EXECUTIVE BOARD MEETING

EBS/21/82

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September 15, 2021

To: Members of the Executive Board

From: The Secretary

Subject: **October 2021 World Economic Outlook—Executive Summary, Chapter 1, and Online Annex**

Board Action:	Executive Directors' **consideration** (Formal)
Tentative Board Date:	**Tuesday, September 28, 2021**
Publication:	Yes, it is intended that the full set of the World Economic Outlook documents will be released to the public at the time of World Economic Outlook press conference, tentatively scheduled for **Tuesday, October 12, 2021.**
Questions:	Ms. Koeva Brooks, RES (ext. 39809) Mr. Nabar, RES (ext. 39024)
Additional Information:	Please note that, as usual, the WEO forecast remains under review. Final projections will be featured in the WEMD presentation to the Board. The paper will be revised for publication in light of the Executive Board discussion. If Executive Directors have additional comments, they should notify Ms. Koeva Brooks and Mr. Nabar by **5:30 p.m. on Friday, September 24, 2021**.

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CHAPTER 1

EXECUTIVE SUMMARY

The global economic recovery is continuing even as the pandemic resurges. The fault lines opened up by COVID-19 are looking more persistent—near-term divergences are expected to leave lasting imprints on medium-term performance. Vaccine access and early policy support are the principal drivers of the gaps. Rapid spread of Delta and the threat of new variants have increased uncertainty about how quickly the pandemic can be overcome. Policy choices have become more difficult, confronting multidimensional challenges—subdued employment growth, rising inflation, food insecurity, the setback to human capital accumulation, and climate change—with limited room to maneuver.

The forecast: The global economy is projected to grow 5.9 percent in 2021 and 4.9 percent in 2022 (0.1 percentage point lower for 2021 than in the July 2021 *World Economic Outlook Update*). The downward revision for 2021 reflects a downgrade for advanced economies—in part due to supply disruptions—and for low-income developing countries, largely due to worsening pandemic dynamics. This is partially offset by stronger near-term prospects among commodity-exporting emerging market and developing economies. Employment is generally expected to continue lagging the recovery in output.

Beyond 2022, global growth is projected to moderate to around 3.3 percent over the medium term. Advanced economy output is now forecast to exceed pre-pandemic medium-term projections—largely reflecting sizable anticipated further policy support in the United States that includes measures to increase potential. By contrast, persistent output losses are anticipated for the emerging market and developing economy group due to slower vaccine rollouts and generally less policy support compared to advanced economies.

Headline inflation rates have increased rapidly in the United States and in some emerging market and developing economies. In most cases, rising inflation reflects pandemic-related supply-demand mismatches and higher commodity prices compared to their low base from a year ago. As discussed in Chapters 1 and 2, for the most part price pressures are expected to subside in 2022. In some emerging market and developing economies, price pressures are expected to persist because of elevated food prices, lagged effects of higher oil prices, and exchange rate depreciation lifting the prices of imported goods. However, great uncertainty surrounds inflation prospects—primarily stemming from the path of the pandemic, the duration of supply disruptions, and how inflation expectations may evolve in this environment.

Overall, the balance of risks for growth is tilted to the downside. The major source of concern is that more aggressive SARS-CoV-2 variants could emerge before widespread vaccination is reached.

Inflation risks are skewed to the upside and could materialize if pandemic-induced supply-demand mismatches continue longer than expected (including if the damage to supply potential turns out worse than anticipated) leading to more sustained price pressures and rising inflation expectations that prompt a faster-than-anticipated monetary normalization in advanced economies (see also the October 2021 *Global Financial Stability Report*).

Multilateral efforts to speed up global vaccine access, provide liquidity and debt relief to constrained economies, and mitigate and adapt to climate change remain essential. Speeding up the vaccination of the world

population remains the top policy priority, while continuing the push for widespread testing and investing in therapeutics. This would save millions of lives, help prevent the emergence of new variants, and hasten the global economic recovery. As discussed in Chapter 1, an IMF proposal lays out concrete, cost-effective steps to vaccinate 40 percent of the population in each country by end-2021 and 60 percent by mid-2022. It is also crucial to ensure that financially constrained countries can continue essential spending while meeting other obligations. The IMF's recent General Allocation of Special Drawing Rights equivalent to $650 billion provided much needed international liquidity. Moreover, doubling down efforts to curb greenhouse gas emissions is critical—current actions and pledges are not enough to prevent a dangerous overheating of the planet. The international community should also resolve trade tensions and reverse the trade restrictions implemented in 2018–19, strengthen the rules-based multilateral trading system, and complete an agreement on a global minimum for corporate taxes that halts a race to the bottom and helps bolster finances to fund critical public investments.

At the national level, the policy mix should continue to be tailored to local pandemic and economic conditions, aiming for maximum sustainable employment while protecting the credibility of policy frameworks.

- *Fiscal policy:* The imperatives will depend on the stage of the pandemic (also see the October 2021 *Fiscal Monitor*). Health-related spending remains the priority. As the pandemic persists and fiscal space is limited in some countries, lifelines and transfers will need to become increasingly targeted to the worst affected and provide retraining and support for reallocation. Where health metrics permit, emphasis should shift toward measures to secure the recovery and invest in longer-term structural goals. Initiatives should be embedded in medium-term frameworks with credible revenue and expenditure measures ensuring debt sustainability.
- *Monetary policy*: Although central banks can generally look through transitory inflation pressures and avoid tightening until there is more clarity on underlying price dynamics, they should be prepared to act quickly if the recovery strengthens faster than expected or risks of rising inflation expectations become tangible. In settings where inflation is rising amid still-subdued employment rates and risks of expectations de-anchoring are becoming concrete, monetary policy may need to be tightened to get ahead of price pressures, even if that delays the employment recovery. The alternative of waiting for stronger employment outcomes runs the risk that inflation increases in a self-fulfilling way, undermining the credibility of the policy framework and creating more uncertainty. A spiral of doubt could hold back private investment and lead to precisely the slower employment recovery central banks seek to avoid when holding off on policy tightening. By contrast, monetary policy can remain accommodative where inflation pressures are contained, inflation expectations are still below the central bank target, and labor market slack remains. The unprecedented conjuncture makes transparent and clear communication about the outlook for monetary policy even more critical.
- *Preparing for the post-pandemic economy:* Finally, it is important to deal with the challenges of the post-pandemic economy: reversing the pandemic-induced setback to human capital accumulation, facilitating new growth opportunities related to green technology and digitalization, reducing inequality, and ensuring sustainable public finances. Chapter 3 explores one dimension of this policy agenda—the importance of basic research investment for spurring productivity growth.

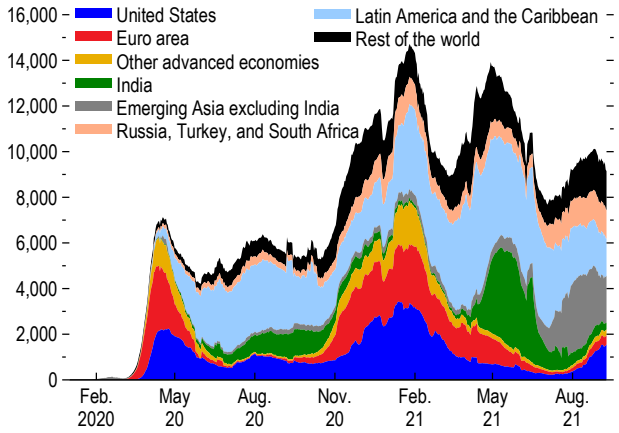
CHAPTER 1

GLOBAL PROSPECTS AND POLICIES

The global economic recovery continues amid a resurging pandemic that poses unique policy challenges (Figure 1.1). Vaccinations have proven effective at mitigating the adverse health impacts of COVID-19. However, unequal access to vaccines, vaccine hesitancy, and higher infectiousness have left many people still susceptible, providing fuel to the pandemic. The marked spread of the Delta variant and the threat of new variants that could undermine vaccine effectiveness make the future path of the pandemic highly uncertain. This has implications for the resilience of a recovery already in uncharted territory—characterized by pandemic-induced supply-demand mismatches which could worsen with a more protracted health crisis.

Figure 1.1. New Confirmed COVID-19 Deaths
(Persons, seven-day moving average)

The pandemic began resurging over the summer.



Sources: Our World in Data; and IMF staff calculations.
Note: Data as of September 9, 2021. Economy group and regional classifications are those in the *World Economic Outlook*. Other advanced economies in terms of International Organization for Standardization (ISO) country codes are AUS, CAN, CHE, CZE, DNK, GBR, HKG, ISL, ISR, JPN, KOR, MAC, NOR, NZL, SGP, SMR, SWE, and TWN.

Gaps in expected recoveries across economy groups have widened since the July forecast, for instance between advanced economies and low-income developing countries. As recoveries proceed, the risks of derailments and persistent scarring in heavily impacted economies remain so long as the pandemic continues.

Meanwhile, inflation has increased markedly in the United States and some emerging market economies. As restrictions are relaxed, demand has accelerated, but supply has been slower to respond. Commodity prices have also risen significantly from their low levels of last year. Although price pressures are expected to subside in most countries in 2022, inflation prospects are highly uncertain. These increases in inflation are occurring even as employment is below pre-pandemic levels in many economies, forcing difficult choices on policymakers—particularly in some emerging market and developing economies.

The chapter first discusses the global outlook and risks, before turning to policies needed to address these challenges.

