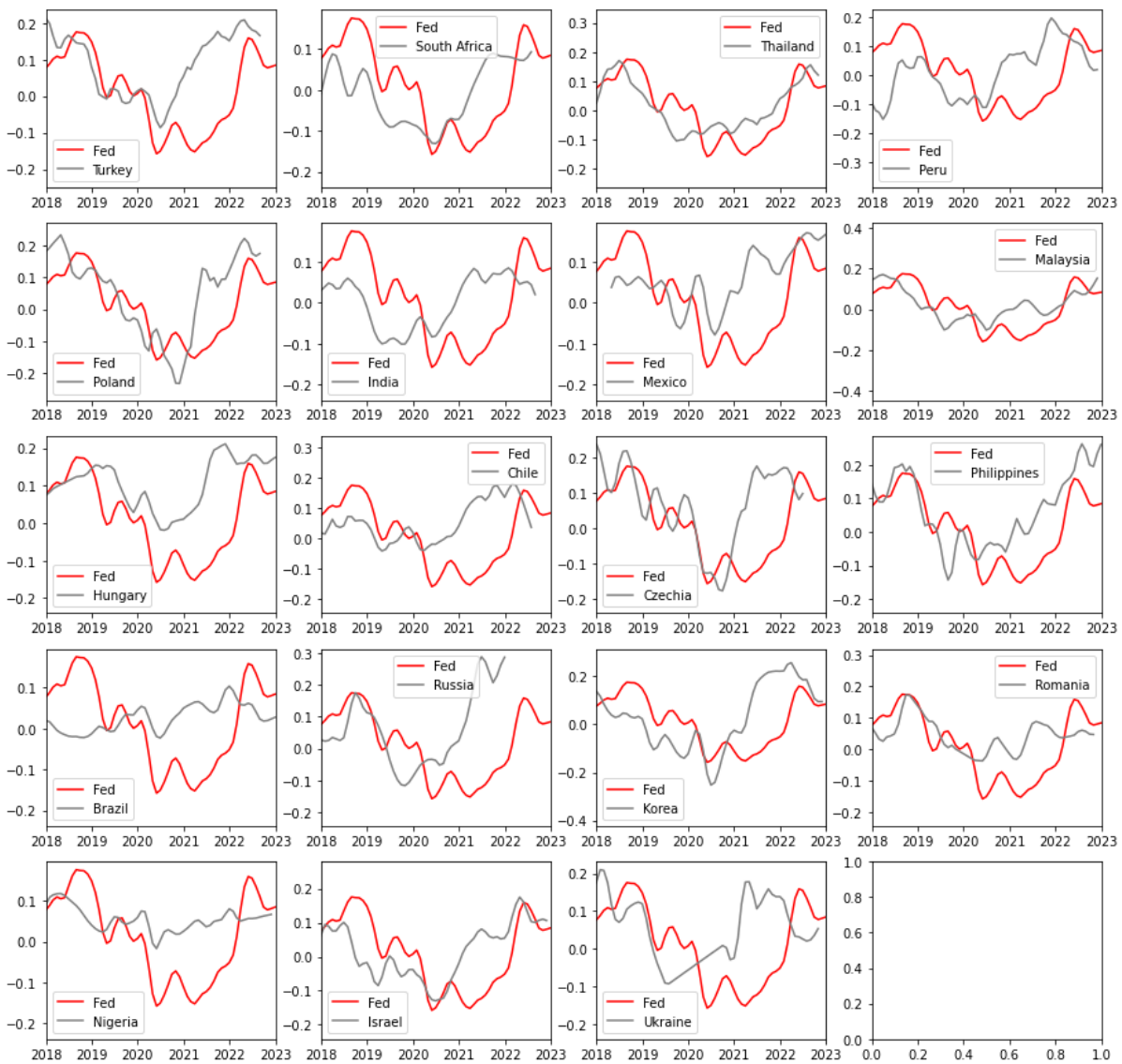
- The **ECB’s** communication reflected a somewhat confused policy mindset but also “growing pains” to become a full-fledged central bank to manage shocks. It attempted to exit from its accommodative monetary policy stance ahead of the Fed with episodes of tightening/hawkishness in 2011 before Draghi’s “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. The ECB’s communication turned more hawkish in the run up to the Covid crisis but this was never followed by an actual tightening due to concerns about the fragility of the recovery.
- The **Fed** was much more hawkish, starting a tightening cycle in late 2015, followed by a (limited) quantitative tightening (QT).

Covid-19:

- 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 a truly global 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.
- However, that synchronization broke down 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 behind the EM central banks in tightening their policy amid inflation spikes in 2021 onwards.

Chart 3 zeroes in on the period around the Covid pandemic shows the communication sentiment metric for each EM central bank in our sample relative to that of the Fed. 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 3: The tone of monetary policy statements: Fed vs EM central banks



2. Topic decomposition

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

We consider three main components: (i) inflation; (ii) economic activity; and (iii) labor market. This allows us to find contributions of each of the three factors 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.

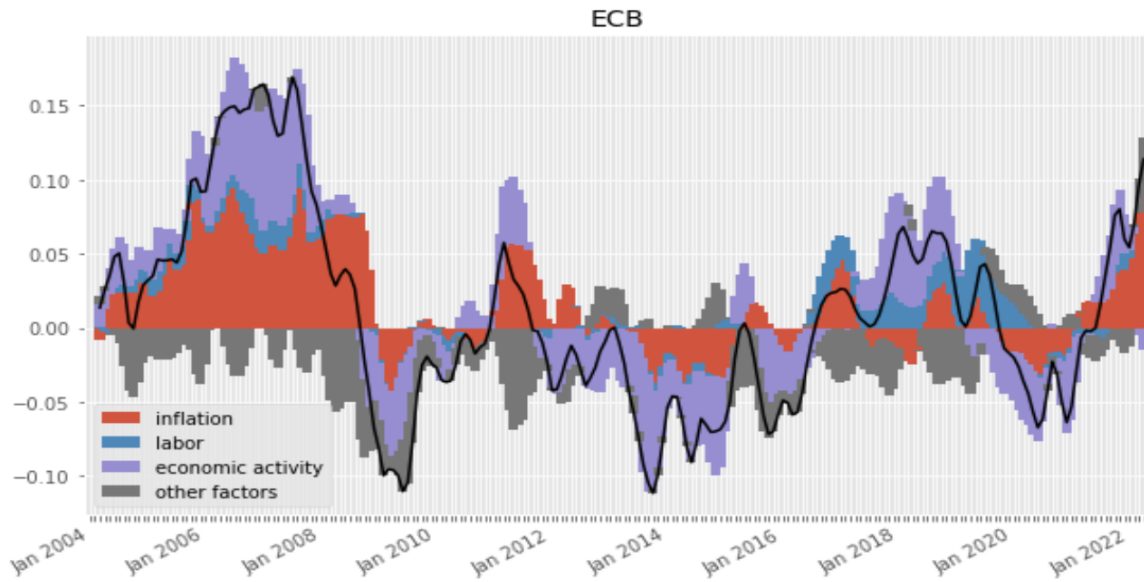
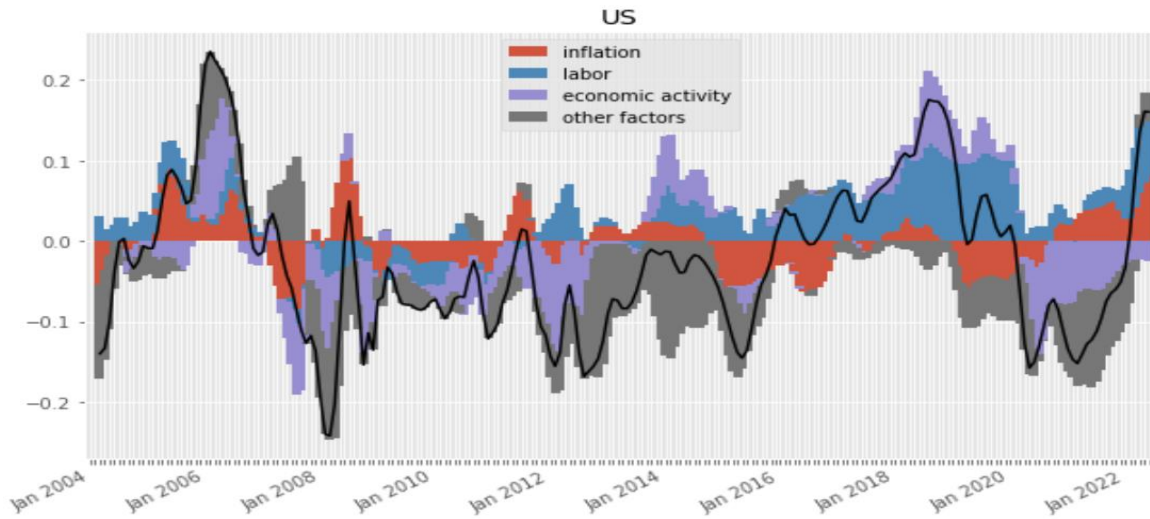
In broad terms, the decomposition confirms that the Fed pays high attention to the labour market and economic activity, while the ECB and EM central bank focus more on the price/inflation objective, along with attention to economic activity.

