How We Missed the Inflation Surge: An Anatomy of Post-2020 Inflation Forecast Errors

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ABSTRACT:

This paper analyzes the inflation forecast errors over the period 2021Q1-2022Q3 using forecasts of core and headline inflation from the International Monetary Fund *World Economic Outlook* for a large group of advanced and emerging market economies. The findings reveal evidence of forecast bias that worsened initially then subsided towards the end of the sample. There is also evidence of forecast oversmoothing indicating rigidity in forecast revision in the face of incoming information. Focusing on core inflation forecast errors in 2021, four factors provide a potential *ex post* explanation: a stronger-than-anticipated demand recovery; demand-induced pressures on supply chains; the demand shift from services to goods at the onset of the pandemic; and labor market tightness. *Ex ante*, we find that the size of the COVID-19 fiscal stimulus packages announced by different governments in 2020 correlates positively with core inflation forecast errors in advanced economies. This result hints at potential forecast inefficiency, but we caution that it hinges on the outcomes of a few, albeit large, economies.

WORKING PAPERS

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1. Introduction

As the COVID-19 pandemic hit the global economy in early 2020, and with interest rates mostly at the effective nominal lower bound in the world's advanced economies, it was up to fiscal policy to prevent deep economic scarring. Indeed, large fiscal interventions were undertaken which provided support to households and businesses as economic activity almost came to a halt. With the rapid development and deployment of COVID-19 vaccines, economic activity rebounded strongly as lockdown measures were gradually lifted. An intense wave of global inflation followed.

Forecasting the course of inflation post the pandemic's initial shock proved a difficult task as considerable uncertainty obscured the economic outlook. Forecasters grappled with changed dynamics in goods and labor markets and faced prints of economic data that were difficult to parse in real time. Realized inflation repeatedly exceeded the forecasts issued by central banks, international institutions, and the private sector. Reflecting the intensity and persistence of underlying inflation forces, inflation outcomes kept surprising on the upside despite upward forecast revisions over the course of 2021 and 2022. While we acknowledge the highly uncertain outlook back in 2020, the extent to which the rapid rise in inflation eluded most forecasters remains intriguing. In this paper, we set out to dissect the inflation forecast errors using a panel of country-level forecasts for headline and core CPI inflation issued by the International Monetary Fund (IMF) over the period 2021Q1-2022Q3. These are published on quarterly basis in the *World Economic Outlook* (WEO) report.

In particular, we ask the following questions. On statistical terms, did the forecasts show evidence of bias, and if so, how did the bias evolve over the study period? Also, was there evidence of oversmoothing, or excessive sluggishness, in updating the forecasts in the face of incoming data? We then move on to a deeper dive into the potential economic underpinnings that may explain the forecast errors. We first conduct an *ex post* analysis to assess what we can learn with the benefit of hindsight as the thick cloud of uncertainty thinned out and economists had a better understanding of post-2020 demand and supply dynamics. We then opt for an *ex ante* assessment to answer the question: could we have seen some of this coming given the information available at the time?

We find that headline forecasts saw significant downward bias in the focal period 2021Q1-2022Q3, at about 1.8 percentage points (pp). It was on the rise over the period 2021Q1-2022Q1 but started to decline from 2022Q2. We also find evidence of oversmoothing in the forecasts, and a positive and significant correlation between cross-country estimates of the magnitude of the smoothing coefficients and the headline inflation forecast errors. In analyzing the economic underpinnings for the forecast misses, we focus on core inflation forecasts errors in 2021—the year for which we have a full set of realized inflation data. The focus on core inflation is natural given we look into variables that portend a potential imbalance between aggregate demand and aggregate supply, while abstracting from other factors that could be driving the non-core components of inflation. We find evidence that four factors could provide an ex post explanation of the core inflation forecast errors: a stronger-than-anticipated demand recovery; demand-induced pressures on supply chains; the demand shift from services to goods at the onset of the pandemics; and labor market tightness. Ex ante, we find that the size of the COVID-19 fiscal stimulus packages announced by different governments in 2020 correlates positively with core inflation forecast errors in advanced economies in 2021. This result hints at potential forecast inefficiency for this group of countries, but we caution that it hinges on the outcomes of a few, albeit large, economies. These are Australia, Canada, the UK and the US.

It is worth noting that the early inflation surprises in our sample preceded the Russian invasion of Ukraine in February 2022. While the war amplified inflationary pressures from the supply side through the disruption of global commodity markets, our analysis of the core inflation forecast errors, and its potential economic drivers, is focused on the period of economic recovery in 2021 after the initial pandemic shock. The war's effect on international energy and food prices in 2022, affecting headline inflation and possibly showing signs of second round effects, may also be a likely contributor to the forecast errors and revisions in 2022. Therefore, we highlight those exercises that included forecasts and data for 2022; however, the crux of our analysis is focused on forecasts and outcomes for 2021.

Our study is among the first to dissect inflation forecast errors, with a particular focus on the recovery period post the initial COVID-19 shock, and with country coverage including both

advanced and emerging economies.[1] In April 2022, the European Central Bank (ECB) released its own assessment of the drivers of the inflation forecast errors issues by the ECB for the euro area (Chahad et al. 2022). Their results also indicate evidence of underprediction that became particularly pronounced in 2021Q3, and the authors attribute the forecast errors for headline inflation primarily to higher-than-anticipated energy prices. A direct comparison to our results, however, is complicated by differences in the country coverage and our focus on core rather than headline inflation when we focus on the economic drivers of the inflation misses. Also, recent work by Borio et al. (2023) finds evidence of a role for monetary growth in explaining inflation forecast errors for Brazil, Canada, euro area, Thailand, the UK, and the US.

Our study also contributes to a recent literature focused on the factors underlying the recent surge in inflation. This literature focuses on the overall surge in inflation, while we assess the factors behind the inflation surprises, that is the deviation of inflation outcomes from predictions. Our result on the COVID-19 fiscal stimulus, which is driven by a few large economies as indicated above, resonates with some recent findings. For example, de Soyres et al. (2022) study a group of advanced and emerging economies and conclude that the COVID-19 fiscal stimulus packages explain excess inflation relative to the 2015-2019 average. Jordà and Nechio (2022) also set out to estimate the impact of the COVID-19 fiscal policy stimulus on inflation and conclude that direct fiscal support measures explain a significant portion of the inflation surge in advanced economies. In a sample of mostly advanced economies, Hale et al. (2023) find that the fiscal measures adopted in 2020 had an inflationary impact when the support measures targeted households rather than businesses. Jordà et al. (2022) similarly find a significant effect of the COVID-19 fiscal stimulus on US inflation. On the drivers of the aggregate demand-supply imbalances, di Giovanni et al. (2022) find that aggregate demand played a more prominent role in US inflation, while aggregate supply shocks were key to the inflation outcomes in the euro area.

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[1] A number of previous studies analyzed WEO forecast errors focusing primarily on growth forecasts. See Celasun et al. (2021) and the references cited therein.

The paper begins by presenting the context for the recent surge in inflation and taking a first pass at the forecast errors in Section 2. Section 3 summarizes the data sources. Section 4 presents the empirical findings, and Section 5 concludes the paper.

# 2. Recent Inflation Misses and Attempts to Rationalize Them

Inflation outcomes consistently exceeded the predictions of central banks, international institutions and professional forecasters starting the first half of 2021, and their magnitude increased markedly by the second half of the year; see, for example, Furman (2022) for the US economy and Chahad et al. (2022) for the euro area. The surprises were large and persistent, affecting both headline and core inflation. In this section, we present some stylized facts on the magnitude and evolution of the forecast errors, followed by a discussion of the potential factors identified in the literature as playing a role in the recent inflation surge.

2.1. Headline and Core Inflation Errors in 2021-2022

Inflation started to pick up as many economies rebounded from the pandemic-induced slump in economic activity in 2020. Figure 1 shows the profile of headline inflation forecasts from the recent WEO vintages over the period January 2021 – October 2022, with advanced economies (AEs) in the top panel and emerging markets and developing economies (EMDEs) in the bottom panel. Inflation forecasts were revised up repeatedly, with the recent vintages
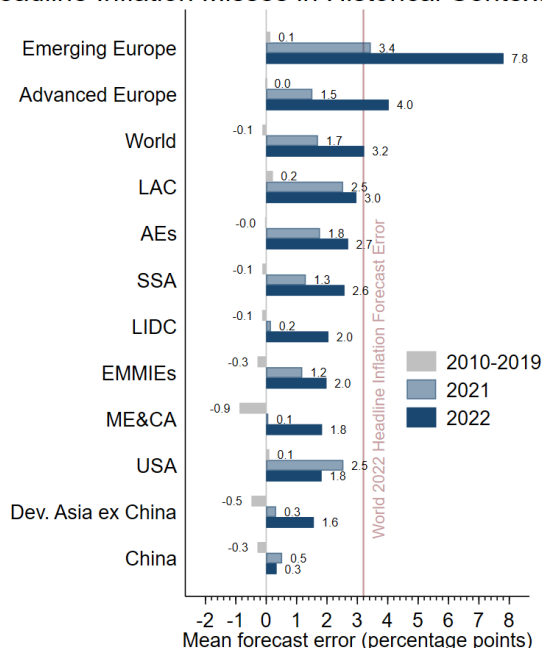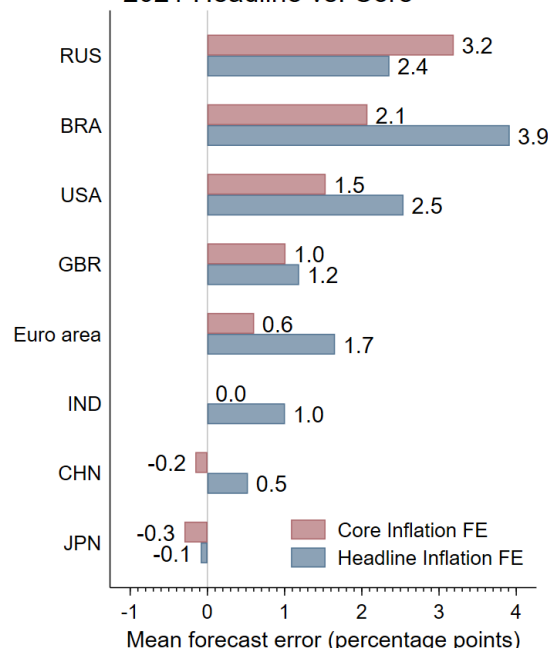
Figure 1: Headline Inflation Forecasts
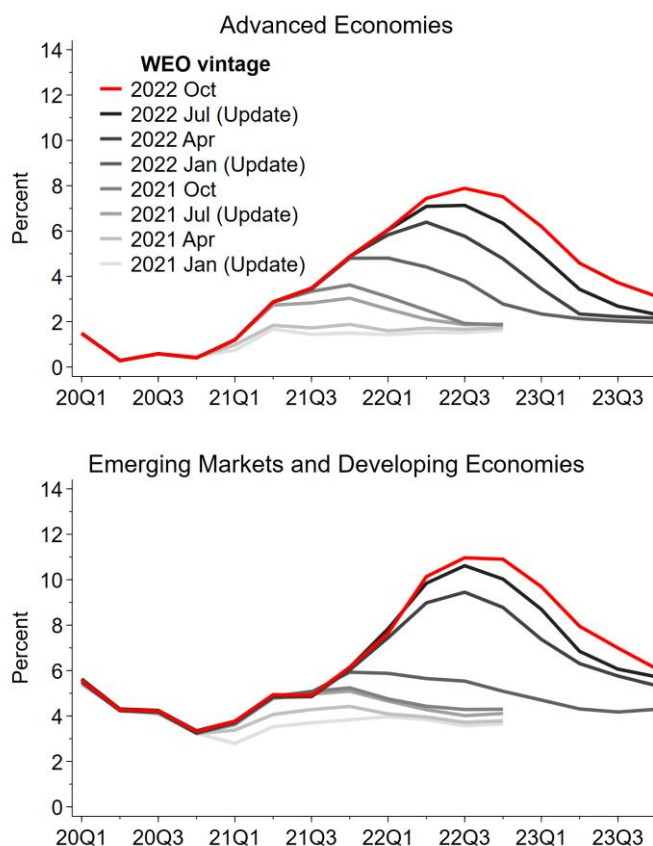
Source: IMF WEO database.
Notes: The lines plot the headline y-o-y quarterly inflation forecasts from different vintages.