Near-Term Recovery Continues While the Pandemic Resurges

GDP growth in the first half of 2021 was broadly in line with expectations. Outturns for first quarter global GDP were stronger than anticipated, reflecting continued adaptation of economic activity to the pandemic and associated restrictions, as well as ongoing policy support in many countries. Momentum, however, weakened in the second quarter, weighed down by increasing infections in many emerging market and developing economies and by supply disruptions. Expenditure decompositions are consistent with input shortages contributing to weak investment in the second quarter (Figure 1.2). Recent high frequency data are mixed. They suggest that the

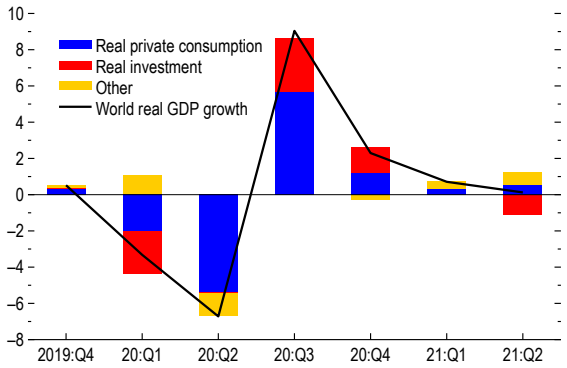
recovery continues, but with some softening in the third quarter, even while broadening across sectors. Services production is expanding, albeit prone to setbacks (Figure 1.3).

The global growth outlook is revised down for 2021 and is unchanged for 2022. The global economy is projected to grow 5.9 percent in 2021 and 4.9 percent in 2022. The 2021 forecast is revised down 0.1 percentage point relative to the July WEO, reflecting forecast downgrades to the advanced economy and low-income developing countries groups, as discussed below.

Vaccine access remains the principal driver of fault lines in the global recovery, reinforced by the resurgence of the pandemic. Many advanced economies have seen remarkable progress in vaccinations since the April WEO. By contrast, most emerging market and developing economies have had a much slower rollout, hampered by lack of supply and export restrictions.

Figure 1.2. Drivers of Global Growth
(Quarter-over-quarter growth contributions, percentage points)

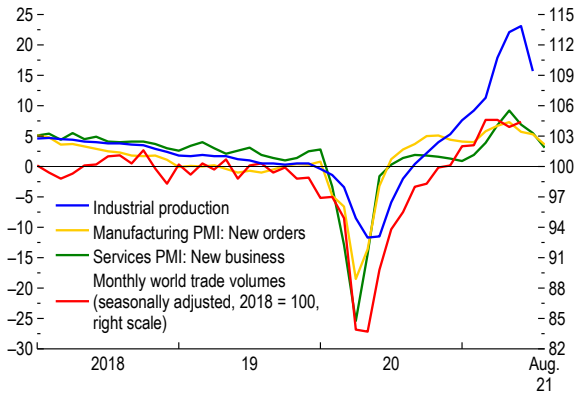
Private consumption and investment have been the engines of growth in the recovery so far.



Sources: Haver Analytics; and IMF staff calculations.
Note: The estimate of world real GDP at the quarterly frequency is based on a sample of economies covering 79.4 percent of global economic activity in 2020. "Other"includes the sum of contributions from public consumption and a residual component, which mixes contributions from the sample's net exports to economies not covered and a statistical discrepancy.

Figure 1.3. Global Activity Indicators
(Three-month moving average, annualized percent change for industrial production, deviations from 50 for PMIs)

Higher-frequency indicators point to a continuing strong rebound of economic activity.



Sources: CPB Netherlands Bureau for Economic Policy Analysis; Haver Analytics; Markit Economics; and IMF staff calculations.
Note: PMI above 50 indicates expansion while below 50 indicates contraction. PMI = purchasing managers' index.

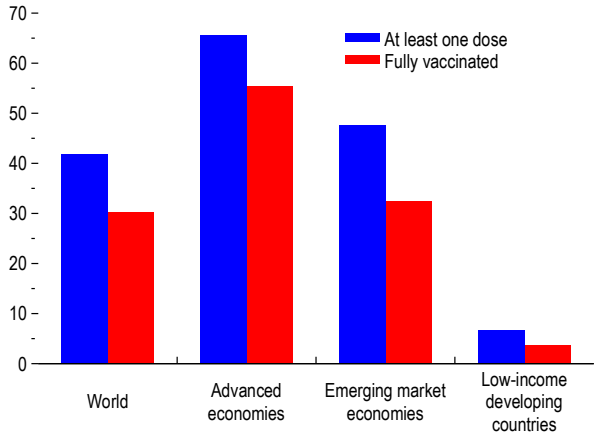
- Advanced economies have achieved broad availability of vaccines, with hesitancy (rather than inadequate supply) the main constraint on further gains. Around 55 percent of the population in advanced economies has been fully vaccinated (Figure 1.4). By contrast, the rest of the world has starkly lower shares of population that are fully vaccinated against COVID-19, at around 32 percent in emerging market economies and less than 4 percent in low-income developing countries. In these economies, vaccine supply and distribution remain the primary constraints.
- The forecast assumes that some emerging market economies will join advanced economies in gaining broad vaccine access in 2021. Most countries are assumed to acquire broad access by end-2022 and some only in 2023. However, it seems likely that vaccinations alone will not be able to completely stamp out SARS-CoV-2 transmission, even though they remain effective against the most adverse health effects of the pandemic (severe illness and death). As a result, hospitalizations and deaths are expected to be brought to low levels everywhere by the end of 2022, through a combination of improved access to vaccines and therapies combined with more highly targeted and effective precautions. Some countries may be able to reduce adverse public health outcomes sooner than others depending on country-specific circumstances. The projections are

tempered by the possibility of renewed outbreaks, particularly before vaccines become widely available.

- So long as the enormous differences in vaccine access persists, the inequalities in health and economic outcomes will increase, driving further divergences across two blocs of countries: those that can look forward to further normalization later this year (almost all advanced economies); and those that will struggle with the adverse health and economic impacts from resurgent infections. The pressure for booster shots in countries with already high rates of vaccination could further delay access in others still at early stages of getting first jabs into arms. The continuing wide circulation of the virus, particularly within countries and populations where vaccination rates are low, poses threats to health and economic recoveries everywhere. The World Health Organization is warning that more transmissible and deadly variants—which could escape protection from existing vaccines—are likely to evolve so long as a substantial share of the world population remains unprotected.

Figure 1.4. The Great Vaccination Divide
(Percent of population)

Progress in vaccinations against COVID-19 remains highly unequal across the world.

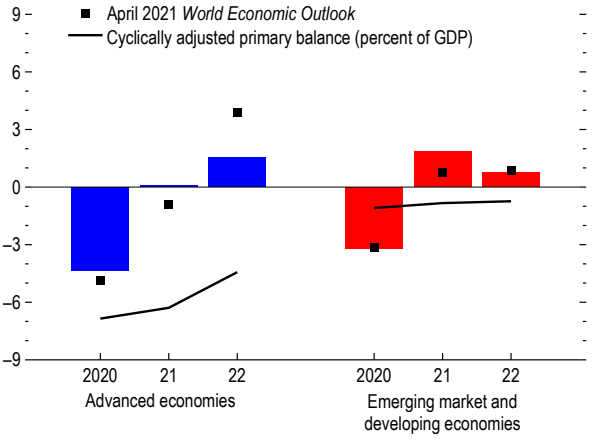


Sources: Our World in Data; and IMF staff calculations.
Note: Data as of September 9, 2021. "Fully vaccinated" are people who received all the doses prescribed for a full vaccination cycle (typically two, but one for Johnson&Johnson and CanSino). In a few cases, the recorded one-dose numbers are smaller than "fully vaccinated" numbers because of reporting lags. For these cases, we make a minimal consistency adjustment, setting one-dose numbers equal to "fully vaccinated" numbers.

Differences in policy support across countries also underlay gaps in recovery speeds. Sizable fiscal support continues in advanced economies, while many emerging market economies are reducing policy support this year as policy space shrinks with the duration of the pandemic (Figure 1.5). Major advanced economy central banks are assumed to leave policy rates unchanged through late 2022, though in some cases asset purchases are expected to be scaled back before then—a process already underway, for example, in Australia and Canada. Meanwhile, some emerging market central banks—including in Brazil, Chile, Mexico, and Russia—shifted to a less accommodative stance over 2021, with tightening expected in more countries over the coming quarters.

Figure 1.5. Fiscal Stance, 2020–22
(Change in structural primary fiscal balance, percent of potential GDP)

Fiscal tightening is already underway in emerging market and developing economies and will pick up in advanced economies as well in 2022.



Source: IMF staff estimates.

- Policy support has helped create the conditions for a hand-off to private demand in the recovery. Where deployed, extensive fiscal measures have provided insurance to households and firms, enabling many to replenish or build up their savings and creating the conditions for private demand to propel the recovery, particularly in 2022 when the advanced economy group is projected to shift its fiscal stance towards tightening. Indeed, household savings accumulated in excess of the pre-pandemic trend shows a positive relationship to the extent of fiscal support.