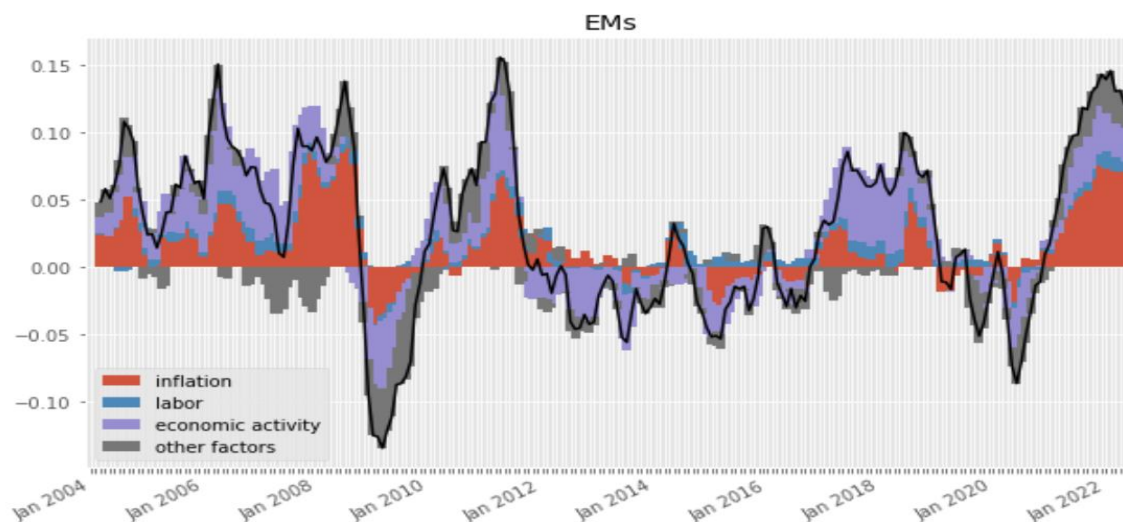
In the Covid period, it appears that both EM and AE central banks *noticed the rising inflation quite simultaneously by early 2021*. However, AE central banks appeared to have been more concerned about the sustainability of the nascent post-pandemic economic recovery, downplaying inflationary pressures and thus on balance keeping their overall rhetoric relatively more dovish. For example, in the case of the Fed, the contribution of the inflation component to the overall hawkishness/dovishness metric became positive around the end of 2020 but it was still offset by the negative contribution of the economic activity component until the end of 2021.

Comparing the Fed, the ECB, and EMs, in the post-pandemic inflation, the concerns about inflation in EMs and the eurozone were not counter-balanced by considerations about the sustainability of the economic recovery, which pushed their overall sentiment metric into the hawkish territory much faster than the Fed. 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.

Chart 4: Decomposition of overall sentiment score of monetary policy statements

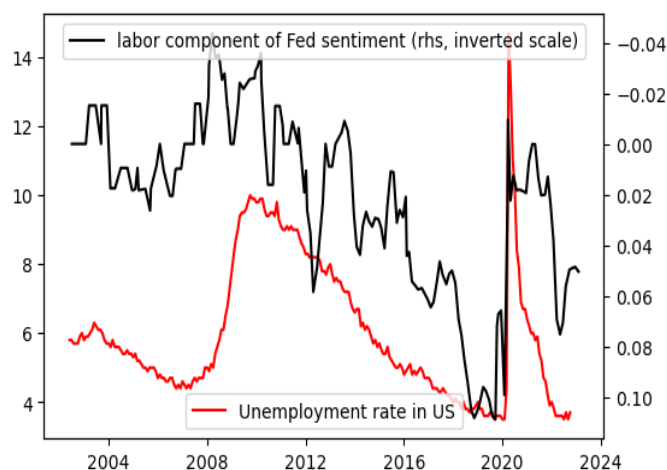
(Solid line represents the overall score)





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. Over the post-Covid period the cumulative contribution of the labor market component is larger than that of inflation. Note that the labor market component of the Fed sentiment score is highly correlated with the US unemployment rate (Chart 5).