implying slower reversion to pre-pandemic levels as inflation pressures broadened and proved persistent. For AEs, a sizable revision took place in January 2022, followed by a similarly large one in April 2022. EMDEs also saw a significant forecast revision in April 2022, primarily reflecting additional inflationary pressures due to the Russian invasion of Ukraine in February 2022 and its impact on global commodity markets.

Figure 2 (left panel) shows that the forecast errors were large by historical standards. In 2021 and 2022, the headline inflation forecast error's world average was 1.7 and 3.2 percentage points (pp), respectively, compared to -0.1 pp over the period 2010-2019.[2] The root-mean-square forecast error is respectively 2.5 and 5 times larger for 2021 and 2022 than it was for 2010-2019. The large headline forecast errors for 2022 for emerging Europe are due to exceptionally high inflation in the Baltic and other eastern European states because of the Russian invasion of Ukraine. Only China and the US saw smaller headline forecast errors for 2022 than for 2021. In China, the slowdown in economic activity due to repeated lockdowns helped contain inflation. The smaller error in the US reflects a significant upward revision to the inflation forecast in the January 2022 WEO Update in reaction to elevated core inflation readings since 2021Q2 and early signs of increasingly tight labor markets.

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[2] As of the time of writing, realized inflation figures for 2022 were yet to be released for many economies, therefore the "forecast error" for 2022 refers to the *forecast revision* for the annual inflation forecast made in the October 2022 WEO relative to the January 2022 WEO *Update*. Accordingly, a positive error for a particular country for 2022 indicates that 2022 inflation is projected (as of October 2022) to be higher than anticipated at the start of 2022.

Figure 2: Headline and Core Inflation Forecast Errors by Region

Source: IMF WEO database; authors' calculations.

Note: The bars in the left panel show annual headline inflation forecast errors using the fixed vintage of the January WEO *Update* since 2010. For 2022, the "forecast errors" refer to the forecast revision between the January 2022 WEO *Update* and the October 2022 WEO. The bars in the right panel show 2021 headline and core inflation. FE = forecast error.

Figure 2 (right panel) compares headline to core inflation misses in 2021, the year for which realized inflation is fully observed for all countries, and also the year in which core inflation misses were more prominent relative to 2022. It shows that core inflation forecast errors were prominent relative to headline inflation forecast errors. This highlights that it is not merely food and energy shocks that were driving inflation, but broader price pressures. For the euro area, core inflation misses were smaller than in the US and the UK, hinting at potential divergence in the forces behind the buildup of core inflationary pressures after the initial pandemic shock.

2.2. Analytical Framework

The New Keynesian Philips curve is a useful framework to think about the potential factors underlying the recent surge in inflation:

$$Inflation = expected\ inflation - \varphi^* slack + error\ term \qquad (1)$$

where $\varphi > 0$ and the *error term* captures supply-side inflationary shocks. Furman (2022) and Ubide (2022) also use the New Keynesian Phillips curve to parse through the evidence on the different contributors to the inflation surprises.

Since our prime focus in this paper is the core inflation misses in 2021, we exclude the *expected inflation* term in (1) as a likely source for the forecast errors. Notwithstanding the nervousness among policymakers about the possibility of de-anchoring of inflation expectations as inflation realizations in many economies significantly exceeded central banks' targets, there is no to little evidence on a material shift in inflation expectations back then.

This leaves us with the remaining terms in (1) as the sources for inflation surprises: an unforeseen reduction in slack in the economy; a larger impact of slack on inflation because of a higher φ; or supply-side shocks featuring in the error term. The literature highlighted several factors as potential culprits behind the inflation surge. In what follows, we discuss these factors with an attempt to attribute them to the right-hand-side terms in (1).

Slack in the economy not as severe as initially thought. The rapid spread of the pandemic and subsequent lockdowns led to a sharp contraction in economic activity in 2020 in most economies. The G7 economies saw output contractions ranging from 3.5 percent to almost 10 percent that year (April 2021 *World Economic Outlook*). However, this does not necessarily mean that output was significantly lower than potential. In addition to restricting demand—especially for services such as travel, hotels and restaurants—the pandemic also restricted labor supply directly because of the lockdowns, and indirectly due to a decline in labor force participation, or what has been termed the "great resignation." This may have made it even more challenging to estimate a measure of slack, such as the output gap, in real time. In addition, the unemployment gap—a widely used alternative measure of slack—may have also been difficult to interpret given the impact of the pandemic shock on labor markets. It gradually became apparent that unemployment, which rose during the pandemic, was not an accurate enough measure of labor market tightness and that the ratio of vacancies to unemployment painted a different picture of labor market conditions. This was demonstrated using data for the US (Furman and Powell 2021, Ball et al. 2022, Domash and Summers 2022), as well as using a broader sample of AEs in
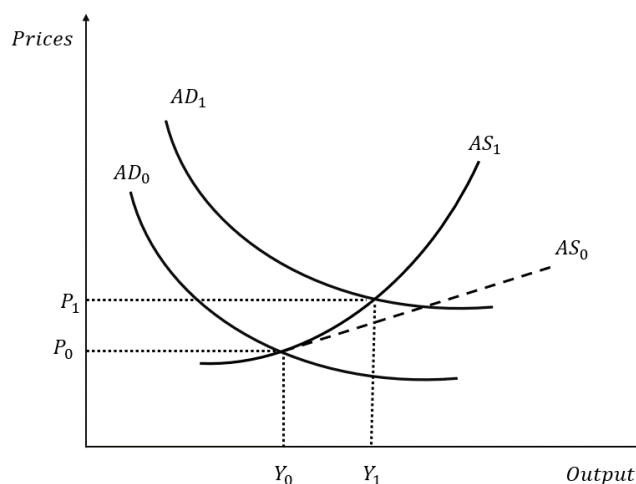
Duval et al. (2022).[3] With slack possibly lower than initially thought, this would have contributed to the inflation surprise through the slack term in (1).

Strong rebound in economic activity. The downturn in activity in 2020 was followed by a remarkable rebound (April 2021 *World Economic Outlook*) thanks to policies that supported aggregate demand during the lockdowns (Chudik et al. 2021). This could have been another surprise coming through the slack term in (1). The policy response to the pandemic aimed to provide, to the extent possible, a cushion against the demand shock by supporting consumption through direct transfers to households or furlough measures to prevent massive job losses. Support was also extended to

Figure 3: Shock to Aggregate Demand and Aggregate Supply

Source: Authors' illustration.

shield firms from bankruptcy risk. The duration of the lockdowns, which were essential to control the spread of the COVID-19 virus, was almost impossible to predict at the onset of the pandemic. The rapid development and deployment of vaccines in early 2021 in most AEs certinainly helped to quicken the pace of re-opening. Pent-up demand for services, boosted by accumulated household savings during the lockdowns, led to household spending picking up with a vengeance. This would translate to a shift in the aggregate demand (AD) curve—as illustrated in Figure 3—with a shift from AD_0 to AD_1. Without an expansion in supply-side capacity, some inflation is inevitable.

Steepening of the aggregate supply curve. The impact of the pandemic on labor and goods markets is also akin to a temporary steeping of the aggregate supply (AS) curve due to increased labor market tightness and clogged supply chains. This is illustrated by the move from

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[3] As a measure of labor market tightness, vacancies-to-unemployment is also a gauge for wage pressures in the bargaining process in search and matching models (Mortensen and Pissarides 1999).