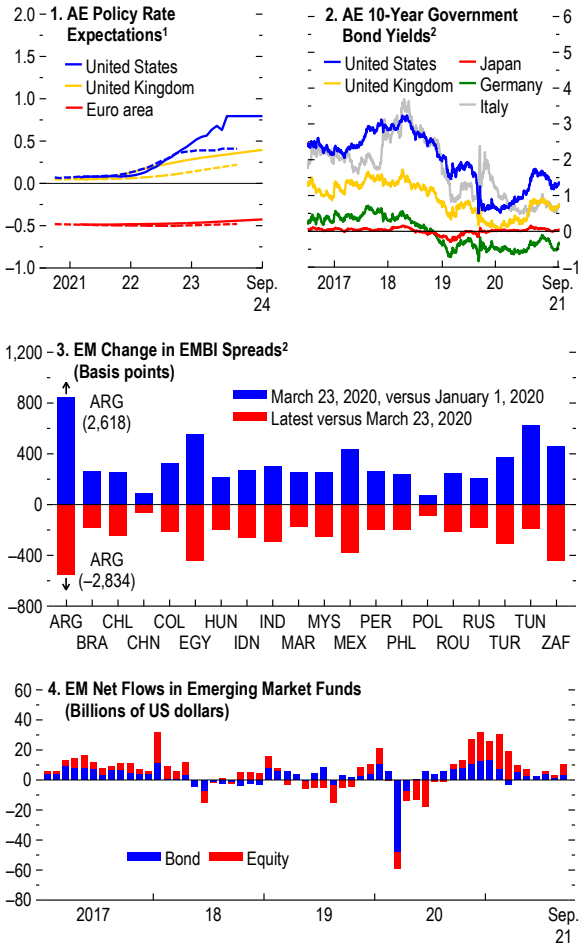
- Moreover, there are signs that historically low-saving countries have tended to accumulate greater savings in the wake of the COVID-19 crisis, putting their finances on firmer footing going forward. The forecast assumes a smooth handoff from extraordinary policy support to private activity-led growth, with some of the additional savings buildup retained in places where previous saving rates were low. Demand is assumed to pick up as vaccination coverage rises—given that vaccines seem to protect against severe illness. The speed with which this happens—and excess savings are drawn down—will influence the pace of the recovery and inflationary pressures (if supply is unable to adjust quickly enough).

The forecast is predicated on financial conditions remaining supportive. Financial market sentiment has largely stayed attuned to the policy outlook as the recovery has proceeded (see the October 2021 *Global Financial Stability Report* and Figure 1.6). However, the high uncertainty around the conjuncture has also led to a heightened sensitivity to any news, in particular about inflation prospects in advanced economies. The first quarter of 2021 and a brief period in June saw a bout of financial market volatility, with investors repositioning portfolio holdings as they reassessed the outlook for US inflation and monetary policy. Concerns about the spread of the Delta variant and associated implications for the recovery have also sparked episodes of volatility.

Even so, the overall picture is still one of broadly supportive financial conditions. Equity markets are buoyant, credit spreads remain tight, and net flows to emerging market

Figure 1.6. Monetary and Financial Conditions
(Percent, unless noted otherwise)

Financial conditions are supportive and attuned to the recovery.



Sources: Bloomberg Finance L.P.; EPFR Global; Refinitiv Datastream; and IMF staff calculations.
Note: Data labels use International Organization for Standardization (ISO) country codes. Dashed lines in panel 1 are from April 2021 WEO. AE = advanced economy; EMBI = J.P. Morgan Emerging Markets Bond Index; EM = emerging market economy; WEO = *World Economic Outlook*.
[1]Expectations are based on the federal funds rate futures for the United States, the sterling overnight interbank average rate for the United Kingdom, and the euro interbank offered forward rate for the euro area; updated September 10, 2021.
[2]Data are through September 9, 2021.

economies have hitherto been broadly stable (particularly into hard currency bond funds). The global growth forecast is predicated on this support continuing.

Growth revisions. Vaccine rollout, policy support, and continued supportive financial conditions constitute the key considerations for the forecasts summarized in Table 1.

- *Advanced economies*. Growth prospects for 2021 are revised down compared to the July forecast, largely reflecting downgrades to the United States (due to large inventory drawdowns in the second quarter, in part reflecting supply disruptions, and softening consumption in the third quarter); Germany (in part because of shortages of key inputs weighing on manufacturing output); and Japan (reflecting the effect of the fourth State of Emergency from July to September as infections hit a record level in the current wave). The US outlook incorporates the infrastructure bill recently passed by the Senate and anticipated legislation to strengthen the social safety net, equivalent to around $4 trillion in spending over the next ten years. The baseline also includes expected Next Generation European Union (EU) grants and loans for EU economies. Across advanced economies, an anticipated stronger rebound in the first half of next year as vaccination proceeds yields an upward revision to the growth forecast for 2022.
- *Emerging market and developing economies.* The forecast for the group is marked up slightly compared to the July 2021 Update, reflecting upgrades across most regions. China's prospects for 2021 are marked down slightly due to stronger-than-anticipated scaling back of public investment. Outside of China and India, emerging and developing Asia is downgraded slightly, as the pandemic has picked up. Growth forecasts in other regions have been revised up slightly for 2021. The revisions in part reflect improved assessments for some commodity exporters outweighing drags from pandemic developments (Latin America and the Caribbean, Middle East and Central Asia, Sub-Saharan Africa). Elsewhere, stronger-than-anticipated domestic demand in key regional economies further lifts the 2021 forecast (Emerging and Developing Europe).
- The growth forecast for the *low-income developing economy* group is marked down 0.6 percentage point relative to July, with the continuing slow rollout of vaccines as the main factor weighing on the recovery. IMF staff analysis indicates that low-income developing economies will require close to $200 billion in spending to combat the pandemic and $250 billion to regain the convergence paths they were on prior to the pandemic. Labor market prospects for low-skilled workers and youth continue to be relatively bleak compared to other demographic groups, pointing to increasing inequality and higher vulnerability to incomes falling below extreme poverty thresholds within countries in this group. Close to 80 million additional people are estimated to have entered extreme poverty during 2020–21 compared to pre-pandemic projections.

Table 1.1. Overview of the *World Economic Outlook* Projections

(Percent change, unless noted otherwise)

		Projections		Difference from July 2021 WEO Update 1/		Difference from April 2021 WEO 1/	
	2020	2021	2022	2021	2022	2021	2022
World Output	**–3.1**	**5.9**	**4.9**	**–0.1**	**0.0**	**–0.1**	**0.5**
Advanced Economies	**–4.5**	**5.2**	**4.5**	**–0.4**	**0.1**	**0.1**	**0.9**
United States	–3.4	6.0	5.2	–1.0	0.3	–0.4	1.7
Euro Area	–6.3	4.8	4.3	0.2	0.0	0.4	0.5
Germany	–4.6	3.2	4.5	–0.4	0.4	–0.4	1.1
France	–8.0	6.3	3.9	0.5	–0.3	0.5	–0.3
Italy	–8.9	5.8	4.2	0.9	0.0	1.6	0.6
Spain	–10.8	6.2	5.8	0.0	0.0	–0.2	1.1
Japan	–4.6	2.4	3.2	–0.4	0.2	–0.9	0.7
United Kingdom	–9.8	6.8	5.0	–0.2	0.2	1.5	–0.1
Canada	–5.3	5.7	4.9	–0.6	0.4	0.7	0.2
Other Advanced Economies 2/	–1.9	4.6	3.7	–0.3	0.1	0.2	0.3
Emerging Market and Developing Economies	**–2.1**	**6.4**	**5.2**	**0.1**	**0.0**	**–0.3**	**0.2**
Emerging and Developing Asia	–0.8	7.3	6.3	–0.2	–0.1	–1.3	0.3
China	2.3	8.0	5.6	–0.1	–0.1	–0.4	0.0
India 3/	–7.3	9.5	8.5	0.0	0.0	–3.0	1.6
ASEAN-5 4/	–3.4	3.1	6.0	–1.2	–0.3	–1.8	–0.1
Emerging and Developing Europe	–2.0	6.0	3.6	1.1	0.0	1.6	–0.3
Russia	–3.0	4.6	3.0	0.2	–0.1	0.8	–0.8
Latin America and the Caribbean	–7.0	6.3	3.1	0.5	–0.1	1.7	0.0
Brazil	–4.1	5.2	1.8	–0.1	–0.1	1.5	–0.8
Mexico	–8.3	6.2	4.0	–0.1	–0.2	1.2	1.0
Middle East and Central Asia	–2.8	4.1	4.1	0.1	0.4	0.4	0.3
Saudi Arabia	–4.1	2.8	4.8	0.4	0.0	–0.1	0.8
Sub-Saharan Africa	–1.7	3.7	3.8	0.3	–0.3	0.3	–0.2
Nigeria	–1.8	2.6	2.7	0.1	0.1	0.1	0.4
South Africa	–6.4	5.0	2.2	1.0	0.0	1.9	0.2
Memorandum							
World Growth Based on Market Exchange Rates	–3.5	5.7	4.7	–0.3	0.1	–0.1	0.6
European Union	–5.9	5.1	4.4	0.4	0.0	0.7	0.5
Middle East and North Africa	–3.2	4.1	4.1	0.0	0.4	0.1	0.4
Emerging Market and Middle-Income Economies	–2.3	6.7	5.1	0.2	–0.1	–0.2	0.1
Low-Income Developing Countries	0.1	3.3	5.6	–0.6	0.1	–1.0	0.4
World Trade Volume (goods and services)	**–8.2**	**9.9**	**6.8**	**0.2**	**–0.2**	**1.5**	**0.3**
Imports							
Advanced Economies	–9.0	9.1	7.3	–0.6	–0.3	0.0	0.9
Emerging Market and Developing Economies	–8.0	12.4	7.2	1.0	0.1	3.4	–0.2
Exports							
Advanced Economies	–9.4	7.9	6.7	–0.1	0.1	0.0	0.3
Emerging Market and Developing Economies	–5.2	11.9	5.8	1.1	–0.9	4.3	–0.2
Commodity Prices (US dollars)							
Oil 5/	–32.7	59.1	–1.8	2.5	0.8	17.4	4.5
Nonfuel (average based on world commodity import weights)	6.7	26.7	–0.9	0.2	–0.1	10.6	1.0
Consumer Prices							
Advanced Economies	0.7	2.7	2.3	0.3	0.2	1.1	0.6
Emerging Market and Developing Economies 6/	5.1	5.5	4.9	0.1	0.2	0.6	0.5
London Interbank Offered Rate (percent)							
On US Dollar Deposits (six month)	0.7	0.2	0.4	–0.1	0.0	–0.1	0.0
On Euro Deposits (three month)	–0.4	–0.5	–0.5	0.0	0.0	0.0	0.0
On Japanese Yen Deposits (six month)	0.0	–0.1	0.0	–0.1	0.0	0.0	0.0

Source: IMF staff estimates.