Chart 5: Unemployment rate and labor market component of Fed sentiment score

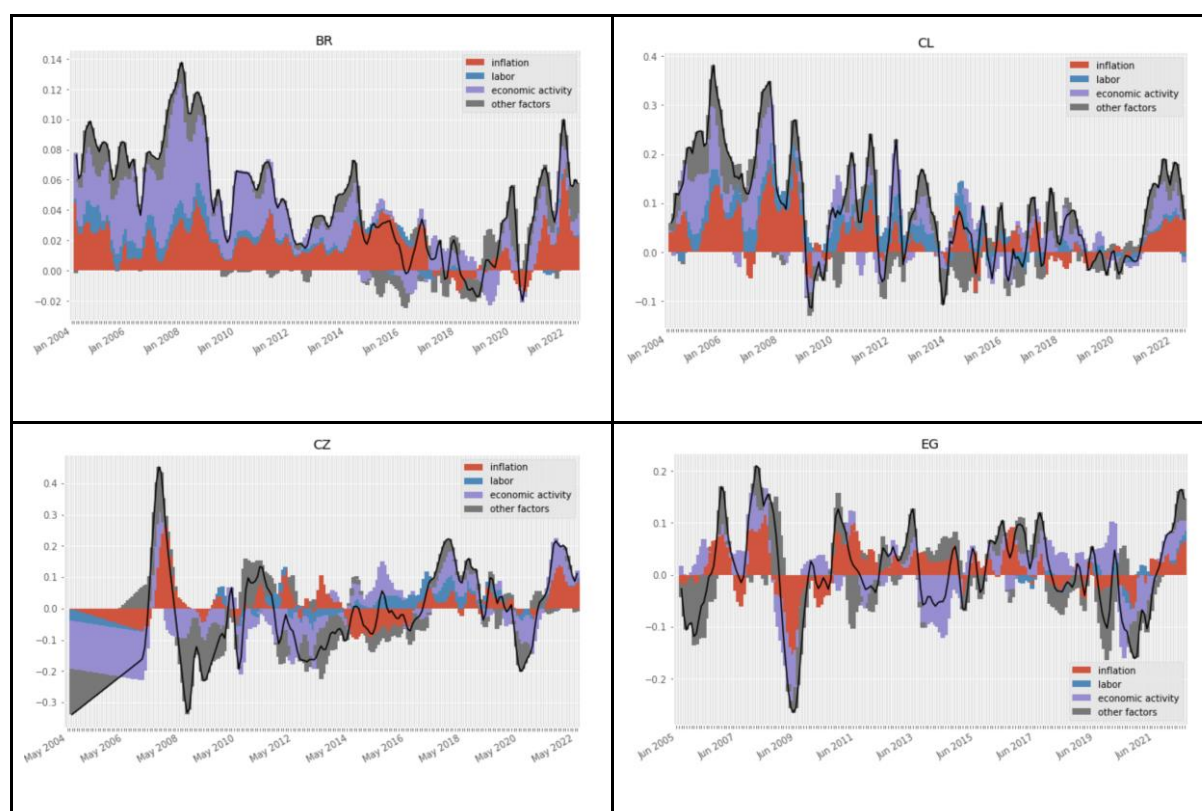


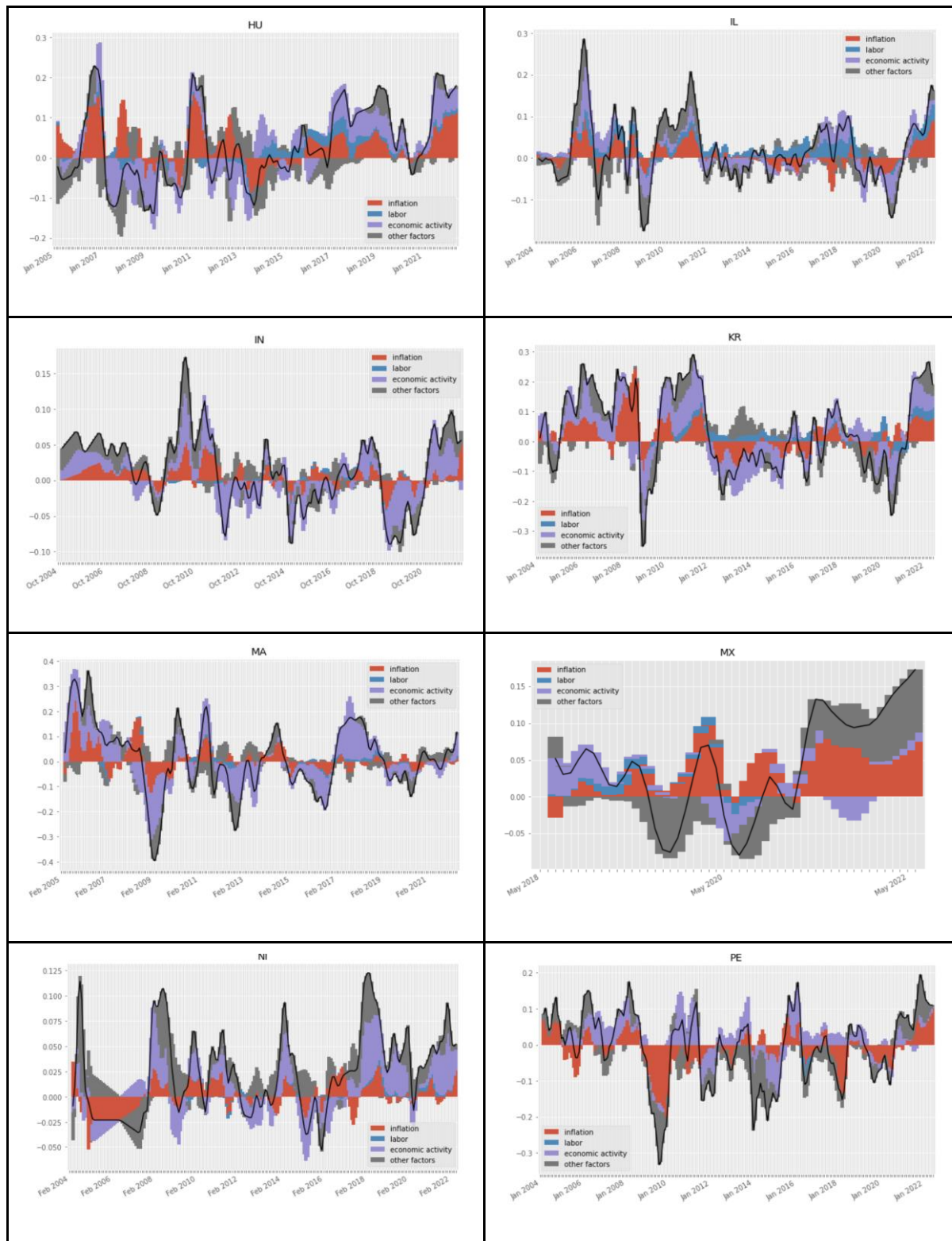
In the case of the **ECB**, historically the focus on inflation has been relatively strong, in line with its primary mandate on price stability. After the GFC, the ECB's concern was mostly

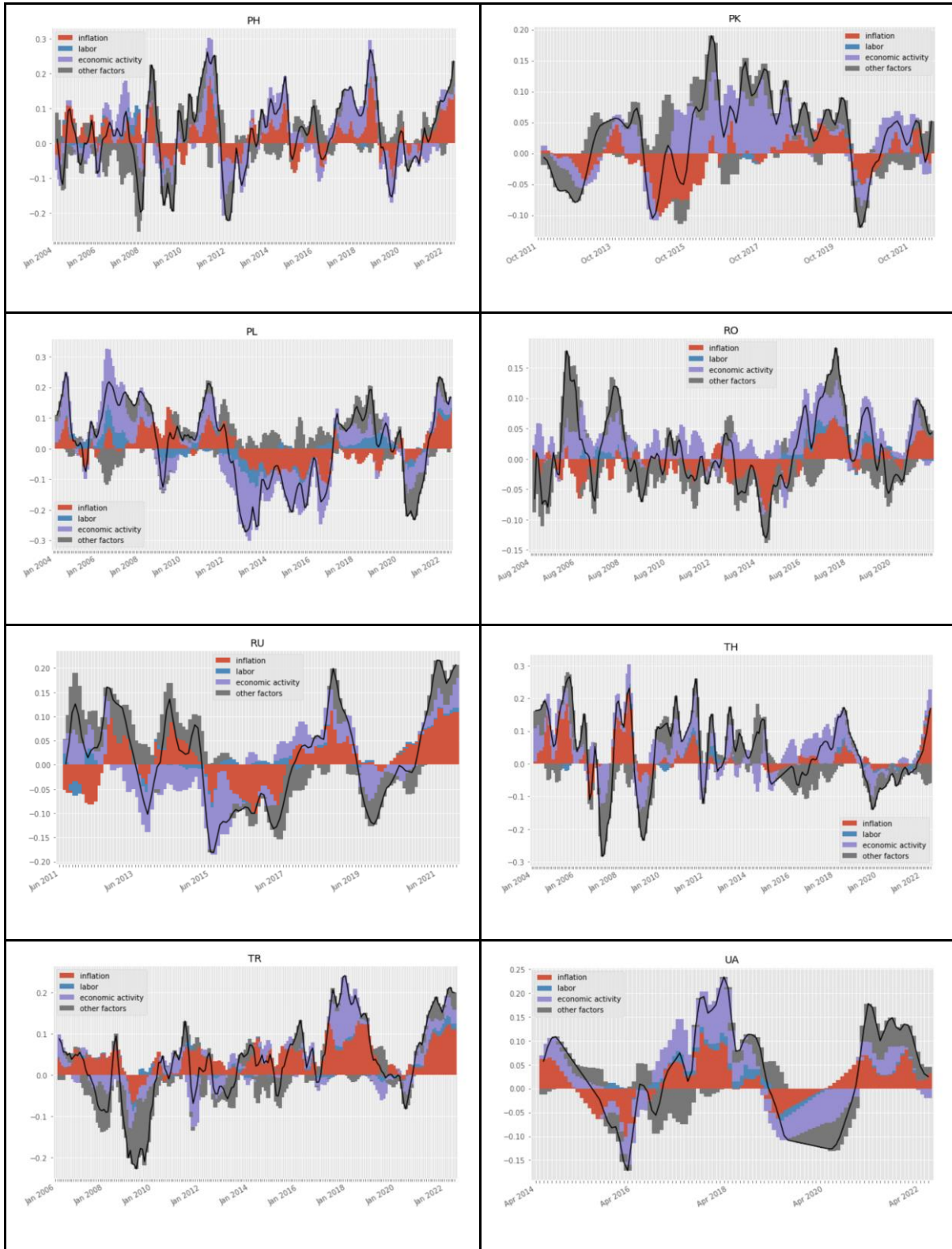
about inflation being persistently below the ECB target (below, but close to 2%). In the years immediately prior to the pandemic the focus on inflation was still present but it became of a more structural nature, focussing on the link between labor market and inflation and the flattening of the Phillips 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 is captured by the grey areas on the Chart 5 that became particularly sizeable in 2017-2019. Against this background, increasingly strong conviction that “inflation is dead” might have decreased the ECB’s vigilance towards inflation risks ahead of post-Covid inflation wave.