AS_0 to AS_1 in Figure 3.[4] In turn, a positive shift in demand from AD_0 to AD_1 would translate into a more pronounced effect on prices. In relation to the Phillips curve in (1), this is equivalent to an increase in φ, which would have persisted for as long as labor and goods markets were disrupted. Furman (2022) and Ubide (2022) discuss this possibility for the US but rule out that it could explain all of the increase in core inflation.[5]

Supply-side disruptions. In addition to supply disruptions caused by the direct impact of the lockdown on labor movement, and the indirect impact on labor force participation, there have been specific supply factors that may have also contributed to inflationary pressures through the error term in (1). For instance, there has been an increase in supplier delivery times, shortages of intermediate inputs, increased congestion in shipping ports and a surge in shipping costs (Celasun et al. 2022). There were also reports of a shortage in microchips, which caused a severe disruption in automotive production (Celasun et al. 2022, Ubide 2022). The impact on the automotive sector is instructive of the potential impact of disruption in one sector on aggregate inflation. Despite their small weight in consumer price indices, the notable increases in the prices of new and used cars seems to have had a disproportionately large impact on US core inflation (Furman 2022, Ubide 2022).

Temporary shift in demand from services to goods. As the leisure and hospitality sector mostly ceased functioning during the pandemic, and as demand for certain goods increased due to working from home, economies saw a temporary shift in demand from services to goods. With strained supply chains, this shift in demand induced higher inflation for goods, and temporarily reversed a trend seen over the past couple of decades of goods inflation that was lower than services inflation. This temporary shift is an inflation surprise coming through the error term in (3). Ball et al. (2022) conclude that this was a contributing factor to the rise in inflation in the US. Also, there is some evidence that the demand shift may have been more pronounced in the US relative to the euro area (Lane 2022).

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[4] It is also conceivable that some of the supply-side disruptions were permanent and not transitory, leading to a full leftward shift in the AS curve rather than steepening.

[5] Furman (2022) argues that even allowing for non-linearities in the Phillips curve (e.g. Forbes et al. 2021) could not fully explain the surge in core inflation in the US.

The sharp delineation between these forces and portraying them as impacting specific terms in (1)—whether slack in the economy, the slope of the Phillips curve, or unforeseen supply-side shocks—is not necessarily clearcut. For instance, and as argued by Furman (2022), the impact of the supply-side disturbances on inflation may not have been fully realized had it not been for the strong demand recovery due to policy support. Another quick look at Figure 3 gives a glimpse of the implications of the counterfactual scenario, where aggregate demand remains at AD_0 or perhaps shifting less aggressively than illustrated in the chart.

In issuing the WEO core and headline inflation forecasts for the period 2021Q1-2022Q3, forecasters may have indeed taken some of these factors into account. Since the focus of this paper is the inflation forecast errors, we are in essence studying the role of economic variables that explain the realized errors but may have not been sufficiently integrated into the outlook, possibly due to lack of data in real time.

3. Data

Our analysis is centered on headline and core inflation forecast errors based on forecasts published in the IMF WEO report. The report is published quarterly in January (*Update*), April, July (*Update*), and October every year. The updates in January and July are shorter reports on the outlook for the world economy compared to the April and October reports. The WEO database is published with the April and October reports. Depending on the exercise, we use either the one-quarter-ahead forecast of year-on-year (y-o-y) inflation at the quarterly frequency, or the one-year-ahead forecast for annual inflation.

The one-quarter-ahead forecasts are used in the statistical tests of forecast bias and oversmoothing. To maximize country coverage, we utilize headline inflation forecasts for the statistical tests. The one-year-ahead forecasts for annual inflation—in 2021 and 2022—are for core inflation and feature in the analysis of the underlying economic drivers. We take the one-year-ahead forecasts from the respective January WEO *Update* to reflect the latest information that is available to forecasters. The country coverage differs between the headline and core inflation forecasts. Specifically, 75 economies accounting for around 91 percent of the world's

purchasing-power-parity (PPP) GDP have one-quarter-ahead headline inflation forecasts. Annual core inflation forecasts are available only for 57 economies accounting for about 77 percent of the world's PPP GDP.

Data on output growth and the output gap is also obtained from the WEO database. For the growth forecast errors in 2021 and 2022, the annual forecast from the January WEO *Update* of the respective year is used. Data sources on the economic drivers that potentially explain the core inflation forecast errors is discussed in detail in Section 3.3. The country coverage for these variables is subject to variation and is documented for each empirical exercise.

3.1. Inflation and Growth Forecast Errors

Here we introduce some notation to ease exposition. For an outcome variable y, define the forecast error for country i at time t as $e_{i,t} = y_{i,t} - \hat{y}_{i,t|t-1}$, where $y_{i,t}$ denotes the actual realization of the variable and $\hat{y}_{i,t|t-1}$ its corresponding forecast using the information set available at time $t-1$. For headline inflation, t denotes quarters and the one-quarter-ahead forecast error for headline inflation is used in the statistical tests of forecast bias and oversmoothing in Section 4.1. For core inflation, t denotes years as the analysis of the underlying economic factors in Section 4.2 focuses on core inflation forecast errors in 2021. Similarly, growth forecasts errors, which are profiled against core inflation misses, are based on the one-year-ahead forecasts of GDP growth.

As of the time of writing, full-year data for 2022 is not yet available for most countries in our sample. So, for 2022 we use the term "forecast error" rather loosely to denote the forecast revision between the January 2022 WEO *Update* and the October 2022 WEO. This is the case for both core inflation and growth forecast errors, and they are only used for comparison when discussing the association between surprises in growth outturns and core inflation misses in Figure 10 (right panel).

In the stylized facts presented in Section 2, all world and regional averages are weighted averages using PPP GDP from the latest vintage. Since our objective is to explore the drivers of inflation in a global context as the world economy recovered from the initial pandemic shock, all

regressions weigh the observations by PPP GDP. Therefore, the findings are less influenced by outlier observations that carry small weight. By the same token, any emerging narrative from the analysis is largely dictated by outcomes in the world's largest economies.

3.2. Outliers

We used only one filter for outliers in the regressions: a country observation is excluded if the absolute forecast error for core inflation or output growth in 2021 exceeded 10 percentage points. It is our conjecture that this filter does not materially change the findings since our objective is to explore the drivers of inflation in a global context—hence the use of weighted regressions—and our sample indeed includes the world's largest AEs and EMDEs with slight variation across exercises because of data availability.

3.3. Potential Economic Drivers

Our choice of variables here is motivated by the discussion in Section 2.2 and the corresponding findings in the literature. In the *ex post* analysis of the forecast errors, and in addition to output growth surprises, we use three additional variables that gauge the demand component of supply chain pressures, the temporary shift in demand from services to goods, and labor market tightness. For the *ex ante* analysis, we utilize cross-country data on the size of the COVID-19 fiscal stimulus packages to test for its informational content with respect to the core inflation forecast errors in 2021. The construction of these variables and the data sources are discussed in the remainder of this subsection.

Demand-induced pressure on supply chain. Demand shocks to supply chains are identified in an auxiliary exercise using a structural vector autoregression (SVAR) that relies on sign-restrictions to identify demand and supply shocks. Specifically, the SVAR model, which is estimated at the country level, includes two subcomponents of the purchasing manager indices (PMI): new orders and suppliers' delivery times. The identification assumption is that demand shocks induce new orders and suppliers' delivery times to move in the same direction, whereas supply shocks move them in opposite directions. The PMI data is available for Australia,

Austria, Brazil, Canada, China, Colombia, Czech Republic, Denmark, France, Germany, Greece, India, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Malaysia, Mexico, Myanmar, Netherlands, New Zealand, Philippines, Poland, Russia, Spain, Switzerland, Taiwan Province of China, Thailand, Türkiye, United Kingdom, United States, and Vietnam.[6] The demand-induced pressure on supply chains is constructed as the ratio of the cumulative demand shock to the sum of cumulative demand and supply shocks over the period 2020Q1-2022Q2.

Demand shift from services to goods. While it is ideal to capture this shift using detailed data on household consumption, this would have significantly restricted the country sample due to data limitations. As an alternative, we use the ratio of CPI core goods inflation to services inflation in 2021 relative to the same ratio in 2020. The data is available for Australia, Brazil, Canada, Chile, Colombia, France, Germany, Indonesia, Italy, Japan, Korea, Malaysia, Mexico, Russia, South Africa, Spain, United Kingdom, and the United States.

Labor market tightness. We use the ratio of vacancies to unemployment in 2021 relative to the same ratio in 2020 as a measure for the change in labor market tightness. As search-on-the-job and related wage gains when switching jobs are important, this measure provides a better sense of the tightness of the labor market and has become focal in the recent discussions of labor market conditions in advanced economies; see, for instance, Ball et al. (2022) and Duval et al. (2022). Unemployment data come from Eurostat and the Organisation for Economic Co-operation and Development (OECD). Vacancy postings are from Eurostat, the Australian Bureau of Statistics, Japan's Ministry of Health, Labour, and Welfare, Statistics Canada, UK Office for National Statistics, and the US Bureau of Labor Statistics.

Fiscal stimulus. For the COVID-19 fiscal stimulus packages, we use above-the-line additional spending or forgone revenues (in percent of GDP) obtained from the IMF Fiscal Monitor Database of Country Fiscal Measures in Response to the COVID-19 Pandemic. This measure excludes public sector loans, guarantees, and below-the-line measures. We use the January 2021 vintage which was compiled as of December 31, 2020. To check for robustness

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[6] We thank Chris Jackson at the IMF Research Department for supplying the demand-supply shock decomposition results.

against the use of an alternative measure of the fiscal stimulus, we also use the cyclically adjusted primary deficit for 2021, projected at the end of 2020, from the WEO database.

4. Empirical Results

The empirical analysis comprises statistical tests of forecast bias and oversmoothing, as well as exploratory analysis of the role of economic drivers that potentially explain the forecast errors. For the statistical tests, we exploit higher-frequency data by examining the properties of the one-quarter-ahead inflation forecast errors for headline inflation forecasts as it provides broader country coverage.

In the analysis of the underlying economic drivers, we shift focus to annual core inflation forecast errors for 2021. The focus on core inflation is natural given the paper's focus on the factors contributing to misjudging the aggregate demand-supply imbalances at the time, which justifies abstracting from other factors that may have impacted headline inflation that year.[7] This, however, somewhat limits the country coverage. The restricted sample, for which core inflation forecasts are issued, makes up roughly 77 percent of the world's PPP GDP, which still retains inferential power to study the factors underlying the forecast errors.