Note: Real effective exchange rates are assumed to remain constant at the levels prevailing during July 23–August 20, 2021. Economies are listed on the basis of economic size. The aggregated quarterly data are seasonally adjusted. WEO = World Economic Outlook.

1/ Difference based on rounded figures for the current, July 2021 WEO Update, and April 2021 WEO forecasts.

2/ Excludes the Group of Seven (Canada, France, Germany, Italy, Japan, United Kingdom, United States) and euro area countries.

3/ For India, data and forecasts are presented on a fiscal year basis, and GDP from 2011 onward is based on GDP at market prices with fiscal year 2011/12 as a base year.

4/ Indonesia, Malaysia, Philippines, Thailand, Vietnam.

5/ Simple average of prices of UK Brent, Dubai Fateh, and West Texas Intermediate crude oil. The average price of oil in US dollars a barrel was $41.29 in 2020; the assumed price, based on futures markets, is $65.68 in 2021 and $64.52 in 2022.

6/ The inflation rates for 2021 and 2022, respectively, are as follows: 2.1 percent and 1.5 percent for the euro area, –0.2 percent and 0.5 percent for Japan, and 4.3 percent and 3.5 percent for the United States.

7/ Excludes Venezuela. See country-specific note for Venezuela in the Country Notes section of the Statistical Appendix.

8/ For world output, the quarterly estimates and projections account for approximately 90 percent of annual world output at purchasing-power-parity weights. For Emerging Market and Developing Economies, the quarterly estimates and projections account for approximately 80 percent of annual emerging market and developing economies' output at purchasing-power-parity weights.

Table 1.1. Overview of the *World Economic Outlook* Projections (continued)

(Percent change, unless noted otherwise)

	Year over Year				Q4 over Q4 8/			
			Projections				Projections	
	2019	2020	2021	2022	2019	2020	2021	2022
World Output	**2.8**	**–3.1**	**5.9**	**4.9**	**2.7**	**–0.4**	**4.5**	**4.0**
Advanced Economies	**1.7**	**–4.5**	**5.2**	**4.5**	**1.6**	**–2.8**	**5.0**	**3.3**
United States	2.3	–3.4	6.0	5.2	2.6	–2.3	6.1	4.0
Euro Area	1.5	–6.3	4.8	4.3	1.1	–4.4	4.4	3.5
Germany	1.1	–4.6	3.2	4.5	0.9	–2.9	4.3	1.9
France	1.8	–8.0	6.3	3.9	0.9	–4.3	4.5	2.6
Italy	0.3	–8.9	5.8	4.2	–0.1	–6.5	5.6	2.9
Spain	2.0	–10.8	6.2	5.8	1.7	–8.9	6.9	3.7
Japan	0.0	–4.6	2.4	3.2	–1.3	–0.8	1.2	2.2
United Kingdom	1.4	–9.8	6.8	5.0	1.2	–7.3	7.2	2.2
Canada	1.9	–5.3	5.7	4.9	1.7	–3.1	4.9	4.0
Other Advanced Economies 2/	1.9	–1.9	4.6	3.7	2.1	–0.6	3.8	3.4
Emerging Market and Developing Economies	**3.7**	**–2.1**	**6.4**	**5.2**	**3.7**	**1.7**	**4.0**	**4.6**
Emerging and Developing Asia	5.4	–0.8	7.3	6.3	4.9	3.7	3.9	5.3
China	6.0	2.3	8.0	5.6	5.8	6.6	3.3	6.3
India 3/	4.0	–7.3	9.5	8.5	2.8	1.5	6.0	2.3
ASEAN-5 4/	4.9	–3.4	3.1	6.0	4.6	–2.7	3.7	5.8
Emerging and Developing Europe	2.5	–2.0	6.0	3.6	3.6	–0.1	4.5	3.9
Russia	2.0	–3.0	4.6	3.0	2.7	–1.9	4.0	2.7
Latin America and the Caribbean	0.1	–7.0	6.3	3.1	–0.4	–3.4	3.3	2.9
Brazil	1.4	–4.1	5.2	1.8	1.6	–1.2	2.1	1.9
Mexico	–0.2	–8.3	6.2	4.0	–0.9	–4.6	4.4	3.7
Middle East and Central Asia	1.5	–2.8	4.1	4.1	. . .	. . .	. . .	. . .
Saudi Arabia	0.3	–4.1	2.8	4.8	–0.3	–3.9	8.2	2.9
Sub-Saharan Africa	3.1	–1.7	3.7	3.8	. . .	. . .	. . .	. . .
Nigeria	2.2	–1.8	2.6	2.7	2.0	–0.5	2.4	1.9
South Africa	0.1	–6.4	5.0	2.2	–0.4	–3.4	1.5	3.2
Memorandum								
World Growth Based on Market Exchange Rates	2.5	–3.5	5.7	4.7	2.3	–1.0	4.6	3.9
European Union	1.9	–5.9	5.1	4.4	1.5	–4.2	5.3	2.8
Middle East and North Africa	1.0	–3.2	4.1	4.1	. . .	. . .	. . .	. . .
Emerging Market and Middle-Income Economies	3.5	–2.3	6.7	5.1	3.6	1.8	3.9	4.6
Low-Income Developing Countries	5.3	0.1	3.3	5.6	. . .	. . .	. . .	. . .
World Trade Volume (goods and services)	**0.9**	**–8.2**	**9.9**	**6.8**	**. . .**	**. . .**	**. . .**	**. . .**
Imports								
Advanced Economies	2.0	–9.0	9.1	7.3	. . .	. . .	. . .	. . .
Emerging Market and Developing Economies	–1.0	–8.0	12.4	7.2	. . .	. . .	. . .	. . .
Exports								
Advanced Economies	1.2	–9.4	7.9	6.7	. . .	. . .	. . .	. . .
Emerging Market and Developing Economies	0.4	–5.2	11.9	5.8	. . .	. . .	. . .	. . .
Commodity Prices (US dollars)								
Oil 5/	–10.2	–32.7	59.1	–1.8	–6.1	–27.6	54.1	–6.2
Nonfuel (average based on world commodity import weights)	0.8	6.7	26.7	–0.9	5.0	15.4	16.3	–1.7
Consumer Prices								
Advanced Economies 6/	1.4	0.7	2.7	2.3	1.4	0.4	3.6	1.8
Emerging Market and Developing Economies 7/	5.1	5.1	5.5	4.9	5.1	3.2	5.2	4.3
London Interbank Offered Rate (percent)								
On US Dollar Deposits (six month)	2.3	0.7	0.2	0.4	. . .	. . .	. . .	. . .
On Euro Deposits (three month)	–0.4	–0.4	–0.5	–0.5	. . .	. . .	. . .	. . .
On Japanese Yen Deposits (six month)	0.0	0.0	–0.1	0.0	. . .	. . .	. . .	. . .

Table 1.2. Overview of the *World Economic Outlook* Projections at Market Exchange Rate Weights

(Percent change)

		Projections		Difference from July 2021 WEO Update 1/		Difference from April 2021 WEO 1/	
	2020	2021	2022	2021	2022	2021	2022
World Output	**–3.5**	**5.7**	**4.7**	**–0.3**	**0.1**	**–0.1**	**0.6**
Advanced Economies	**–4.6**	**5.2**	**4.5**	**–0.5**	**0.2**	**0.0**	**0.9**
Emerging Market and Developing Economies	**–1.9**	**6.5**	**5.0**	**0.1**	**–0.1**	**–0.1**	**0.1**
Emerging and Developing Asia	0.1	7.4	6.1	–0.2	–0.1	–1.0	0.3
Emerging and Developing Europe	–2.2	5.8	3.7	0.9	0.0	1.5	–0.3
Latin America and the Caribbean	–7.1	6.3	3.0	0.6	–0.1	1.8	–0.1
Middle East and Central Asia	–4.2	3.9	3.9	0.1	0.4	0.3	0.3
Sub-Saharan Africa	–2.2	3.8	3.9	0.4	–0.1	0.4	0.1
Memorandum							
European Union	–6.0	5.0	4.3	0.4	0.0	0.7	0.5
Middle East and North Africa	–4.7	3.8	3.9	0.0	0.4	0.0	0.4
Emerging Market and Middle-Income Economies	–2.0	6.7	5.0	0.1	–0.1	–0.1	0.1
Low-Income Developing Countries	–0.1	3.3	5.4	–0.6	0.0	–1.0	0.3

Source: IMF staff estimates.

Note: The aggregate growth rates are calculated as a weighted average, in which a moving average of nominal GDP in US dollars for the preceding three years is used as the weight.. WEO = World Economic Outlook.

1/ Difference based on rounded figures for the current, July 2021 WEO Update, and April 2021 WEO forecasts.