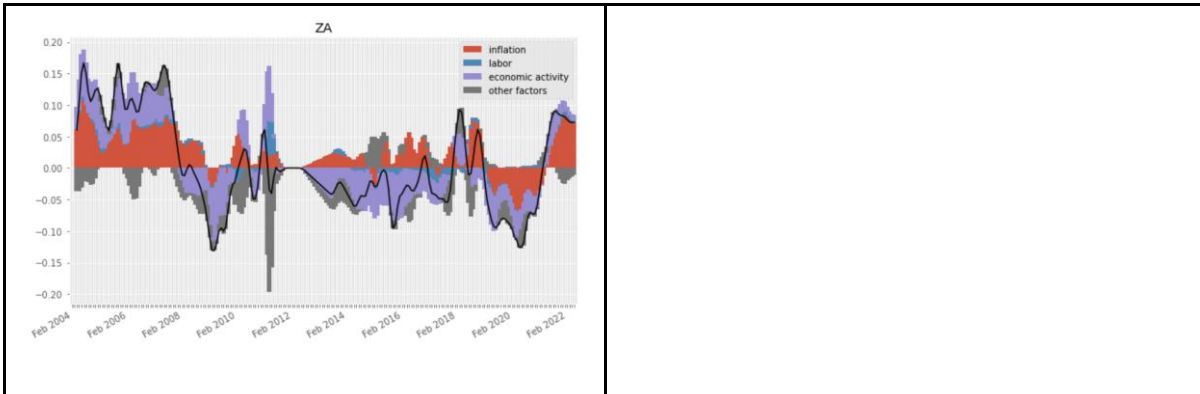
In the case of **EMs**, the *dominant* factor is inflation, and the role of labor market factors is minimal. The dominant role of inflation dynamics in defining the overall sentiment score is particularly visible for Brazil, Czechia, Hungary, South Korea, Mexico, Peru, Philippines, Poland, Romania, Russia, 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.

Chart 6: Decomposition of overall monetary policy sentiment score by EM counties









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.
- Identify some caveats around using ML models.

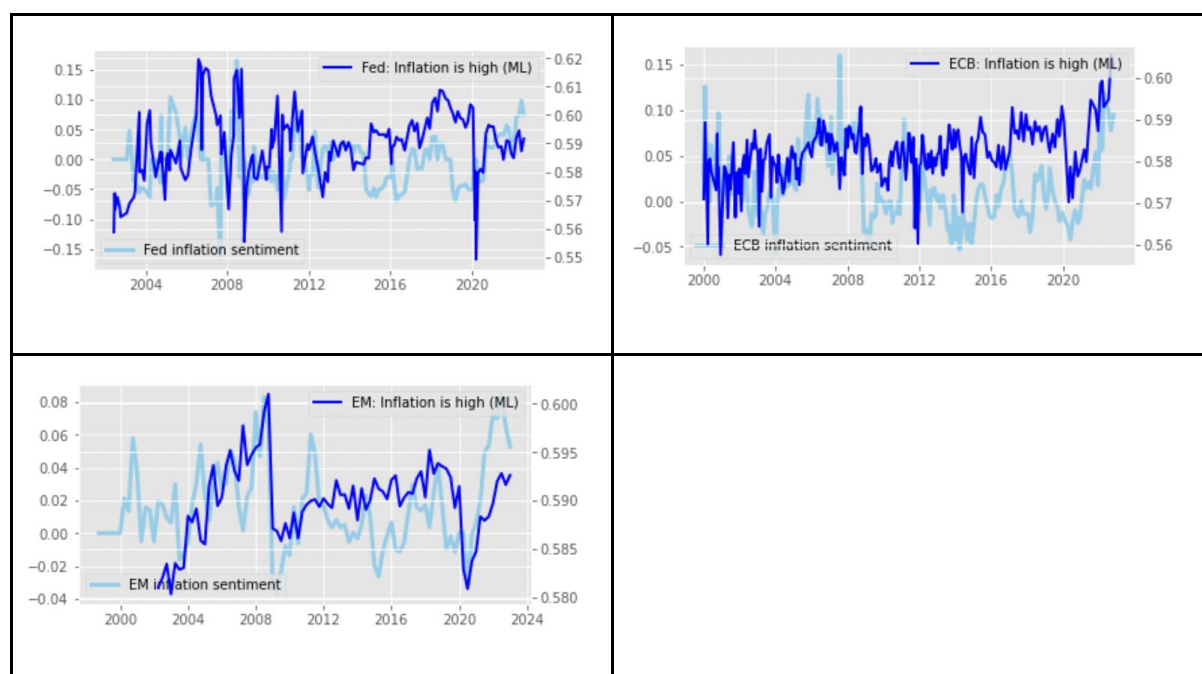
For the ML approach we calculate thematic correlation between individual sentences of central banks' statements and pre-defined, "base" phrases. The approach relies on calculating embeddings, or representation by the state-of-the-art models of sentences or phrases in a numeric-vector format. Dot product of two such vectors would indicate how correlated or thematically linked two sentences or phrases are. For the central bank communication analysis we correlate individual sentences in their statements against three phrases. Specifically, we correlate sentences against three phrases: "Inflation is high", "Employment is high", "Consumer spending is high". The level of the resulting score is not always interpretable, but its trend is (higher values would mean higher similarity).

It is important to note that the ML analysis does not produce hawkishness/dovishness metrics. Instead, it tries to capture thematic similarity between communication and given topics.⁵

⁵ The advantage of the ML method is its flexibility. The dictionary method relies on keeping the dictionary up-to-date and in line with the central bank communication style. ML methods are able to 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 emphasize inflation, but we would be less certain whether this is due to inflation being high or being low. The second limitation of the ML method is its sensitivity to the chosen "base phrase".

We start our analysis by comparing the quantification of inflation communication between the two approaches: dictionary and ML. Both share similar trends, although during certain time periods we observe differences. Indeed, whereas we find that while ML- and dictionary-based metrics are correlated (Chart 7), sometimes they result in different conclusions. This effect is particularly pronounced for the **Fed**, where dictionary-based methods can single out the inflation sentiment, but ML appears to be struggling with this task. We attribute it to several factors: (i) inflation less central in Fed’s communication, and thus harder to identify; (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.

Chart 7: Sentiment analysis: comparing dictionary and machine learning methods



As the next step, we compare trends of various topics and find, reassuringly, similarities with the results of the dictionary approach: **EM central banks** started voicing alarm around inflation early on post Covid; the **Fed** communicates more about the labor market and its overall reaction to inflationary pressures was weak; and the ECB is in between the two.