4.1. Statistical Tests: Bias and Oversmoothing

4.1.1. Forecast Bias

Using the one-quarter-ahead forecast errors for headline inflation, we test for forecast bias using the following regression:

$$e_{i,t} = \alpha + \varepsilon_{i,t} \tag{2}$$

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[7] It is worth noting that commodity prices, particularly oil and food prices, showed rapid increases from 2021Q1, increasing at double-digit y-o-y rates. Some pass-through to core inflation, especially from higher energy prices, may have occurred in 2021. IMF (2022) and McGregor and Toscani (2022) find supporting evidence for the role of commodity price increases in euro area inflation over the period 2021Q1-2022Q2.

where the intercept α is the coefficient of interest. A positive and statistically significant estimate for α indicates downward bias in the forecast.[8]

Figure 4 shows estimates of α using the entire panel over four different sample periods. For the full sample period (2011Q1-2022Q3), and the pre-COVID sample (2011Q1-2019Q4), forecasts are marginally biased. During the downturn in 2020 due to the initial pandemic shock, the average forecast error was negative as inflation was lower than predicted. For the most recent quarters, the intercept estimate switched sign and reveals a sizable and significant downward forecast bias of about 1.8 pp.

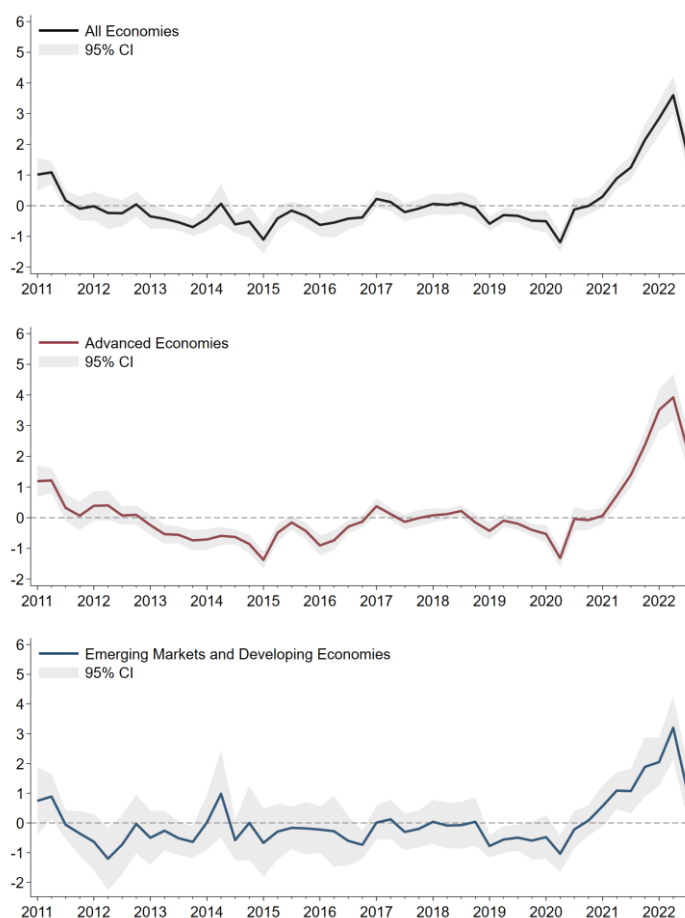**Figure 4: Headline Inflation Forecast Bias Test Results**
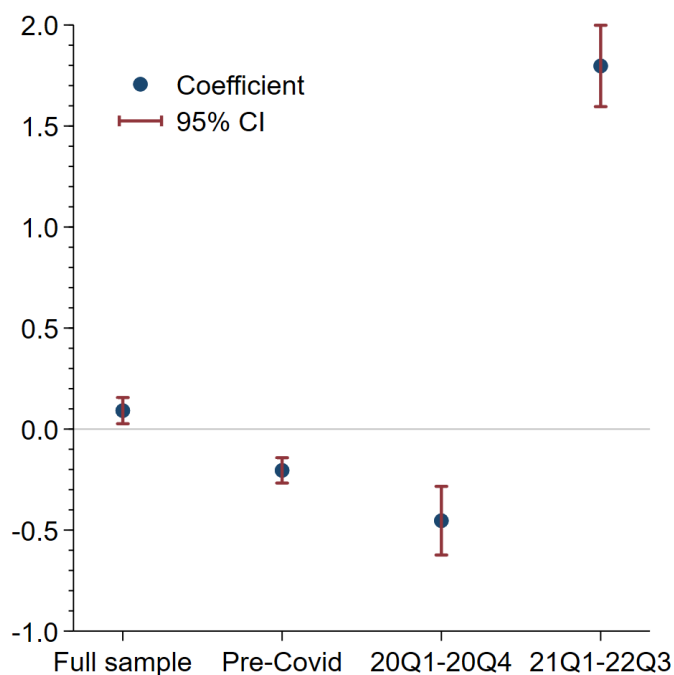
Source: IMF WEO database; authors' calculations.
Note: The dots show the point estimate of α in (2) using the one-quarter-ahead headline inflation forecast for the full panel over different sample periods, along with 95 percent confidence intervals. The sample period is 2011Q1-2022Q3. The sample includes advanced economies (AUS, AUT, BEL, CAN, CHE, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, NOR, NZL, PRT, SGP, SVK, SVN, SWE, TWN, USA) and emerging markets and developing economies (ARG, BLR, BRA, CHL, CHN, COL, ECU, HRV, HUN, IDN, IND, JOR, KAZ, KGZ, LCA, LSO, MDA, MEX, MYS, NGA, PER, PHL, POL, ROU, RUS, SAU, SRB, SWZ, THA, TUR, UGA, UKR, VEN, VNM, ZAF).

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[8] This is a restricted version of the widely used Mincer-Zarnowitz regression (Mincer and Zarnowitz 1969). In its original formulation, the test is specified as $y_{i,t} = \alpha + \beta \hat{y}_{i,t|t-1} + \varepsilon_{i,t}$. We impose the restriction $\beta = 1$, and focus on the estimate of α to obtain a summary estimate of the average bias. Timmermann (2006) utilizes a similar approach.

Figure 5 captures the variation in the bias over time using repeated cross-section regressions for each quarter in the full sample period. It reveals a worsening in the magnitude of the bias particularly over the period 2021Q2 to 2022Q1. This occurred despite repeated revisions to the forecasts (see Figure 1), an indication of persistence in the inflation misses. In 2022Q2, the bias started moderating as the forecasts were adjusted in anticipation of an acceleration in the rate of inflation, partly reflecting the impact of the war in Ukraine on global commodity prices. We also look at AE and EMDE subsamples in the middle and bottom panels. Despite a larger band for the estimation error in EMDEs, the pattern appears roughly similar for the two groups with the intercept estimate hovering around zero for the earlier part of the sample,

Figure 5: Headline Inflation Forecast Bias Evolution

Source: IMF WEO database; authors' calculations.
Note: The solid lines are coefficient estimates of α in (2) from a repeated cross-section regression for each quarter in the sample period 2011Q1-2022Q3 using the one-quarter-ahead headline inflation forecast, along with 95 percent confidence intervals. The top panel includes all countries, while the middle and bottom panels includes advanced economies (AUS, AUT, BEL, CAN, CHE, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, NOR, NZL, PRT, SGP, SVK, SVN, SWE, TWN, USA) and emerging markets and developing economies (ARG, BLR, BRA, CHL, CHN, COL, ECU, HRV, HUN, IDN, IND, JOR, KAZ, LCA, MDA, MEX, MYS, NGA, PER, PHL, POL, ROU, RUS, SRB, SWZ, THA, TUR, UGA, UKR, VNM, ZAF).

followed by some upward forecast bias in 2020 and then switching to significant downward forecast bias from 2021Q2, followed by moderation from 2022Q2.

4.1.2. Forecast Oversmoothing

A question that follows naturally from the analysis of forecast bias, especially given evidence of the persistence in the bias over a few quarters, is whether the forecast was overly rigid or subject to oversmoothing. We answer this question by estimating the following regression:

$$\underbrace{y_{i,t} - \hat{y}_{i,t|t-1}}_{forecast\ error} = \alpha + \beta \underbrace{(\hat{y}_{i,t|t-1} - \hat{y}_{i,t|t-2})}_{forecast\ revision} + \varepsilon_{i,t} \qquad (3)$$

This is a time series regression for each country in the sample over the period 2011Q1-2022Q3, which tracks the relationship between the forecast errors and the forecast revisions from one quarter to the next in the spirit of Nordhaus (1987). Suppose you predict inflation two

Figure 6: Evidence of Forecast Oversmoothing
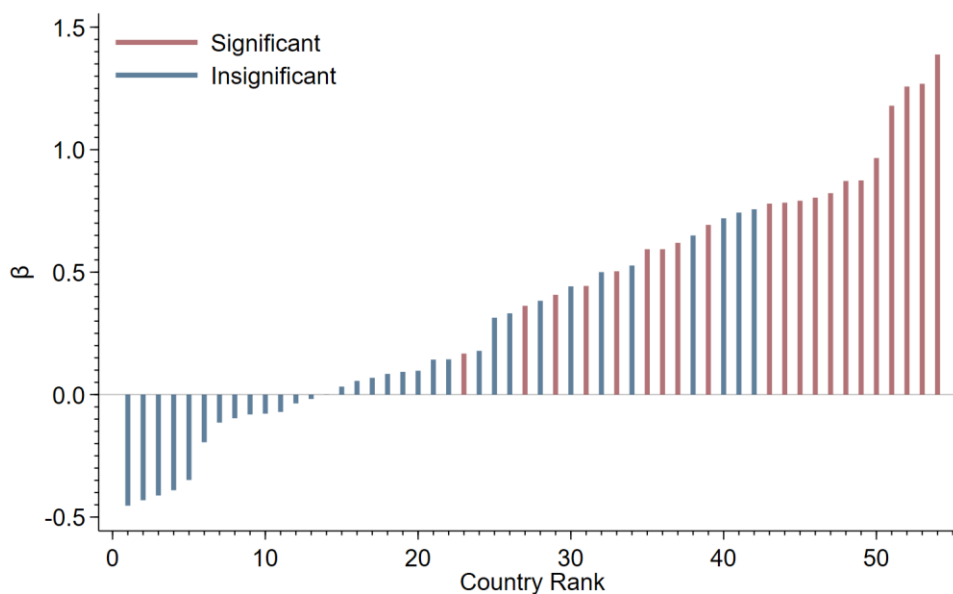
Source: IMF WEO database; authors' calculations.
Notes: The bars show coefficient estimates for β in (3) using the one-quarter-ahead headline inflation forecast over the sample period 2011Q1-2022Q3. The red bars denote statistically significant coefficients at the 5 percent significance level, and the countries are ranked in ascending order by the magnitude of the estimated β. The sample includes advanced economies (AUS, AUT, BEL, CAN, CHE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, NOR, NZL, PRT, SGP, SVK, SVN, SWE, TWN, USA) and emerging markets and developing economies (BLR, BRA, CHL, CHN, COL, HRV, HUN, IDN, IND, MDA, MEX, MYS, PER, PHL, RUS, SRB, THA, TUR, VEN, VNM).

quarters ahead in the April 2022 WEO. Imagine you change the same forecast in the July 2022 WEO *Update* due to incoming information. The forecast revision between April and July should be uncorrelated with the ultimate forecast error when inflation is realized. If the July revision reflected all information efficiently, the forecast error should be unforecastable, and β in (3) should equal zero. Coibion and Gorodnichenko (2015) rationalize this regression in a framework for testing for information rigidities.