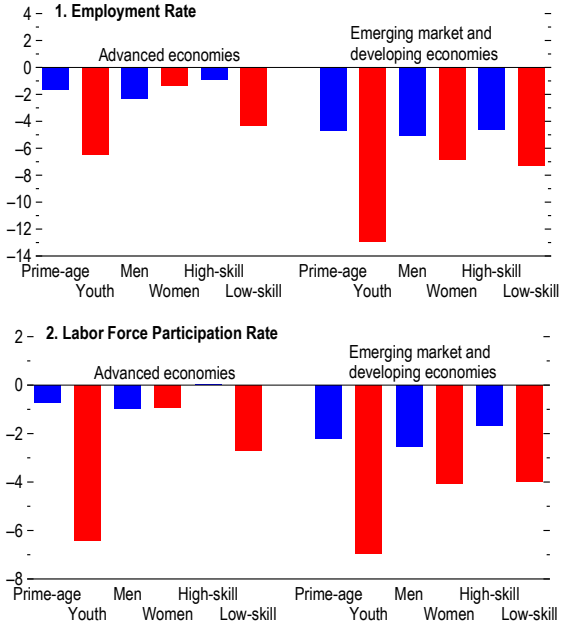
Employment Growth Projected to Lag Output Recovery

Labor market recovery underway, but uneven. Labor markets are recovering from a catastrophic hit in 2020. According to the International Labour Organization (ILO), the decline in hours worked was equivalent to 255 million full-time jobs lost. But the pace is uneven across economies and workers. Employment around the world remains below its pre-pandemic levels, reflecting a mix of negative output gaps, worker fears of on-the-job infection in contact-intensive occupations, child-care constraints, labor demand changes as automation picks up in some sectors, replacement income through furlough schemes or unemployment benefits helping to cushion income losses, and frictions in job searches and matching.

Emerging market and developing economies have been hit harder than advanced economies on average. ILO estimates suggest that Latin America and the Caribbean and South Asia were among the regions where declines in working hours in 2020 were particularly large.

Figure 1.7. Labor Markets by Economy and Worker Groups
(Average percent difference from 2019:Q4 to 2021:Q1)

Employment and participation in labor markets are still below their pre-pandemic levels, with emerging market and developing economies hit harder than advanced economies on average. Developments have been highly unequal across worker groups, with youth and lower-skilled workers still more impacted.



Sources: International Labour Organization; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: The bars are derived from year fixed effects in a regression of each employment rate/labor force participation rate class on time and country fixed effects, to account for sample changes (see Karbarbounis and Neiman 2014). High-skill = tertiary education and above; Low-skill = above secondary and nontertiary education and below; Prime-age = ages 25 to 54; Youth = ages 15 to 24. Value for the average labor force participation rate difference for high-skilled workers in advanced economies is 0.01 percent.

Within economies, employment of youth and lower-skilled workers remains weaker than that of prime-age and higher-skilled workers (Figure 1.7). Women's employment in emerging market and developing economies remains more adversely impacted than men's, while in advanced economies, earlier differences by gender have largely subsided. Some of these asymmetric impacts reflect differences in sectoral employment across worker groups. Youth and lower-skilled workers tend to be employed in sectors that are more contact-intensive and vulnerable to automation. These sectors have been more impacted by the pandemic and are experiencing an acceleration of the long-term trend toward greater automation (see chapter 3 of the April 2021 WEO).

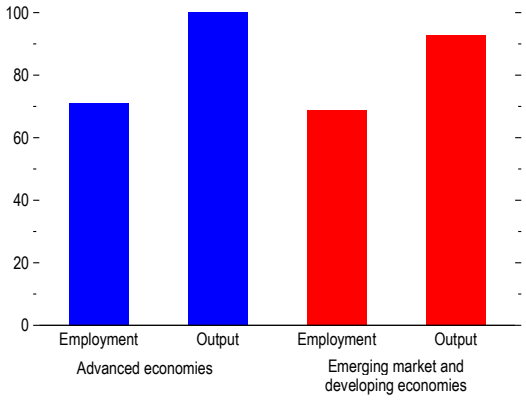
On the supply-side of labor markets, participation is also troublingly lower than pre-pandemic, with historically more disadvantaged groups again exhibiting worse outcomes. Youth participation rates are over 6 percent lower as of early 2021 in both advanced and emerging market economies on average, much more than the decline for prime-age workers (Figure 1.7, panel 2). Lower-skilled workers' participation is also depressed. Similar to the differences in employment by gender, women's participation in emerging market and developing economies still shows a larger relative decline than men's, while in advanced economies they are roughly similar. If these participation gaps persist, they could have severe medium-term implications for economic inequalities across

worker groups. Moreover, if participation does not rebound and firms cannot substitute with machines undertaking more tasks, it may put greater upward pressure on wages and prices, as employers compete for scarcer workers.

Employment growth is expected to lag the output recovery. While recent developments are encouraging, the employment recovery is expected to lag output for a large share of economies—reflecting possible lingering health concerns, replacement income under furlough schemes or unemployment benefits cushioning income loss, and the accelerated shift to automation. All advanced economies are expected to regain pre-COVID output levels by the end of 2022, but only two-thirds are projected to regain their earlier employment. Emerging market and developing economies show a similar pattern (Figure 1.8). This differential between projected output and employment recoveries suggest COVID-related structural shifts may cause an increase in inequality and social tension, as discussed below.

Figure 1.8. Share of Economies Projected to Regain Pre-Pandemic Employment and Output Levels by 2022
(Percent)

Almost all advanced economies and a large fraction of emerging market and developing economies are expected to regain or surpass their pre-pandemic output levels by the end of 2022. The recovery in employment is instead expected to lag that of output in a number of countries.



Source: IMF staff estimates.
Note: For employment, the bars measure the fraction of countries expected to regain 2019 employment by 2022. For output, the comparison is of real GDP between 2019:Q4 and 2022:Q4.

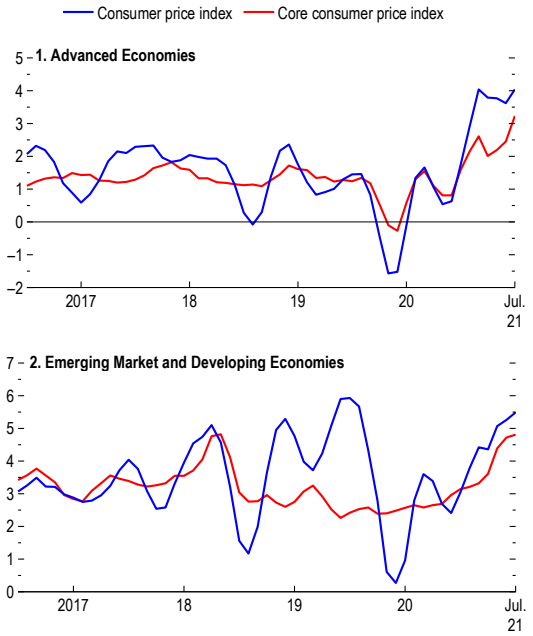
Rises in Inflation, High Uncertainty

Even as employment rates remain below pre-pandemic levels—suggesting substantial labor market slack—headline inflation rates have increased rapidly in the United States and in some emerging market and developing economies in recent months, although there are differences in the extent of pressures across countries. In some countries in sub-Saharan Africa and the Middle East and Central Asia, food prices have increased significantly amid local shortages and the rise in global food prices. Core inflation—which removes the influence of food and energy prices—has also risen in many countries, but to a lesser extent (Figure 1.9).

To a large degree, the increase in inflation reflects a combination of pandemic-induced supply-demand mismatches, rising commodity prices, and policy-related developments (such as the expiration of last year's temporary value-added tax cut in Germany and the increase in the shelter component of US consumer prices as rent and mortgage moratoriums

Figure 1.9. Inflation Trends
(Three-month moving average; annualized percent change)

Headline inflation has picked up on average, with advanced economies seeing a sharper rise. Core inflation has also increased, but more moderately.



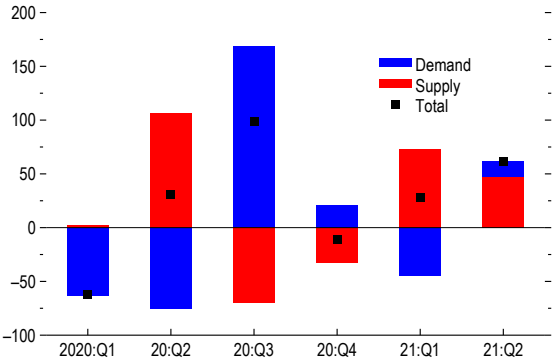
Sources: Consensus Economics; Haver Analytics; and IMF staff calculations.
Note: Average inflation rates by economy group are PPP GDP-weighted averages. In terms of International Organization for Standardization (ISO) country codes, advanced economies comprise AUT, BEL, CAN, CHE, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HKG, IRL, ISR, ITA, JPN, KOR, LTU, LUX, LVA, NLD, NOR, PRT, SGP, SVK, SVN, SWE, TWN, USA; emerging market and developing economies comprise BGR, BRA, CHL, CHN, COL, HUN, IDN, IND, MEX, MYS, PER, PHL, POL, ROU, RUS, THA, TUR, ZAF. PPP = purchasing power parity.

expire in some jurisdictions), rather than a sharp drop-off in spare capacity. In some countries, exchange rate depreciations have contributed to higher import good prices.

Supply bottlenecks. The sharp contraction in demand in 2020 led many businesses to slash orders of intermediate inputs. As the recovery picked up steam in 2021, some producers found themselves flatfooted and unable to ramp up sufficient supply again quickly (for example, microchip production relative to demand remains hampered). Moreover, the world distribution of shipping containers had become highly distorted during the pandemic, leaving many stranded off their usual routes. Temporary disruptions (such as the closure of the Suez Canal, restrictions in ports in China's Pearl River Delta following COVID-19 outbreaks, and congestion in the ports of Los Angeles and Long Beach) exacerbated delays in delivery times. Analysis of the Baltic Dry Index—an index of expenditures related to international shipping—suggests that the bulk of its rise over the past few months has been due to supply factors (Figure 1.10).