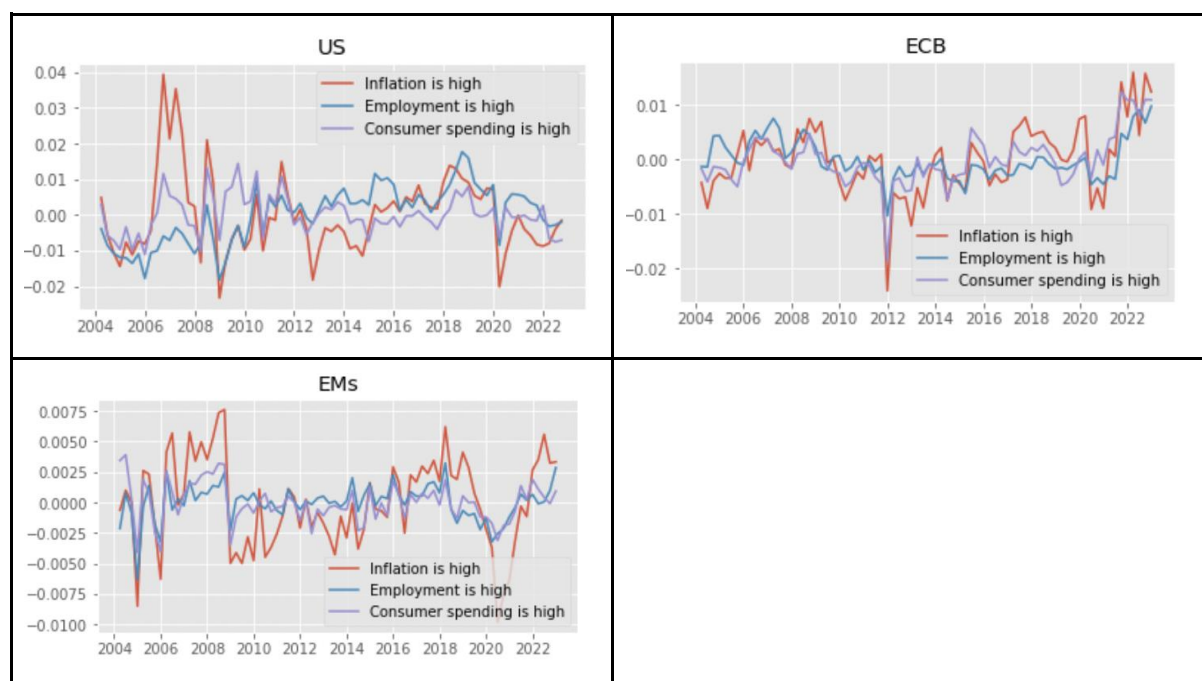
However, we have found some differences:

- A major part of **ECB’s** communication during the post-Covid inflation spike was devoted to economic activity.
- Inflation appears to have been an important topic for ECB even before the pandemic.

- The ML algorithm picks up on the **Fed's** inflation concerns only in early-2022, but the strength of the concern remained relatively *low*. This means that inflation talk detected by the dictionary approach *was too subtle* for the ML model to discern.
- **EM central banks** seem to drop the 'inflation is high' sentiment when a crisis hit (2008 and 2020), but then quickly return to inflation-focus afterwards.

We observe a high correlation across all of the metrics. This means that the model groups them into one similar category, as is expected of a general-purpose language model.

Chart 8. Central bank communication themes (ML approach)



3. "See-say-act"

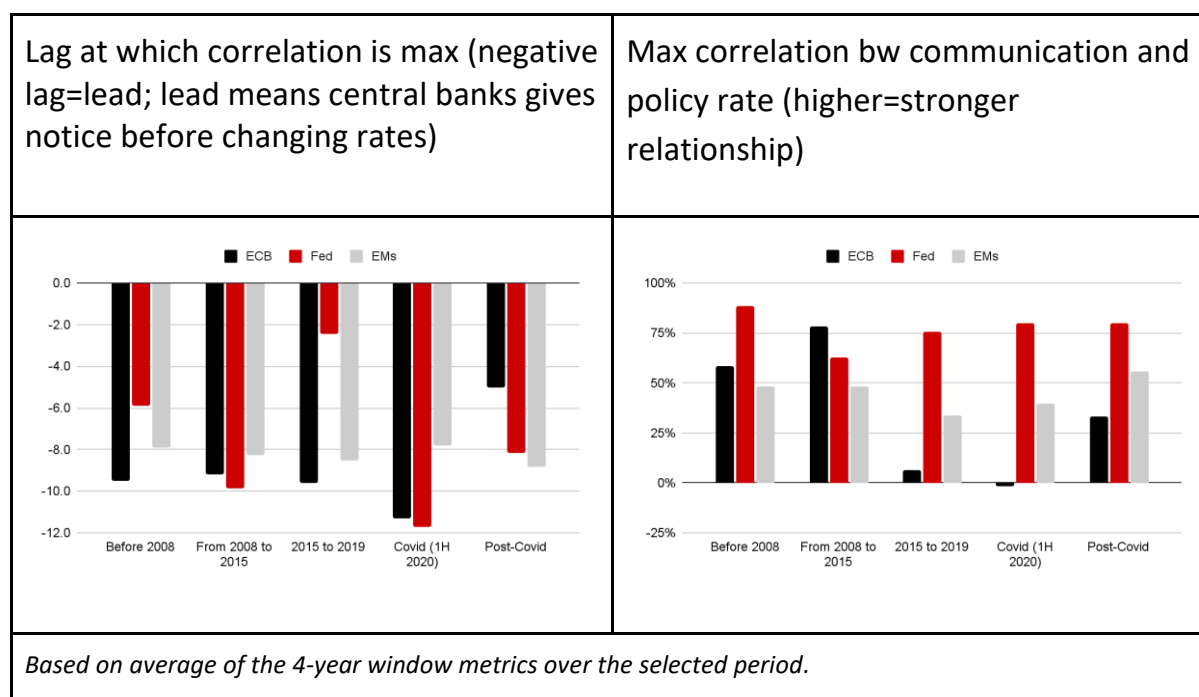
We then analyze how central banks' communication relates to reality. First we check if communication is indicative of the future policy rates moves. Second, we investigate how inflation influences communication: Do central banks foresee it? Do they react or do they ignore it?

Communication and policy rates

The key objective is to check to what extent central banks follow the signal sent by the monetary policy statement with the actual key rate moves. We try to find the lag with 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 over a 4-year rolling window, each time finding 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 12 months' warning time from communication to policy rate action). We find that, on average, EM the sentiment score *leads* the policy rate moves by 8 months, which means that EM central banks typically start preparing the markets and the economic agents about their future moves well in advance (Chart 9).