Figure 7: Oversmoothing and Forecast Errors
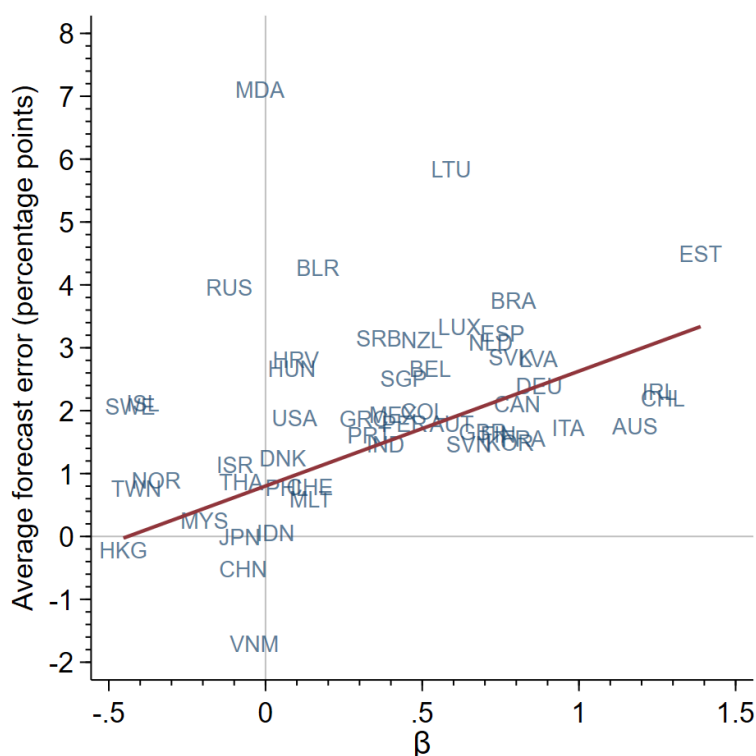
Source: IMF WEO database; authors' calculations.

Notes: The scatter plots the coefficient estimates for β in (3)—also in Figure 6—against the headline inflation average forecast error over 2021Q1-2022Q3. The regression line is $y = 0.80 + 1.83x$, with a statistically significant slope at the 1 percent significance level. The sample includes advanced economies (AUS, AUT, BEL, CAN, CHE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, NOR, NZL, PRT, SGP, SVK, SVN, SWE, TWN, USA) and emerging markets and developing economies (BLR, BRA, CHL, CHN, COL, HRV, HUN, IDN, IND, MDA, MEX, MYS, PER, PHL, RUS, SRB, THA, VNM).

Figure 6 ranks all economies by the magnitude of the estimated β, with statistically significant coefficients shown in red bars. It shows that 21 out of 54 coefficients are positive and statistically significant, providing evidence of forecast oversmoothing in many cases. This finding stands in line with the previous evidence on the persistence of forecast bias over the recent sample period, suggesting some country forecasts were not adjusted rapidly enough to the changing inflation environment. Figure 7 plots the estimated β coefficients against the average forecast error over 2021Q1-2022Q3. Interestingly, but perhaps unsurprisingly, we find that countries where the oversmoothing

coefficient was larger also saw larger forecast errors with most observations located in the top right quadrant.

4.2. Economic Factors

In this subsection, we discuss some of the factors identified in the literature as likely culprits behind the recent inflation surge. We start with the *ex post* analysis, where we consider what we know today and what we can learn with the benefit of hindsight. This is followed by an *ex ante* forecast evaluation exercise incorporating what we knew at the time of issuing the forecast, and may have not been sufficiently integrated into the outlook for 2021.

4.2.1. Ex Post Analysis

Here we consider four specific factors. The first is the strength of output recovery in 2021 beyond what was incorporated into the forecast at the time. In other words, we analyze the role of output growth surprises in explaining the inflation surprises. Second, we consider supply chain disruptions, particularly the contribution of demand shocks to supply chain pressures. Third, we assess the shift in demand from services to goods, and whether the large inflation differential between these two subgroups in the CPI explains the forecast errors. Fourth, we consider the role of labor market tightness and its variation across countries.

Stronger-than-anticipated output recovery. As the pandemic shock hit the global economy, policymakers were quick to provide support to avoid deep scarring from the crisis. Still, some scarring was expected and output gap projections for 2021 foresaw a large contraction in economic activity compared to potential. Only in retrospect did it become clear that the output slump, relative to potential, was not as dire. How did our view of the output gap evolve? Figure 8 reveals that the output gap for 2021 was misjudged in real time for both the US and the euro area, to give two prominent examples. This can be seen by comparing the grey line—estimate at the beginning of 2021—to the redline—estimate available by the October 2021 vintage. This was the case for most world economies which are now known to have had smaller

output gaps than projected in early 2021, an indication that the rapid recovery in demand exceeded expectations. Figure 9 shows the output gap revisions from the January 2021 WEO *Update* to the October 2021 WEO for the economies in our sample. The revisions have been to the upside for around 80 percent of the world economy. They were sizable in some cases, particularly in EMDEs denoted by blue bars. Also, all but one of the AEs—denoted by red bars—saw upward revisions.

Figure 8: Output Gap Real-Time Uncertainty
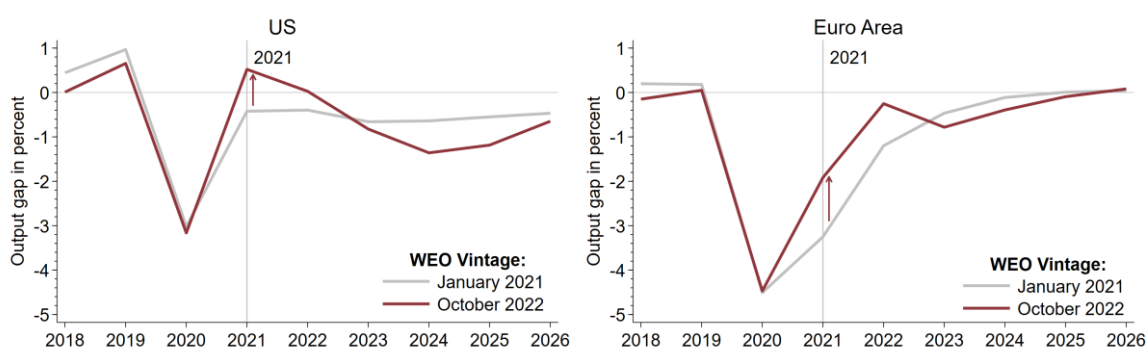
Source: IMF WEO database; authors' calculations.

Notes: Estimates of the output gap for the USA and euro area from the January 2021 WEO *Update* and the October 2022 WEO *Update* along with 5-year projections.

Figure 9: Output gap revisions for 2021 across economies
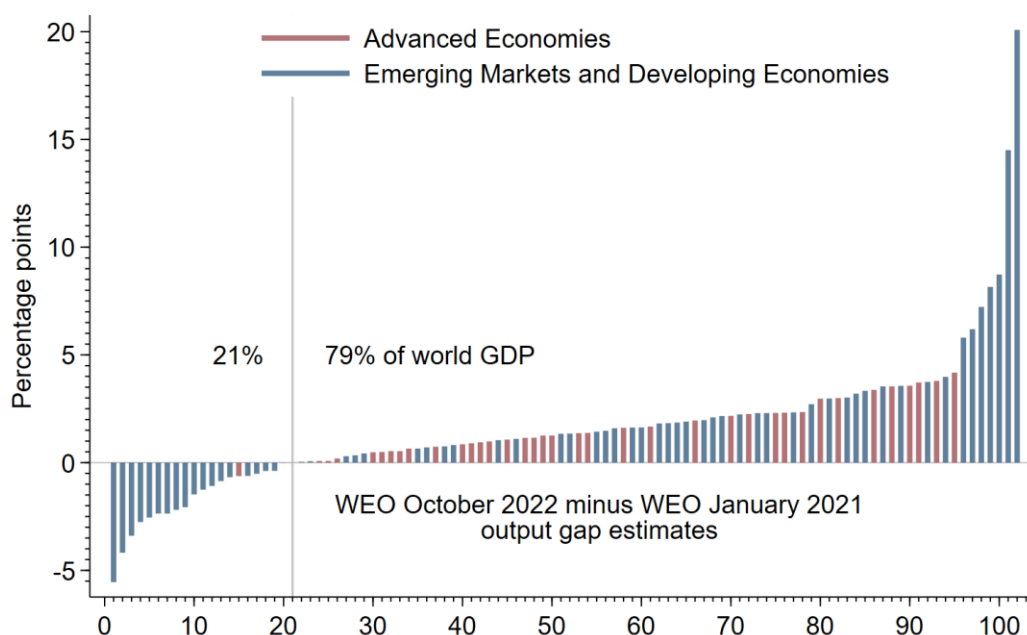
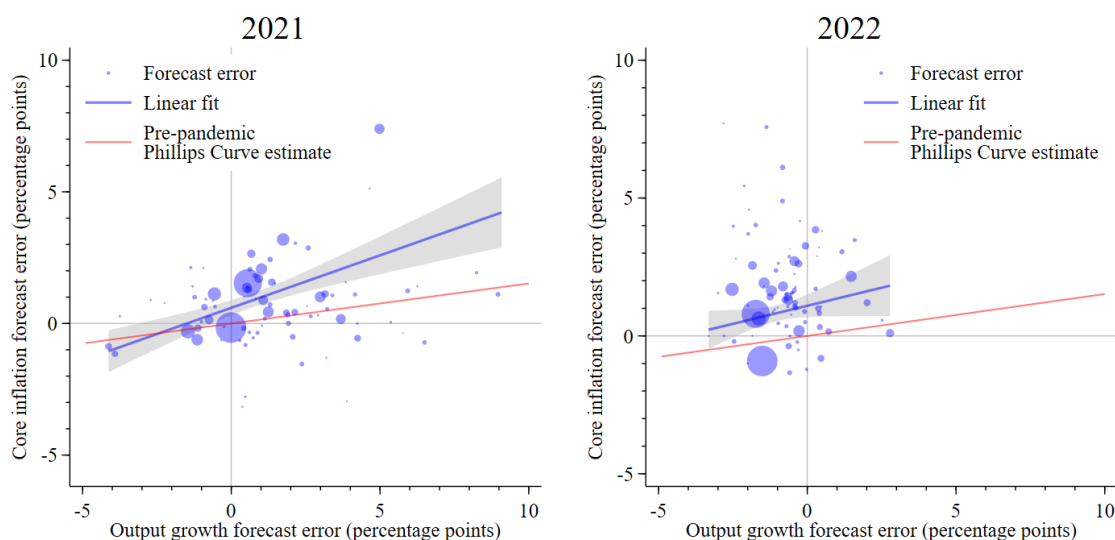**Source:** IMF WEO database; authors' calculations.