Figure 1.10. Supply and Demand Drivers of Shipping Expenditure Growth
(Percent)

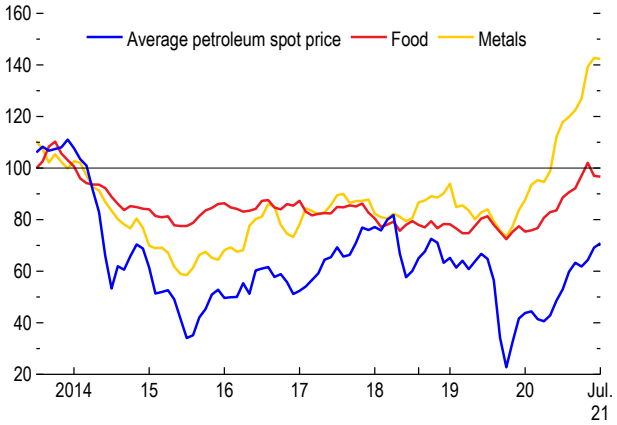
Increases in the Baltic Dry Index were driven mostly by supply factors in 2021:Q1 and 2021:Q2.



Sources: Haver Analytics; and IMF staff calculations.
Note: The decomposition is derived from a global dynamic factor model (GDFM) that contains 20 variables, including purchasing managers' index, industrial production, world trade, house prices, confidence indicators, and the Baltic Dry index. The GDFM was inspired by the Federal Reserve Bank of New York's nowcasting model. The decomposition is based on the Baltic Dry Index's average quarterly growth rate, and the demand component is what is explained by the model.

Figure 1.11. Commodity Prices
(Deflated using US consumer price index; 2014 = 100)

Commodity prices have risen markedly from their pandemic recession troughs.



Sources: IMF, Primary Commodity Price System; and IMF staff calculations.

Rising commodity prices. Commodity prices have continued their upward tear with strengthening economic activity (Figure 1.11). Oil prices are expected to increase in 2021, close to 60 percent above their low base for 2020. Non-oil commodity prices are expected to rise almost 30 percent above their 2020 levels, reflecting particularly strong increases in the price of metals and food over recent months (see also the Commodity Special Feature for further discussion, including on the impact of the energy transition on the markets for metals). Food price rises have unfortunately tended to concentrate in places where food insecurity is high, putting poorer households under greater stress and raising the specter of greater social unrest (Figure 1.12).

Wage growth has been high in some sectors. As the recovery continues, labor markets have tightened, making it more difficult for employers in some countries to fill positions quickly. For example, the ratio of job openings to unemployed workers is close to one in the United States. Consistent with a resumption of greater activity, there are signs of higher wage growth in some sectors—for

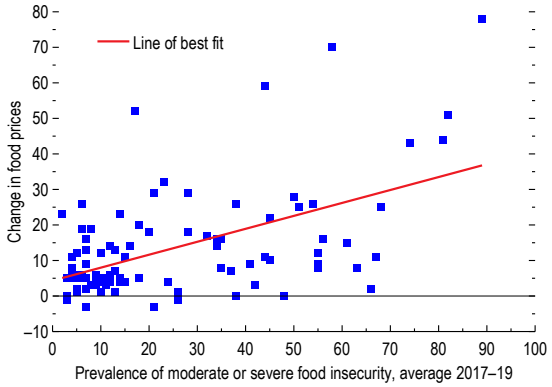
instance, leisure and hospitality, retail, and transportation in the United States (Figure 1.13). At the same time, wages for individuals with either lower incomes or lower levels of educational attainment in Atlanta Fed's Wage Growth Tracker—which follows the same employed individuals over time, thereby correcting for compositional changes due to entry and exit—have improved better-than-average compared to a year ago. Overall, average, economy-wide nominal wage inflation remains contained (Canada, Germany, Spain, the United Kingdom, and the United States).

Inflation expectations appear contained across most economies. Some household survey-based measures, for example in the United States, have registered a recent increase in inflation expectations—possibly linked to rising fuel prices. Moreover, market-implied measures also point to inflation pressure over a 2–3 year horizon consistent with the Federal Reserve's Average Inflation Targeting policy framework. However, market-implied medium-term inflation expectations have so far remained well-behaved, hovering around the levels seen just before the pandemic struck in early 2020 (Figure 1.14).

Inflation outlook. The various indicators discussed above point to a highly uncertain outlook for inflation (see Chapter 2 for a more in-depth analysis). In the baseline projections, across most economies, inflation is expected to come down to its pre-pandemic range in 2022, once supply-demand mismatches resolve. This is motivated by three pieces of evidence: (i) labor market slack remains large even as job postings have increased, with employment rates typically below their pre-shock levels; (ii) in large, advanced economies, inflation expectations are still well-anchored according to benchmark market-based measures; and (iii) structural factors that have lowered the sensitivity of prices to shrinking labor market slack—such as increasing automation—continue to operate or are even intensifying. However, the lagged passthrough to broader inflation from higher food and oil prices for importers means that price pressures are anticipated to stay elevated into 2022 in some emerging market and developing economies. In economies where the stock of vacant dwellings is low, the pandemic shock and low borrowing costs have also spurred an increase in house prices. This has already

Figure 1.12. Food Price Inflation and Food Insecurity
(Percent)

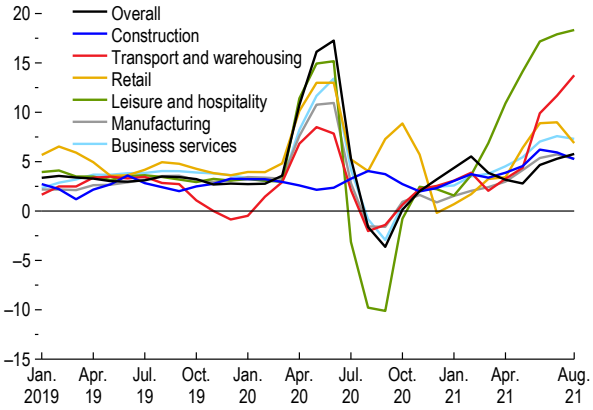
Food price increases in the past two years have been more substantial in countries where food insecurity is more prevalent.



Sources: Food and Agriculture Organization of the United Nations; and IMF staff calculations.
Note: Each square corresponds to one country. Five countries with changes in prices larger than 100 percent are not shown in the figure to enhance readability. The change in food prices is the percent change between March 2019 and March 2021.

Figure 1.13. US Average Hourly Earnings: Overall and Selected Sectors
(Annualized percent change of three-month moving average)

Wages in the United States are rising, markedly in sectors hit harder by the pandemic.



Sources: Haver Analytics; and IMF staff calculations.
Note: Data are as of August 2021. Hourly earnings are seasonally adjusted.

directly impacted headline inflation in these economies through its impact on imputed rents and could contribute to more persistent inflationary pressures if demand remains high, as it takes time to increase the housing stock (see Box 1.1 for a detailed look at real estate price dynamics and inflation).

The evolution of inflation expectations in this uncharted recovery will prove decisive for the inflation outlook. The aftershocks from the upheaval of 2020 and the prospect of renewed restrictions to slow virus transmission could translate into more persistent supply disruptions. Faced with continued rising demand, firms may increase prices and workers may bid-up wages more broadly than has occurred so far. More generally, should households, businesses, and investors begin anticipating that price pressures from pent-up demand and the many factors outlined above will persist, there is a risk that medium-term inflation expectations could drift upwards and lead to a self-fulfilling further rise in prices (as prices and wages are reset in line with higher inflation expectations). As noted, there are no signs of such a shift, with expectations still tightly bound to central banks stated targets.

Figure 1.14. Five-Year, Five-Year Inflation Swaps
(Percent)

Inflation in the United States and euro area is expected to be slightly higher over the medium term, but it remains contained.

Sources: Bloomberg Finance L.P.; and IMF staff calculations.
Note: Market-implied average inflation rate expected over the five-year period starting five years from date shown.

Large Differences in Medium-Term Economic Losses Linger

The differential recovery speeds across economy groups are likely to leave long-lasting imprints. The pattern of emerging market and developing economies suffering larger medium-term damages compared to advanced economies on average—discussed earlier in Chapter 2 of the April 2021 WEO—persists in the latest projections.

Output losses. Activity is generally expected to remain below its pre-pandemic path through 2023 across economy groups (Figure 1.15, panel 1). Output in the advanced economy group is projected to return to pre-pandemic trends by 2022 and rise slightly above it thereafter, mainly because of the anticipated additional policy support in the United States. The other income groups, however, are expected to remain below their pre-pandemic paths throughout the forecast horizon. Moreover, negative output gaps—indicative of slack—are expected across many economies over the next three years (Figure 1.15, panel 2). In other words, scarring—defined as medium-term economic performance below pre-shock projections—is expected to be pervasive outside of the advanced economy group (Figure 1.15, panel 3).

As discussed in chapter 2 of the April 2021 WEO, the pattern of medium-term damages across economy groups is different from what was observed after the 2008-09 global financial crisis. Then, advanced economies were hit hard and emerging market and developing economies fared better. Today the reverse appears likely, consistent with the greater protection against further COVID-19 shocks from more widespread vaccinations in many advanced economies and sizable policy support. The better-than-expected performance in the United States for example—where output is anticipated to end up above its pre-pandemic trend—reflects the

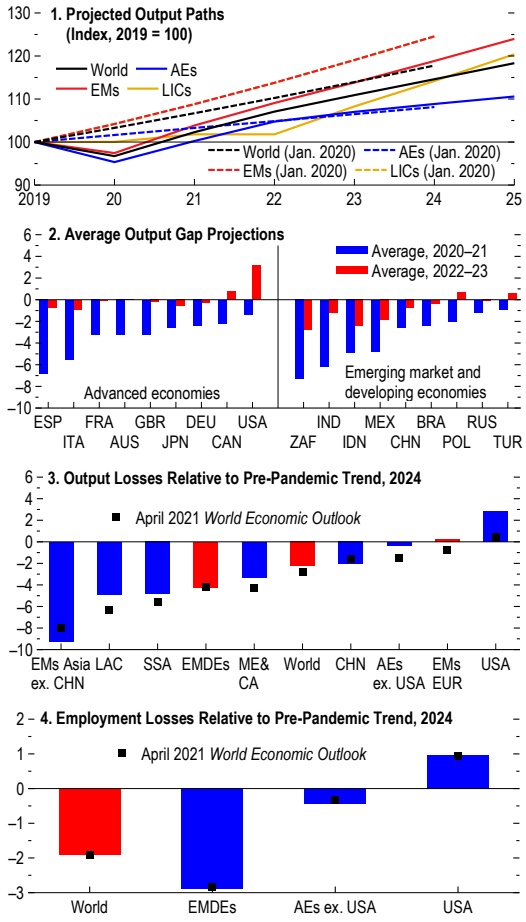
impacts of the new structural investments planned by the government, upgrading dilapated infrastructure, and hastening a green energy transition.