Chart 9: Correlation and lags between overall sentiment score and policy rate

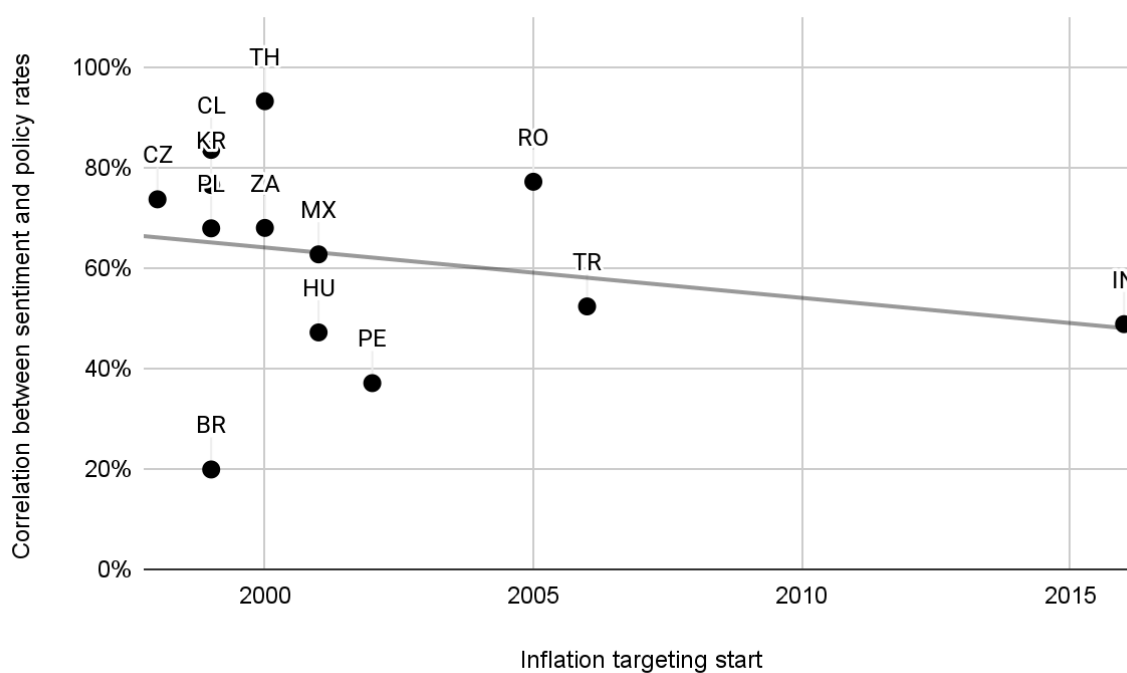


We also find that in the case of the **Fed**, the communication and the actual policy rate changes are very closely linked. The correlation between the overall sentiment score and the policy rate is typically around 80%. The Fed does what it says. The **ECB** used to exhibit similar high correlations, but this has changed due to a prolonged period of flat zero interest rates, which distorts the results. With the latest hiking cycle we see that the ECB is recovering its correlations.

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 months in advance (see above), the actual rate change is delivered less frequently than for the Fed. Most of the time average correlation for EM oscillated around 50% implying ample room for further improvement in communication quality. EMs communicate with better warning signals but delivery is still less powerful than in the case of the Fed. EM central banks don't necessarily do what they say.

We test if inflation targeting experience matters when it comes to communication and inflation. We find that it does: for countries that started inflation targeting sooner, communication correlates more strongly with policy decisions.

Chart 10. Correlation between tone of monetary policy statements and inflation during the Covid inflation depends on the time of adopting inflation targeting

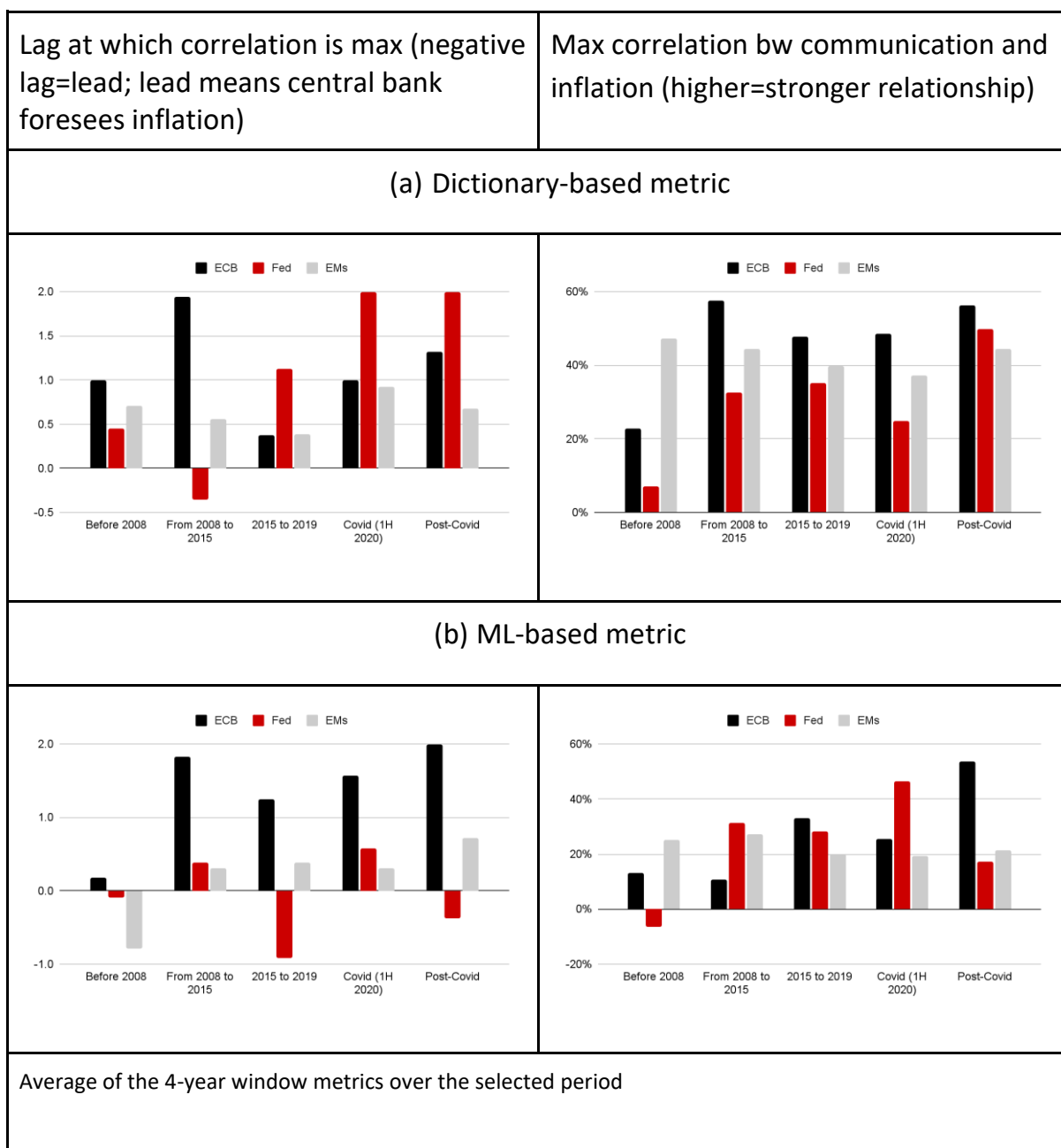


Communication and inflation

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. As inflation measure we use month-on-month⁶ seasonally adjusted inflation.

⁶ We use month-to-month change in price level as it reflects current inflation trends much better than yoy change. The latter is greatly affected by base effects which are less relevant for forward-looking monetary policy.

Chart 11: Correlation and lags between (a) inflation sentiment score and inflation; and (b) ML “Inflation is high” metric and inflation



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 11 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 1-2 months lag. This is a surprising result.

Using the dictionary-based metric, we find that compared to ECB and EM central banks, the **Fed's** inflation component of the sentiments is *less* correlated with inflation over most periods. The correlation is very often below 40%. This is a bit curious, even if one takes account of the Fed's dual mandate. The highest correlation (sometimes up to 80% after the global financial crisis) is observed for the ECB, likely due to its firm focus on price stability.

As explained earlier, an ML-based metric is not designed to measure hawkishness or dovishness, instead, it instead correlates the general themes. A decline in the ML metric, for example, could mean either change of topic (e.g. talking about unemployment rather than inflation) or change in the tonality (e.g. inflation accelerating versus decelerating). Despite this difference, we see similar results when using the two metrics: the **ECB** is more focused on inflation than others; in **all countries** communication tends to lag - rather than predict - inflation; and compared to the pre-GFC period, correlation has increased between inflation and central banks' inflation talk for all countries.

Moreover we find that during the post-Covid inflation shock, **Fed's** communication about inflation was subtle or convoluted, and the ML method failed to correlate it with inflation. This stands in contrast to the dictionary-based metrics, which singled out inflation communication for the Fed and its strong correlation with the actual inflation. However, we also saw that inflation was not a focus for the Fed, so it is not surprising the message got lost.

We also observe a dramatic increase in correlations (inflation communication and inflation, using ML metrics) for the **ECB**, which we can attribute to the efforts around improving communication readability (see below). This could mean that ML algorithms trained on generic text data are now better able to understand the ECB. Overall, however, it seems that ML models should be trained on the economics and finance domain before being able to confidently parse the statements.