Notes: Revisions (in percentage points of GDP) in the estimates of the output gap for different economies from the January 2021 WEO *Update* to the October 2021 WEO, ranked in ascending order. The red and blue bars are for AEs and EMDEs, respectively. The sample includes advanced economies (AUS, AUT, BEL, CAN, CHE, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MAC, MLT, NLD, NOR, NZL, PRI, PRT, SGP, SVK, SVN, SWE, TWN, USA) and emerging markets and developing economies (ABW, ARG, ATG, BGR, BHS, BIH, BLZ, BRA, BRB, CHL, CHN, COL, CRI, DMA, DOM, DZA, ECU, EGY, GEO, GRD, GTM, GUY, HND, HRV, HTI, HUN, IDN, IND, IRN, JAM, KAZ, KEN, KNA, KWT, LCA, MAR, MDA, MEX, MOZ, MUS, MYS, NAM, NIC, OMN, PAK, PAN, PER, PHL, POL, ROU, RUS, SDN, SLV, SUR, SWZ, TGO, THA, TUN, TUR, UKR, URY, VCT, VNM, ZAF).

We find evidence that countries for which the economic recovery from the initial pandemic shock was faster than expected also saw inflation being higher than predicted. Figure 10 (left panel) shows the positive correlation between the growth forecast errors and the core inflation forecast errors with most observations located in the top-right quadrant. The fitted blue line has a slope of 0.4. This can be thought of as a proxy for the slope of the Philips Curve as it captures the impact of stronger-than-anticipated output realizations on inflation outcomes. The superimposed red line shows the slope of the pre-pandemic Phillips curve based on WEO

estimates for the period 2000-2019, which has a slope of 0.15.[9] The larger slope of the blue fitted line suggests some economies may have been on the steeper part of their respective aggregate supply curves, in which case positive output surprises would be associated with higher-than-anticipated inflation; see also Figure 3 and the corresponding discussion.

Figure 10: Output Growth Forecast Errors

Source: IMF WEO database; authors' calculations.

Note: The scatter plots show the one-year-ahead forecast errors for core inflation and GDP growth from the January 2021 (left panel) and January 2022 (right panel) WEO *Update*. The bubble size scales with the PPP GDP for each economy using the respective vintage. The blue fitted line is a weighted regression line using PPP GDP as weights. For 2021, the regression line is $y = 0.59 + 0.40x$, with a statistically significant slope at the 1 percent significance level. For 2022, the regression line is $y = 1.09 + 0.26x$, with a statistically significant slope at the 10 percent significance level. The superimposed red line is included for contrast and represents an estimate of the pre-pandemic Philips curve. The sample includes advanced economies (AUS, AUT, BEL, CAN, CHE, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, NOR, NZL, PRT, SGP, SVK, SVN, SWE, USA) and emerging markets and developing economies (AGO, ARM, BRA, CHL, CHN, CIV, CRI, DJI, DMA, DOM, DZA, ECU, EGY, GMB, GRD, HRV, HUN, IDN, IRQ, JOR, KAZ, KEN, KGZ, KHM, LAO, LCA, LSO, MAR, MDG, MEX, MKD, MLI, MNE, MYS, NGA, PAK, PHL, POL, PRY, QAT, ROU, RWA, SAU, SEN, SLV, SSD, SWZ, THA, TJK, TUN, TUR, UGA, VNM, ZAF).

For comparison, Figure 10 (right panel) repeats the same exercise for 2022 where we see core inflation surprising again on the upside. Growth, however, surprised on the downside with most economies in the top-left quadrant of the chart. While the relationship remains positive

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[9] The pre-pandemic estimate is based on a hybrid Phillips curve specification estimated over the period 2000-2019; see Chapter 2 of the October 2021 WEO for further details. The translation from a Phillips curve estimate based on the unemployment gap to one based on the output gap uses a "gap version" of Okun's law, where a 1 pp increase in unemployment is associated with a 2 pp rise in the output gap.

when fitting a weighted regression line, it is less tight of a relationship. Also, the slope of the blue line is statistically indistinguishable from that of the pre-pandemic Phillips curve. The evidence hints at a potential role for the strong demand recovery in 2021, coupled with supply-side constraints, in explaining the core inflation forecast errors.

Demand-induced pressures on supply chains. Supply chain bottlenecks may occur due to either demand or supply shocks. During the initial COVID-19 lockdowns, a formidable combination of both forces was at play—demand for goods was increasing at a fast pace, while supply saw a temporary substantial retreat. From an auxiliary SVAR model using components of the PMI—new orders and suppliers' delivery times—we obtain estimates of the relative contribution of demand vs. supply shocks in exerting pressure on supply chains, the latter being gauged by the increase in suppliers' delivery times. We find that countries in which demand

Figure 11: Demand-Induced Supply Chain Pressures
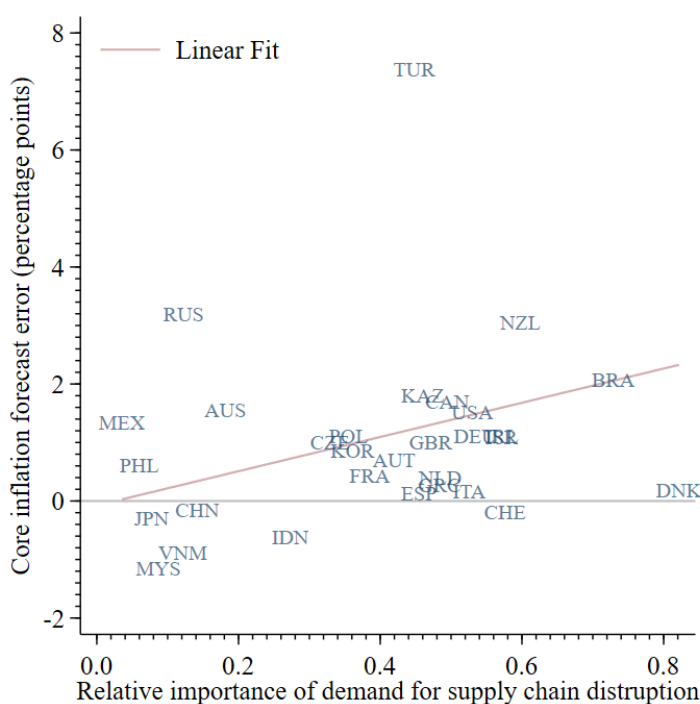
Source: IMF WEO database; Markit PMI; ISM; Haver Analytics; authors' calculations.

Notes: The forecast error is for the one-year-ahead forecast for core inflation from the January 2021 WEO *Update*. The relative importance of the demand component is extracted from a sign-restricted structural vector autoregression using the PMI components new orders and suppliers' delivery times. See Section 3.3 for details on its construction. The fitted line is $y = -0.08 + 2.93x$ with a statistically significant slope at the 5 percent significance level. The sample includes advanced economies (AUS, AUT, CAN, CHE, CZE, DEU, DNK, ESP, FRA, GBR, GRC, IRL, ISR, ITA, JPN, KOR, NLD, NZL, USA) and emerging markets and developing economies (BRA, CHN, IDN, KAZ, MEX, MYS, PHL, POL, RUS, TUR, VNM).

played a more prominent role relative to supply in straining supply chains saw larger forecast errors on average as shown in Figure 11, with the regression being statistically significant.

Temporary demand shift. The demand-supply imbalances may have also been amplified by the temporary shift in demand from services to goods in 2021, particularly during the lockdowns when the leisure and hospitality sectors ceased functioning. This temporarily reversed a trend seen over the last couple of decades where goods inflation was lower than services inflation. Figure 12 shows that economies where this reversal seemed sharp, with goods inflation more elevated relative to services inflation, also saw larger forecast errors. The fitted line has a statistically significant slope at the 5 percent significance level. Our findings here are in line with those of di Giovanni et al. (2020).