Labor market scarring. A similar picture of lasting effects emerges when looking at labor markets, suggesting that employment is a major channel through which economic scarring manifests. As with output, worse-than-expected employment prospects are concentrated in emerging market and developing economies (Figure 1.15, panel 4). According to the latest projections, employment prospects have actually deteriorated slightly for a number of emerging market and developing economies.

Early responses to the health and economic crisis are expected to limit persistent losses. When unpacking these patterns further, high persistence in output and employment shocks is anticipated, with revisions this year passing through almost one-for-one with expectations five years out. Such persistence—particularly of adverse shocks—has been well-documented in the recent literature. This feature suggests that actions to improve output and employment outcomes today are very likely to pay out dramatically through reduced scarring. This is especially true when it comes to the speed of vaccinations—a key driver of medium-term growth upgrades since April 2021 (Figure 1.16). Forecasts for medium-term output have been revised up more for countries with higher vaccination rates. Additional fiscal support to households and firms in response to the pandemic since April 2021 is associated with a small downgrade to output, suggesting that recent countercyclical support has been concentrated in economies where the recovery lags.

Figure 1.15. Medium-Term Prospects: Output and Employment
(Percent, unless noted otherwise)

Output and employment over the medium term are expected to remain below pre-pandemic trends in many places.



Source: IMF staff calculations.
Note: Output in panels 1 and 3 is real GDP. Output gap in panel 2 is the difference between real and potential GDP as a percent of potential GDP. Medium-term losses in panels 3 and 4 are the difference between forecasts of the indicated variable for 2024 from the October 2021 WEO and January 2020 WEO Update vintages. The sample of countries in panel 4 comprises those which have comparable employment projections in both vintages. The EMDE employment aggregate excludes China and India due to changes in employment definitions across vintages. AEs (ex. USA) = advanced economies (excluding United States); EMs = emerging market economies; EMs (Asia ex. CHN/EUR) = emerging market economies (in Asia excluding China, in Europe); EMDEs = emerging market and developing economies; LAC = Latin American and Caribbean economies; LICs = low-income countries; ME&CA = Middle Eastern and Central Asian economies; SSA = sub-Saharan African economies. ISO country abbreviations used.

Trade Growing, Imbalances Projected to Narrow over Medium-Term

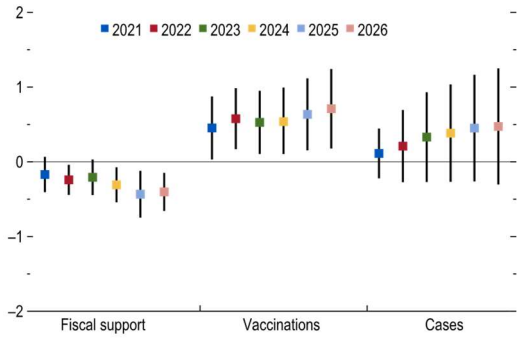
Global trade. Despite temporary disruptions, trade volumes are expected to grow almost 10 percent in 2021, moderating to around 7 percent in 2022—in line with the projected broader global recovery. Trade growth is projected to moderate to around 3.5 percent over the medium term. The overall trade recovery masks a subdued outlook for tourism-dependent economies and cross-border services more generally. As noted in the October 2020 WEO, countries where

tourism and travel account for a larger share of GDP are projected to suffer larger declines in activity compared to pre-COVID forecasts. Travel restrictions and lingering fears of contagion are likely to weigh on cross-border tourist activity until virus transmission declines durably.

Global current account balances. As noted in the 2021 *External Sector Report*, global current account balances—the sum of absolute deficits and surpluses—are set to widen for the second successive year in 2021 following an increase in 2020. The widening in 2020 reflected the impact of the pandemic—seen in elevated exports of some goods (medical equipment, work-from-home electronics, consumer durables), subdued travel, and lower oil prices. For 2021, the widening reflects a larger deficit in the United States from the increased fiscal support and corresponding increases in surpluses. Current account balances are expected to narrow over 2022–26, reflecting anticipated declines in the US deficit and China's surplus (Fig 1.17, panel 1).

Figure 1.16. Correlates of Projected Output Revisions
(Percentage points)

Higher COVID-19 vaccination rates and lower infection rates are associated with improved output expectations across horizons since April 2021, while increased fiscal support measures since then appear more concentrated in places where the recovery is lagging.



Sources: IMF, Database of Country Fiscal Measures in Response to the COVID-19 Pandemic; Our World In Data; and IMF staff calculations.
Note: Chart shows point estimates and 90 percent confidence intervals (with heteroscedasticity-consistent standard errors) for coefficients of a cross-sectional, cross-country regression (unweighted) of forecast revisions at different horizons since the April 2021 *World Economic Outlook* on the set of explanatory variables (shown) and region fixed effects (not shown). Fiscal support refers to additional above-the-line spending and forgone revenues and liquidity support in response to COVID-19 between March 17, 2021, and June 5, 2021, as a share of GDP. Vaccinations and cases are the difference in the cumulative share of population either fully vaccinated or diagnosed with COVID-19, respectively, between March 31, 2021, and September 9, 2021. Explanatory variables are standardized to have zero mean and unit standard deviation.

Global creditor and debtor positions. Stocks of external assets and liabilities are close to historic highs, even after allowing for the fact that the substantial widening as a share of global GDP in 2020 reflects the large drop in the denominator and valuation changes (Fig 1.17, panel 2). As noted in the 2021 *External Sector Report*, this poses risks to both debtor and creditor economies. The stocks are expected to decline somewhat in 2021 and shrink modestly thereafter, consistent with the gradual narrowing of global current account balances.

Uncertainty Grows as Variants Threaten Recovery's Resilience

The baseline forecast is subject to high uncertainty regarding the evolution of the pandemic, the outlook for inflation, and the associated shifts in global financial conditions. The balance of risks suggests growth outcomes—over both the near and medium term—are more likely to disappoint than to register positive surprises.

On the *downside*, the main risk factors are the following (some of these aspects are explored in alternative scenarios using the IMF's G20 Model—see the Scenario Box):

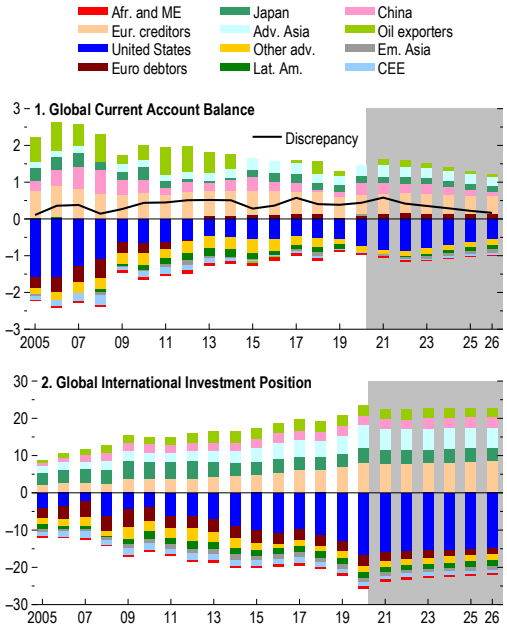
- *Emergence of more transmissible and deadlier SARS-CoV-2 variants* could further reenergize the pandemic's spread and intensity, prolonging the pandemic and precipitating pullbacks of economic activity. Trade disruptions and supply-demand mismatches could increase, with port closures due to renewed lockdowns. Early studies suggest that existing vaccines may show reduced efficacy against the Delta variant, although their levels of protection against severe disease still remain high. Roadblocks in the global distribution of vaccines to countries still lacking sufficient access, high levels of vaccine hesitancy in countries with advanced vaccination campaigns, and any other factors that delay broad vaccine coverage of the world

population, heighten these risks. Each infection represents another opportunity for the virus to mutate into an even more detrimental pathogen.

- *More persistent supply-demand mismatches, price pressures, and faster-than-anticipated monetary policy normalization*. Pandemic-induced supply-demand mismatches could persist longer than expected, leading to sustained price pressures and rising inflation expectations. In response, a faster-than-anticipated monetary normalization in advanced economies could lead to a sudden tightening of global financial conditions. Compressed volatility and elevated equity price valuations point to the possibility of rapid repricing of financial assets in the event of a reassessment of the outlook (see the October 2021 *Global Financial Stability Report*). As discussed in the April 2021 WEO, vulnerable emerging market and developing economies with large foreign currency debt and financing needs would be particularly exposed. Difficulties with rolling over their external obligations could force abrupt adjustments in these economies, leading to adverse growth outcomes.

Figure 1.17. Current Account and International Investment Positions
(Percent of global GDP)

Current account balances are expected to narrow over 2022–26, while global stocks of external assets and liabilities are anticipated to remain near their historical highs.