4. EM-specific topics

We also 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.* EM 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. 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-existent⁷.

Compared to EMs' attention to inflation, their the reference to exchange rate looks marginal and does not challenge the priority of inflation targets. In fact, some attention to the exchange rate is fully justified given the EM import price-inflation channel and that many EMs have financial dollarisation.

Chart 12. Share of sentences in MP statements containing reference to exchange rate

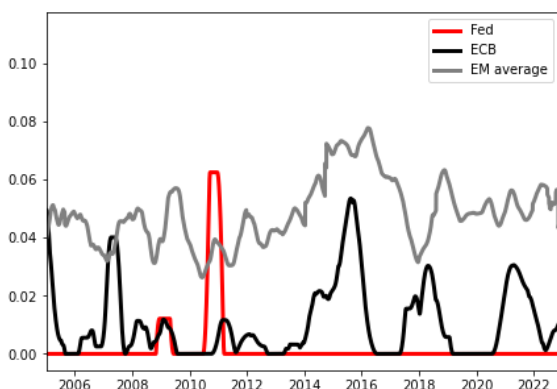
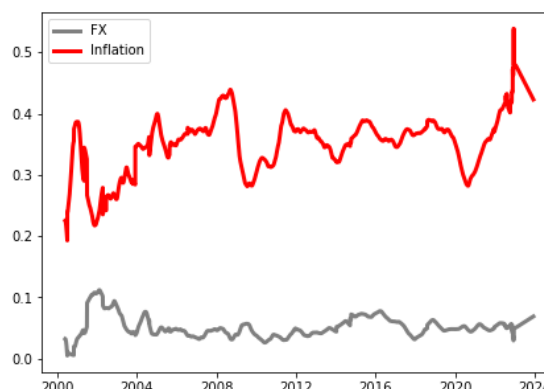


Chart 13. Share of sentences in MP statements of EM central banks containing reference to exchange rate and inflation



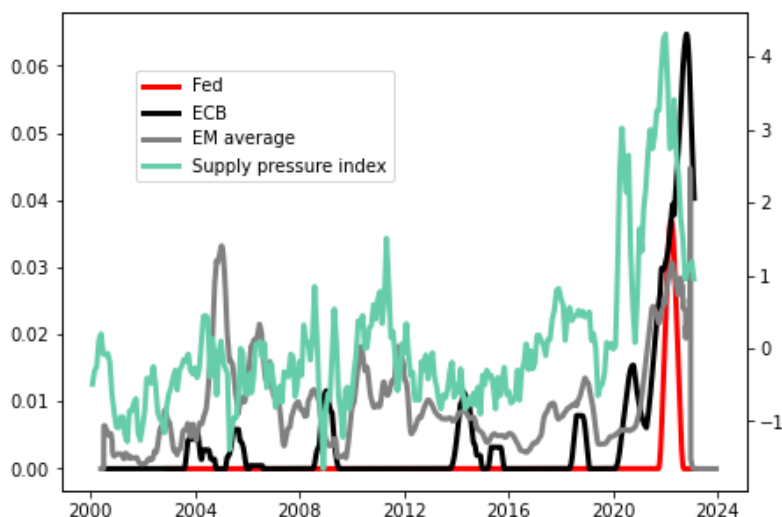
- *Supply side factors of inflation.* We explore the extend to which central banks discussion inflation. The Fed and ECB typically refrained from discussing supply-side inflation factors, possibly due to their view that monetary policy has limited ability to address them. **EM central banks**, in contrast, tend to talk quite regularly about supply factors. They systematically devote around 1%-3% of the statement to this topic. The correlation between communication about supply-side factors of inflation and supply pressure index⁸ exceeds 50% in case of EMs. Importance of supply-side

⁷ 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.

⁸ The Global Supply Chain Pressure Index (GSCPI) was developed by the Federal Reserve Bank of New York and includes 27 monthly variables reflecting events within supply chains and transportation costs in the maritime and air cargo sectors.

factors for EM central banks may be linked to higher risks of second-round effects in countries with less well-anchored inflation expectations.

Chart 14: Supply-side factors in central bank communication



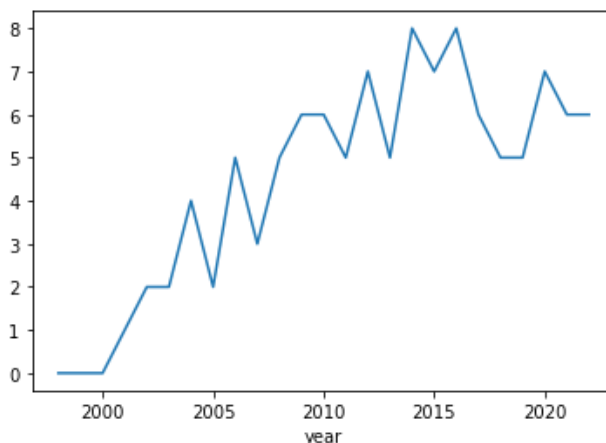
5. Macroprudential language

We also check the extent to which EM central banks pay attention to macroprudential topics in their monetary policy statements⁹. 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 being no exception (Chart 13). We view these developments as another sign of policymakers' appropriate focus and improvements in the quality of their communication.

In this section we focus purely on how *frequently* macroprudential 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 macroprudential language in the monetary policy statements.

⁹ 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.

Chart 15: Number of EM countries using words from macroprudential vocabulary at least 5 times per year



Note, however, that in a few countries financial stability, and/or the 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 macroprudential language in monetary policy press-releases is not necessarily equivalent to lack of focus on macroprudential policies in the country. Therefore, our analysis that is based solely on monetary policy statements should be interpreted with caution.

Our analysis shows that since the Global Financial Crisis, and in particular over the last decade, many EM central banks have achieved considerable progress in becoming more transparent, securing greater independence, signaling their future moves in their communication and paying increasing attention to macroprudential tools. While it is hard to establish a proper causal effect, we believe that these efforts taken together have empowered EM central banks to become more competent in monetary policy conduct and catch up with advanced country peers.

6. Forward guidance

Another dimension of change in EM's central bank communication is increased use of forward guidance invented not long ago by AE central banks as they confronted the 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 time line 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 over the last decade. AE central banks have been publishing their forecasts for some time and some central banks in our sample also started to publish the forecast of the key rate trajectory, such as the Czech National Bank in 2008 or the Bank of Russia.

Yet we find that EM central banks use very different language to formulate their forward guidance. In most cases their signals to the markets remains imprecise, allowing for ample flexibility for central banks in the face of a rapidly changing external environment. In this way central banks seek, at the same time if giving the guidance, avoid over-commitment to a predefined monetary policy path that could potentially clash with new data and endanger their credibility. Even with this ambiguity, EM central bank statements seem to be more forward-looking in nature. The below table highlights some EM central bank typical language.

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. 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 find the following (Chart 16):

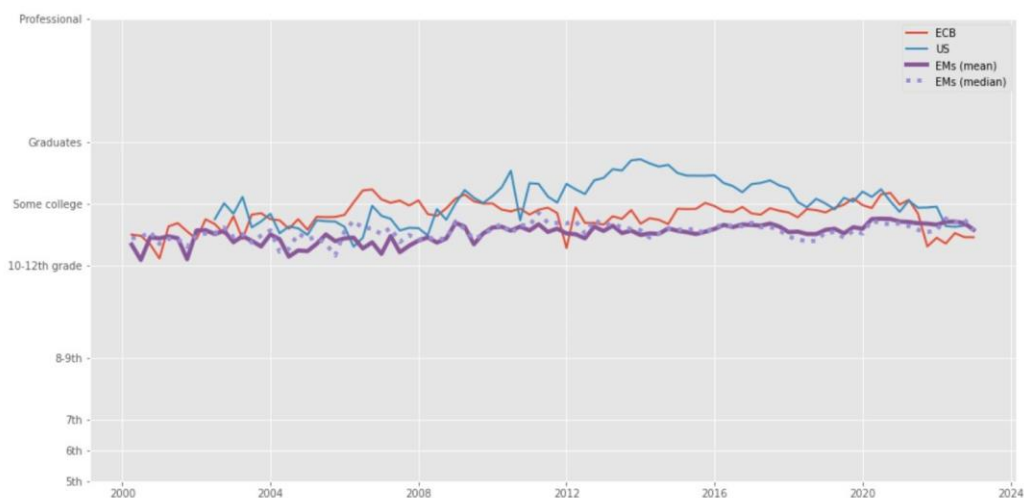
- The readability of EM monetary policy statements appears to have been *easier* than that of AEs and quite stable during most of the sample period. Understanding the statements still requires either high school education or some college degree in EMs and even higher in ADs until recently.
- EM readability has shown a very subtle decline since 2008, due to using longer words, whereas sentence length remained broadly the same.
- 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 that 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.