Figure 12: Temporary Demand Shift
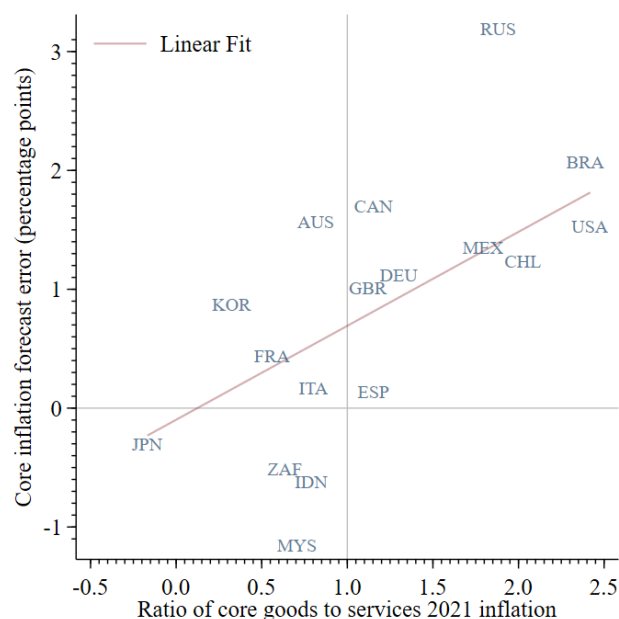
Source: IMF WEO database; consumer price index subcomponents from national sources via Haver Analytics; authors' calculations.
Notes: The forecast error is for the one-year-ahead forecast for core inflation from the January 2021 WEO *Update*. The fitted line is $y = -0.10 + 0.79x$ with a statistically significant slope at the 1 percent significance level. The sample includes advanced economies (AUS, CAN, DEU, ESP, FRA, GBR, ITA, JPN, KOR, USA) and emerging markets and developing economies (BRA, CHL, IDN, MEX, MYS, RUS, ZAF).

Labor market tightness. Figure 13 shows the relationship between core inflation forecast errors and labor market tightness, which we measure by the ratio of vacancies to unemployment in 2021 relative to 2020. Labor markets were particularly tight in Australia, Canada, the UK and the US among the group of AEs (Duval et al. 2022). The correlation is positive and statistically significant. This also accords with the findings of Ball et al. (2022) that labor market tightness partly explains the recent inflation surge in the US.

Taken together, these four factors help rationalize the core inflation forecast errors with the benefit of hindsight and based on the information we know today. The underlying forces point to misjudging the balance, or rather imbalance, between aggregate demand and supply, as well as changed dynamics in goods and labor markets. These were indeed difficult to parse
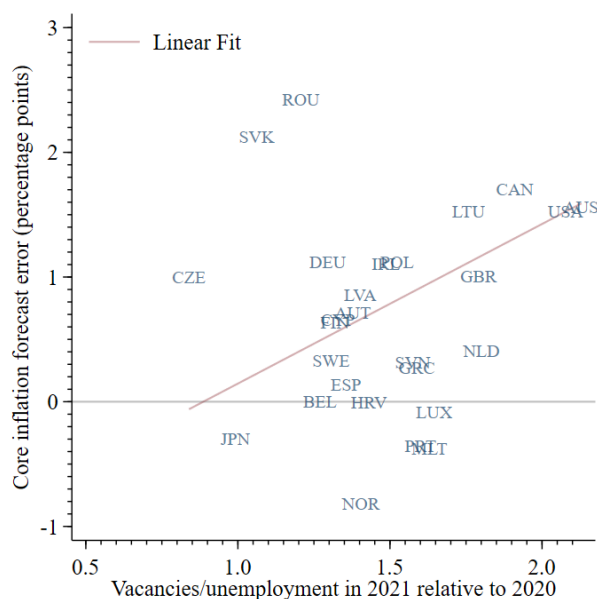
around the time of the January 2021 WEO *Update*, which means the 2021 forecast was surrounded by a thick cloud of uncertainty. This leads us to the assessment of the information set forecasters had at the time to see if it included useful information with predictive content that could have improved forecast accuracy.

Figure 13: Labor Market Tightness

Source: IMF WEO database; OECD; Eurostat; national authorities; authors' calculations.

Notes: The forecast error is for the one-year-ahead forecast for core inflation from the January 2021 WEO *Update*. Labor market tightness is gauged by the ratio of vacancies to unemployment in 2021 relative to 2020. The fitted line is $y = -1.13 + 1.28x$ with a statistically significant slope at the 1 percent significance level. The sample includes advanced economies (AUS, AUT, BEL, CAN, CYP, CZE, DEU, ESP, FIN, GBR, GRC, IRL, JPN, LTU, LUX, LVA, MLT, NLD, NOR, PRT, SVK, SVN, SWE, USA) and emerging markets and developing economies (HRV, POL, ROU).

4.2.2. Ex Ante Analysis: The Role of the COVID-19 Fiscal Stimulus Packages

In this subsection, we explore the role of the COVID-19 fiscal stimulus packages as a potential explanatory variable for the inflation forecast errors. As discussed earlier, this has been the focus of several recent studies focusing on both advanced and emerging market economies (di Giovanni et al. 2022, de Soyres et al. 2022, Jordà and Nechio 2022, Jordà et al. 2022, and Hale et al. 2023). Importantly, the size of the announced fiscal stimulus packages was part of the forecasters' information set at the time of issuing the forecast.

The large fiscal interventions at the onset of the pandemic were necessary to prevent deep scarring, however, they may have also boosted aggregate demand at a time when the supply side was largely constrained. Thus, output gains during the recovery from the initial pandemic shock

may have been associated with higher-than-anticipated inflation. Figure 14 plots the fiscal stimulus packages against the core inflation forecast errors. From the magnitude of the fiscal interventions, especially in the advanced economies, the stimulus packages were indeed quite large reaching 15 percent of GDP in some cases and can be considered comparable to major wartime spending (Hall and Sargent 2022).

In the spirit of an augmented Mincer-Zarnowitz regression (Mincer and Zarnowitz 1969), we consider the following specification:

Figure 14: Announced COVID-19 Fiscal Stimulus Packages
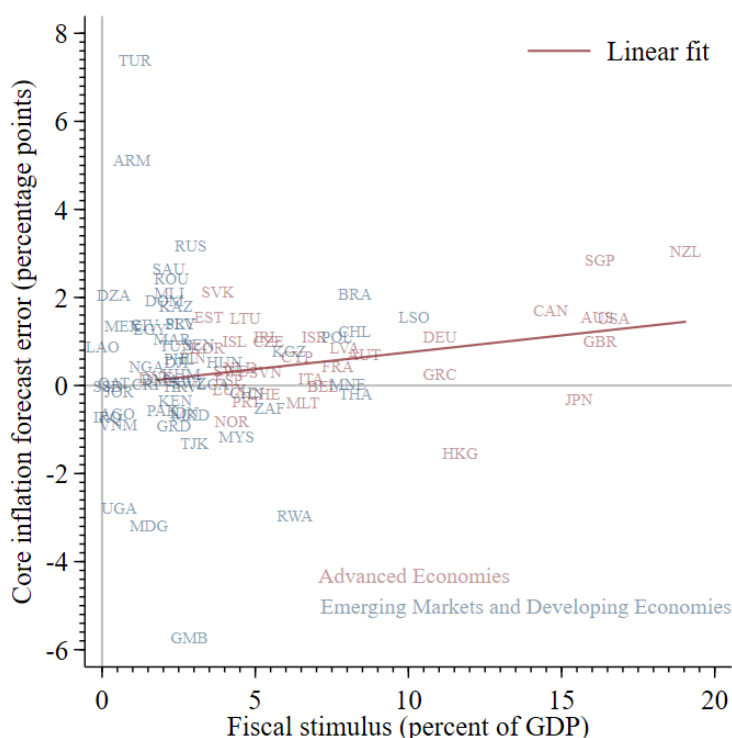
Sources: IMF WEO database; IMF Fiscal Monitor Database of Country Fiscal Measures in Response to the COVID-19 Pandemic; author's calculations.
Notes: The forecast error is for the one-year-ahead forecast for core inflation from the January 2021 WEO *Update*. The fiscal stimulus measure refers to the announced above-the-line additional spending or forgone revenues and excludes public sector loans, guarantees, and below-the-line measures. AEs appear in red and EMDEs in blue. The fitted line is from a weighted simple regression for illustration; equation (4) is the specification used to test for forecast efficiency and the results are reported in Table 1. The sample includes advanced economies (AUS, AUT, BEL, CAN, CHE, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, NOR, NZL, PRT, SGP, SVK, SVN, SWE, USA) and emerging markets and developing economies (AGO, ARM, BRA, CHL, CHN, CIV, CRI, DJI, DMA, DOM, DZA, EGY, GMB, GRD, HRV, HUN, IDN, IRQ, JOR, KAZ, KEN, KGZ, KHM, LAO, LCA, LSO, MAR, MDG, MEX, MKD, MLI, MNE, MYS, NGA, PAK, PHL, POL, PRY, QAT, ROU, RUS, RWA, SAU, SEN, SLV, SSD, SWZ, THA, TJK, TUN, TUR, UGA, VNM, ZAF).

$$e_{i,2021} = \alpha + \beta f_{i,2021} + \gamma\big(f_{i,2021} \text{ x } y_{i,2021}\big) + \delta_1 e_{i,2020} + \delta_2 e_{i,2019} + \varepsilon_{i,t} \qquad (4)$$

where $e_{i,2021}$ is country i's core inflation forecast error for the year 2021 given the forecast made using the information set as of the end of 2020, $f_{i,2021}$ and $y_{i,2021}$ respectively denote the fiscal stimulus for 2021 and the predicted output gap for 2021—both known at the end of 2020—and $e_{i,2020}$ and $e_{i,2019}$ are the core inflation forecast errors from the previous two years.[10] The inclusion of the interaction term $f_{i,2021}$ x $y_{i,2021}$ allows for the impact of the fiscal stimulus $f_{i,2021}$ to vary with the size of the projected output gap, a state-contingency in fiscal multipliers commonly found in the literature (Jordà and Taylor 2016).