- Overall, the readability indices of EM central banks, the Fed and the ECB by now have converged due to the above described specific efforts by the latter two. But central bank communication still requires higher than a high school degree to comprehend.

Chart 16: Flesch-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)



*Mexico is excluded as data only starts in 2018.

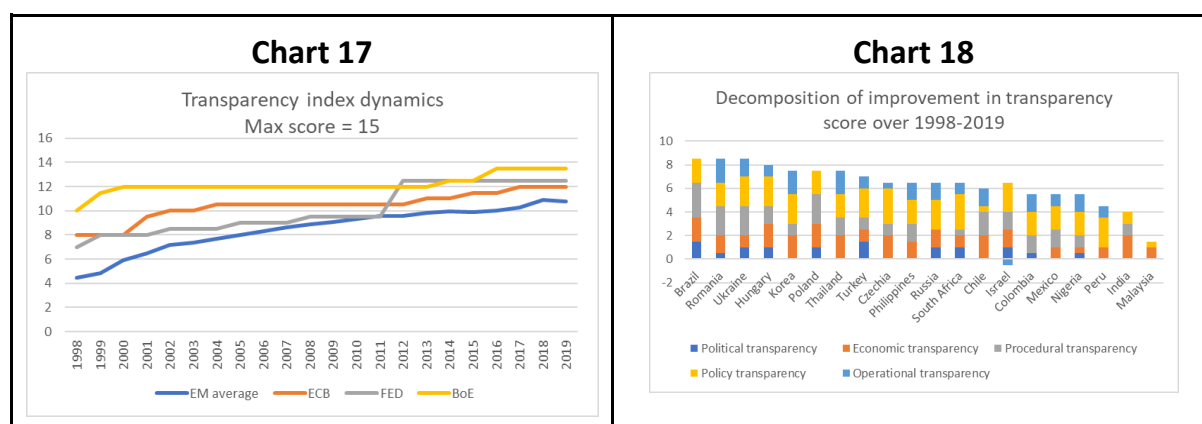
8. Transparency

We use the transparency metric developed by Dincer and Eichengreen (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.

To recall, 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 (Chart 18).

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 (Czechia, Chile, Hungary, Korea, South Africa).

The improvements took place across-the-board over five dimensions (political, economic, procedural, operational and policy transparency (Chart 19). 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).



Source: Based on Dincer and Eichengreen (2022)

Conclusion

In this paper we have compared the evolution of monetary policy communication of 20 emerging market economy central banks with that of the Federal Reserve of the and the ECB, drawing on our unique dataset of central bank statements and other communications between 2003 and 2023. We find that EM central banks have come a long way in their policy and communication, catching up with lead advanced country central banks over the past two decades in some important respects with, of course, still significant room for

improvement in certain areas that we have highlighted. EMs are also a divergent group and, particularly in the areas of transparency and independence, show a divergent picture. Yet in the core area of central banking, fighting inflation, EM central banks have come well ahead of the ECB and the Fed, and communicated their divergent views on global inflation clearly and confidently. In this critical area of central banking, emerging markets may have overtaken the masters.

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Annex 1

Methodology

Dictionary approach

Along with other metrics and characteristics, we assess the evolution of monetary policy framework through the lens of the quality of communication. To this end we analyse the monetary policy statements of 20 EM central banks from our sample. We employ several methods of text analysis allowing us to check the robustness of our findings.

We start with linguistic analysis aimed at measuring the degree of monetary policy statements' hawkishness/dovishness. To this end 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 were expanded with additional relevant words typically used in monetary statements of the central banks in our sample. The lists can be found in the Annex.

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 carry a more dovish meaning (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, 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. A sentence with a direct keyword 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. 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 three components: **inflation**, *labor market* and economic activity

(these highlights are used in the below matrix). The keywords used to produce these metrics are highlighted accordingly in the dictionaries used for the overall sentiment. The methodology for calculating each component is identical to the overall approach described above but is implemented using narrower dictionaries. The difference between the overall sentiment score and the sum of 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.

Even though we broadly follow the procedures by Gonzalez and Tadle, 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 meaningful 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 among the EM countries since the pandemic. To assess the impact of this factor on the overall tone of 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.

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	<u>activity</u> , balance, competitiveness, condition, confidence, <u>construction</u> , <u>consumption</u> , cost , CPI , credit, creditworthiness, <u>demand</u> , <u>economy</u> , <i>employment</i> , <u>expenditure</u> , exports, flow, <u>GDP</u> , <u>growth</u> , income, indicator, inflation , interest, <u>investment</u> , <i>job</i> , <i>labor</i> , loan, <u>manufacturing</u> , market, outlook, <u>output</u> , performance, policy, pressure, price , <u>production</u> , rate, rent , repo, <u>sales</u> , sectors, sentiment, <u>turnover</u> , <i>wage</i>
Reverse keywords	caution, deficit, disinflation , holdings, purchases, <u>recession</u> , risk, uncertainty, <i>unemployment</i> , supply

Positive modifiers	<p>above, accelerate, added, aggravate, 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, upper, upside, upswing, upswinging, upswung, uptrend, upturn, upward, vigorous, widen, wider</p>
Negative modifiers	<p>adverse, accommodate, 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, slow, slowdown, slower, slowest, sluggish, small, smaller, smallest, soften, speculate, stress, stringent, subdued, subprime, suffer, sunk, support, suppress, threaten, tougher, turbulent, uncertain, unclear, undermine,</p>

	unfavorable, unfavourable, unstable, vulnerable, wane, weak, weaken, weaker, weakest, weigh, worse, worsen, worst
Macroprudential keywords	Basel, capital adequacy, capital buffer, capital shortfall, capital standard, collateral, credit risk, debt restructuring, debt serviceability, financial and economic stability, financial instability, financial risk, financial stability, financial stress, financial vulnerabilities, housing market, impairment, indebtedness, liquidity ratio, liquidity risk, loan loss, loan provision, macro prudential, macro-financial, macro-prudential, macroprudential, nonperforming loan, non-performing loan, prudential measures, risk management, search-for-yield behavior, speculative bubble, stress test, stress-test, supervision, systemic risk, systemic stress, systemically important
QE dictionary	purchase programme, purchase government securities, purchase government bonds, securities purchase, purchase leu-denominated government securities

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 communiqués 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",
- "Employment is high",
- "Consumer spending is high".

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.

Annex 3: Limitation of the ML approach

Our ML approach relies on “correlating” individual sentences in the central bank communication against a pre-defined phrase, which we call “base phrase”. Specifically, we use “Inflation is high”, “Employment is high”, “Consumer demand is high”. The model appears to be somewhat sensitive to the choice of the formulation of the “base phrase”. The charts below demonstrate this sensitivity by comparing the correlation of statements to “Inflation is high” vs “Inflation is high. Prices are rising. Inflation is accelerating. Prices are growing”. Overall, the “base phrase” should be chosen according to the desired goal or a set of “base phrases” should be used.