Table 1: Forecast Efficiency Test Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	AE	*EMDE*	*ALL*	*AE**	*AE*	*EMDE*	*ALL*	*AE**
$f_{i,2021}$	0.070***	-0.078	0.045	0.024	0.086**	0.103	-0.008	-0.114*
	(0.022)	(0.240)	(0.032)	(0.032)	(0.034)	(0.200)	(0.057)	(0.064)
$f_{i,2021}$ x $y_{i,2021}$	0.017**	0.037	0.032**	0.030**	0.046***	0.296**	0.106***	0.021
	(0.007)	(0.051)	(0.013)	(0.012)	(0.015)	(0.108)	(0.026)	(0.022)
$e_{i,2020}$	-0.200	0.845*	0.672**	-0.038	-0.133	-0.225	0.298	0.055
	(0.235)	(0.472)	(0.261)	(0.209)	(0.241)	(0.657)	(0.321)	(0.163)
$e_{i,2019}$	-0.093	-0.046	-0.066	-0.311	0.013	-0.957	-0.205	0.061
	(0.317)	(0.754)	(0.424)	(0.289)	(0.326)	(0.933)	(0.484)	(0.241)
Observations	34	28	62	30	33	22	55	29
R^2	0.42	0.23	0.18	0.24	0.39	0.58	0.36	0.44

Source: IMF WEO database; authors' calculations.
Note: The table presents regression results for the estimation of equation (4) with standard errors reported in parentheses. Columns (1)-(4) use above-the-line additional spending or forgone revenues (in percent of GDP), obtained from the IMF Fiscal Monitor Database of Country Fiscal Measures in Response to the COVID-19 Pandemic, as the measure of fiscal stimulus. Columns (4)-(8) use the cyclically adjusted primary deficit for 2021, projected at the end of 2020, from the WEO database. The sample includes advanced economies (AUS, AUT, BEL, CAN, CHE, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, NOR, NZL, PRT, SGP, SVK, SVN, SWE, USA) and emerging markets and developing economies (AGO, ARM, BRA, CHL, CHN, CIV, CRI, DJI, DMA, DOM, DZA, EGY, GMB, GRD, HRV, HUN, IDN, IRQ, JOR, KAZ, KEN, KGZ, KHM, LAO, LCA, LSO, MAR, MDG, MEX, MKD, MLI, MNE, MYS, NGA, PAK, PHL, POL, PRY, QAT, ROU, RUS, RWA, SAU, SEN, SLV, SSD, SWZ, THA, TJK, TUN, TUR, UGA, VNM, ZAF). *AE** = advanced economies excluding Australia, Canada, the UK and the US.

The augmented Mincer-Zarnowitz regression is a test of forecast efficiency. If the forecast efficiently incorporates all available information, none of the right-hand-side variables, which are known to the forecasters at the time of issuing the forecast, should be significant in the regression. Our object of interest is the estimate of β. When considering all economies in the

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[10] We do not include additional lags of the forecast errors since this reduces the sample's cross-section significantly.

sample, the estimate of β is statistically insignificant implying no significant relationship between the size of the fiscal stimulus and the core inflation forecast errors (Table 1, column 3). However, for the subsample of AEs, the estimate of β is statistically significant and suggests that a 10 percentage points (of GDP) increase in the fiscal stimulus is associated with a 0.7 pp core inflation forecast error. Furthermore, the estimate of γ is also statistically significant and positive suggesting that the fiscal stimulus is associated with a larger forecast error in those AEs in which output was projected to be not far off from potential (Table 1, column 1).[11]

This finding hints at forecast inefficiency and suggests that the demand boost due to the COVID-19 fiscal impulse, coupled with strained supply, may have pushed inflation up in AEs in ways that could have been anticipated. This result, however, should be interpreted with caution. First, the significance of the estimate of β in (4) hinges on four economies in the sample: Australia, Canada, the UK, and the US. Excluding them renders the regression insignificant (Table 1, column 4). Recall that these economies experienced elevated labor market tightness relative to other AEs; see Section 4.2.1 and Duval et al. 2022. Using the cyclically adjusted primary deficit as an alternative measure of the fiscal stimulus even yields a negative estimate for β, with marginal significance, when these four economies are excluded from the sample. Therefore, we view our finding for the COVID-19 fiscal stimulus as largely driven by these four economies, which are influential economies by virtue of their sheer size and influence on global demand.

Second, if taken at face value as evidence of forecast inefficiency, this result still begs the following question: Is the predictive content of the fiscal stimulus for the core inflation forecast errors due to the forecasters having misjudged the impact of the fiscal stimulus on the demand recovery, or their inability to foresee the severity of supply constraints? To answer this question, Figure 15 shows the scatter between the fiscal stimulus and the growth forecast errors. For AEs, the slope of the red fitted line is statistically insignificant, which provides evidence against the first possibility. This favors the interpretation that forecast errors are more attributable to misjudging the severity of supply constraints, including in labor markets, rather than

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[11] For the sample of EMDEs, both β and γ are statistically insignificant (Table 1, column 2). These results are robust to the use of an alternative measure of the fiscal stimulus, which is the 2021 cyclically adjusted primary deficit projected at the end of 2020 (Table 1, columns 5-7).

underestimating the impact of fiscal policy on the rebound in economic activity. This also accords with the evidence presented in Figure 10 (left panel), which suggests that aggregate supply constraints may have been a key factor in explaining the large inflation outcomes in 2021.

5. Conclusion

Our empirical findings reveal that inflation forecasts over the period 2021Q1-2022Q3 were subject to significant downward forecast bias; however, the bias moderated towards the end of the sample period. We also found evidence of forecast rigidity or oversmoothing, the magnitude of which correlates positively with the forecast errors. The economic underpinnings for the forecast misses relate to misjudging the balance, or rather imbalance, between aggregate demand and supply. Ex post, the core inflation forecast errors for 2021 are potentially explained by four factors: a stronger-than-anticipated output recover; demand-induced pressure on supply chains; a temporary shift in demand from services to goods; and historically tight labor market. Ex ante, the COVID-19 fiscal stimulus appears as a significant predictor of the subsequent errors for advanced economies; however, this

Figure 15: Fiscal Stimulus and Growth Forecast Errors
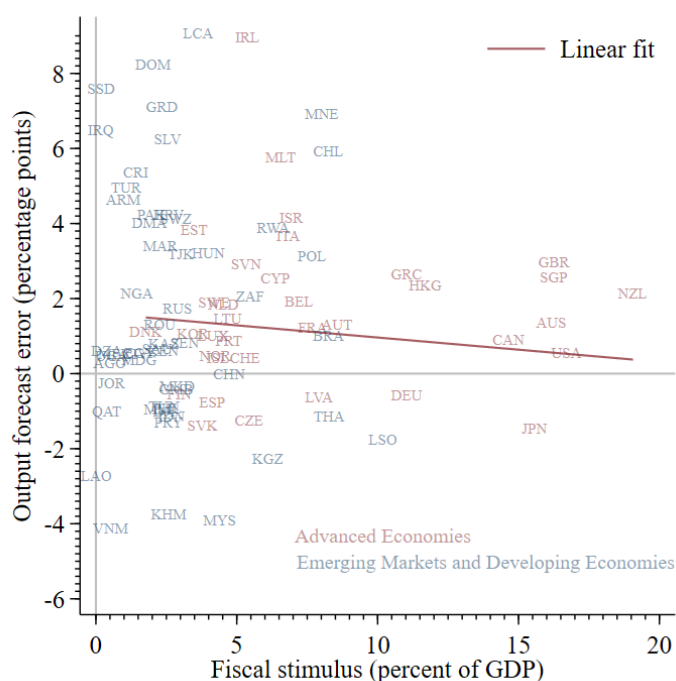
Sources: IMF WEO database; IMF Fiscal Monitor Database of Country Fiscal Measures in Response to the COVID-19 Pandemic; author's calculations.

Notes: The forecast error is for the one-year-ahead forecast for core inflation from the January 2021 WEO *Update*. The fiscal stimulus measure refers to the announced above-the-line additional spending or forgone revenues and excludes public sector loans, guarantees, and below-the-line measures. AEs appear in red and EMDEs in blue. The fitted line is $y = 1.61 - 0.06x$ with a statistically insignificant slope coefficient at the 10 percent significance level. The sample includes 35 AEs (AUS, AUT, BEL, CAN, CHE, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, MLT, NLD, NOR, NZL, PRT, SGP, SVK, SVN, SWE, USA) and 54 EMDEs (AGO, ARM, BRA, CHL, CHN, CIV, CRI, DJI, DMA, DOM, DZA, EGY, GMB, GRD, HRV, HUN, IDN, IRQ, JOR, KAZ, KEN, KGZ, KHM, LAO, LCA, LSO, MAR, MDG, MEX, MKD, MLI, MNE, MYS, NGA, PAK, PHL, POL, PRY, QAT, ROU, RUS, RWA, SAU, SEN, SLV, SSD, SWZ, THA, TJK, TUN, TUR, UGA, VNM, ZAF).

results hinges on the outcomes of four economies (Australia, Canada, the UK and the US) which were also seeing particularly tight labor markets.

The ex ante forecast evaluation result hinting at the role of the COVID-19 fiscal stimulus as a potential driver of the recent inflation surge is in line with some of the findings in the recent literature. However, this result is difficult to advance as a general finding for AEs as it is driven by a few economies, albeit large ones. In this respect, our finding indeed resonates with some views in the literature and among policymakers that the fiscal stimulus may have overstimulated aggregate demand in the US but not in the euro area. The evidence also suggests that it was misjudging the severity of supply constraints rather than underestimating the impact of the fiscal stimulus on demand that contributed to the inflation misses.

In reflecting on the policy choices when the pandemic hit the global economy in 2020, one could argue that too little a dose of fiscal stimulus would have risked prolonged scarring due to a deep recession. But doing too much also risked overstimulating demand and sparking inflation. In balancing the risks, policymakers in the largest advanced economies threw their weight behind a large fiscal stimulus to avoid scarring.

The evidence in our sample indicates that the usefulness of the fiscal stimulus in predicting the inflation forecast errors depend on the outcome for a few economies. However, they are far from being insignificant outlier economies that are merely distorting the relationship. So, the large fiscal stimulus announced in 2020 should have tilted the balance of risks on inflation to the upside. Going forward, the inflation outlook should better integrate the impact of fiscal policy, particularly in an environment where supply constraints amplify the impact of excess demand on inflation. Policymakers could have been advised to reduce speed somewhat back in 2020 given the danger of a potential surge in inflation. This remains, however, a partial assessment. Only by comparing it to the counterfactual scenario of deep scarring can we really gauge the adequacy of the policy choices made back then.

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