Source: IMF staff estimates.
Note: Adv. Asia = advanced Asia (Hong Kong SAR, Korea, Singapore, Taiwan Province of China); Afr. and ME = Africa and the Middle East (Democratic Republic of the Congo, Egypt, Ethiopia, Ghana, Jordan, Kenya, Lebanon, Morocco, South Africa, Sudan, Tanzania, Tunisia); CEE = central and eastern Europe (Belarus, Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovak Republic, Turkey, Ukraine); Em. Asia = emerging Asia (India, Indonesia, Pakistan, Philippines, Thailand, Vietnam); Eur. creditors = European creditors (Austria, Belgium, Denmark, Finland, Germany, Luxembourg, The Netherlands, Norway, Sweden, Switzerland); Euro debtors = euro area debtors (Cyprus, Greece, Ireland, Italy, Portugal, Spain, Slovenia); Lat. Am. = Latin America (Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay); Oil exporters = Algeria, Azerbaijan, Iran, Kazakhstan, Kuwait, Nigeria, Oman, Qatar, Russia, Saudi Arabia, United Arab Emirates, Venezuela; Other adv. = other advanced economies (Australia, Canada, France, Iceland, New Zealand, United Kingdom).

- *Smaller US fiscal package*. The baseline forecast assumes a fiscal impulse in the Unites States broadly consistent with the infrastructure bill recently passed by the Senate and the Administration's blueprint to remake the US social safety net. Any significant change in the size or composition of the fiscal package will have repercussions for US growth prospects and its trading partners.
- *Greater social unrest*. Instances of social unrest had declined during the early phases of the pandemic but rose in the second half of 2020 and at the beginning of 2021 (Barrett and Chen 2021). The causes vary across countries. Frustration with the handling of the pandemic is juxtaposed in some cases with the increase in food prices, slow employment growth, and long-standing erosions of trust in government institutions. A further intensification could damage sentiment and weigh on the recovery. Recent turmoil in Afghanistan has worsened the humanitarian situation in the region and is fueling a wave of refugees, with the potential to further increase regional tensions, economic spillovers and fiscal strains on host countries.
- *More adverse climate shocks*. Climate change, a principal driver of more frequent and intense weather-related disasters, already has had visible immediate impacts, with spillovers beyond the regions where the disasters strike. Cross-border migration pressures, financial stresses (including among creditors and insurers in countries not directly impacted by a given event),

and health burdens may rise, with implications that persist long after the event itself. Against the backdrop of the ongoing pandemic, climate shocks may pose further challenges to the global recovery.

- *Cyberattacks*. An increase in the spread and destructiveness of cyberattacks involving critical infrastructure could act as further drags on the recovery (as evinced by recent and damaging ransomware cases), particularly as telework and automation increase.
- *Intensification of trade and technology tensions*. Geopolitical risks remain elevated. An escalation of trade and technology tensions, notably between the United States and China, could weigh on investment and productivity growth, raising additional roadblocks in the recovery path.

On the *upside*:

- *Faster vaccine production and distribution*. Large amounts of new vaccine supplies are expected to come online over the coming months, both in terms of production of existing vaccines and deployment of completely new vaccines. Pledges have also been made by countries with large stocks of unused vaccines to donate them. A faster pace of vaccinations than what is assumed in the baseline projections would have a direct positive effect on economic activity. It could also boost the confidence of consumers and firms, triggering a rise in spending and investment that would strengthen the economic recovery.
- *Productivity growth spurt*. The pandemic has accelerated change across many sectors of the economy, through greater automation and a transformation of workplaces which can rely more on technology platforms to conduct work remotely. Productivity growth could accelerate as a result of these changes in production, distribution, and payment systems. More specifically, faster and more effective deployment and implementation of structural investment plans (for example in the context of the anticipated public investment push in the United States and the Next Generation EU plan) could lift the medium-term growth outlook for regions where subdued long-term prospects have long been a concern. In turn, this could lead to stronger investment and more robust near-term growth.

Policy Actions to Strengthen the Recovery

The large divergences in economic losses and the sizeable downside risks surrounding the conjuncture discussed above call for strong policy effort at both multilateral and national levels to strengthen global economic prospects. This section first discusses multilateral priority actions to address the pandemic (highlighting vaccine deployment), climate policy, and international liquidity. It then turns to national policies to complement the multilateral effort. These will require much more tailoring to country-specific conditions and better targeting, as policy space constraints become more binding the longer the pandemic lasts.

Multilateral actions with positive spillovers

Global vaccine deployment. The global community needs to increase its efforts to vaccinate adequate numbers everywhere. This would save millions of lives by reducing risks of severe health outcomes and deaths, lower the risks of new variants emerging, and thereby add trillions to the global economic recovery. It would also reduce the expected divergence in recoveries between advanced and emerging market and developing economy groups.

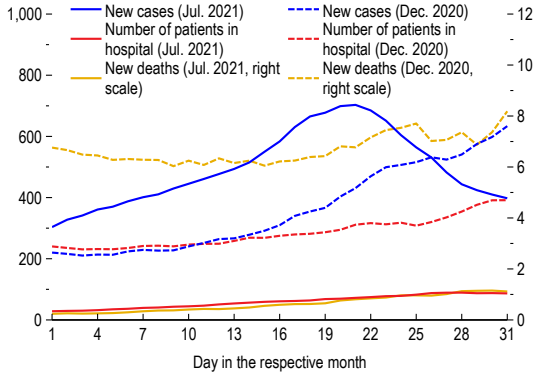
- Most of the currently approved vaccines markedly lower the risk of severe disease from all current COVID-19 variants and thus limit hospitalizations and deaths. The case of the United Kingdom is instructive in the effectiveness of large-scale vaccination campaigns, even against highly contagious variants. Although the number of confirmed daily COVID-19 cases in July 2021 was higher than that seen in December 2020 for most of the month (reflecting the greater infectiousness of the delta variant), hospitalization and death rates were only 10-20 percent of the levels registered last winter (Figure 1.18). The key difference between the two points in time is that the United Kingdom had fully vaccinated about half of its population (two-thirds at least partially vaccinated) by July 2021, whereas in 2020 there was no vaccine protection available.

- In addition to preventing severe health outcomes, recent evidence from the United States suggests that widespread vaccinations can also have powerful, positive economic effects, bolstering the recovery. US counties where first-dose vaccinations went up showed a simultaneous boost in weekly credit card spending and a decline in weekly unemployment claims (Figure 1.19).

- The IMF has proposed a plan—jointly endorsed by the World Health Organization, the World Bank, and the World Trade Organization—to vaccinate at least 40 percent of the population in every country by end-2021 and at least 60 percent by mid-2022, alongside ensuring adequate diagnostics and therapeutics (Agarwal and Gopinath 2021). At an estimated cost of around $50 billion, the plan has the potential to yield massive social and economic returns. About half of the countries in the world—accounting for 35 percent of global population—are not on track to achieve the 40 percent mark by the end of 2021 (Figure 1.20). There is an urgent need for *vaccine donations* by countries with large shares of their population already vaccinated. The IMF proposal estimates that at least 1 billion doses could be shared by the end of 2021 without jeopardizing national vaccination targets. Recent pledges by China, the G7, and other countries are welcome steps in the right direction, though donations should be accelerated to rapidly fulfill the commitments

Figure 1.18. COVID-19 Vaccine Rollouts and Health Outcomes: The Case of the United Kingdom
(Per million)

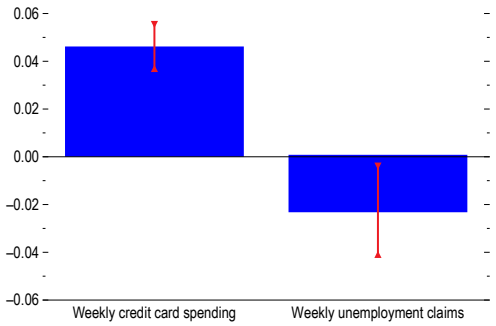
Despite similar COVID-19 infection rate paths in July 2021 and December 2020 in the United Kingdom, hospitalization and death rates were substantially lower in July 2021, reflecting widespread vaccinations.



Sources: Airfinity; Our World in Data; and IMF staff calculations.
Note: As of July 31, 2021, 56.5 percent of the UK population was fully vaccinated and 69 percent had received at least one dose. In December 2020, rates were effectively zero as the mass vaccination effort had yet to start.

Figure 1.19. COVID-19 Vaccinations and Economic Activity in US Counties
(Percent change, year over year, relative to pre-pandemic levels)

Counties in the United States that had increased vaccination rates saw higher spending and reduced unemployment.



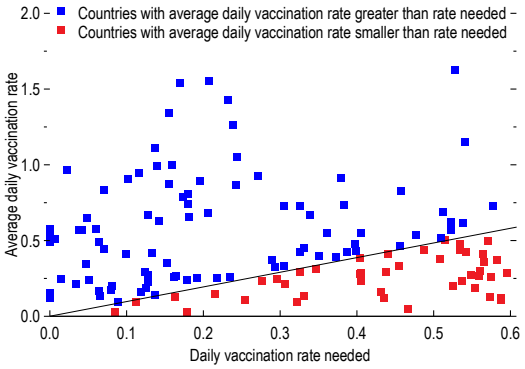
Sources: Centers for Disease Control and Prevention; Opportunity Insights Economic Tracker; and IMF staff calculations.
Note: The figure shows the average effect of a 10 percentage point rise in the fully vaccinated population share. For spending, the estimation sample covers 1,608 counties in week 12–21 in 2021. For unemployment claims, the estimation sample covers 378 counties in week 12–24 in 2021. Credit card spending is the year-over-year change as percent of the January 2020 level. Unemployment claims are expressed as percent of the 2019 labor force. Regressions control for county and state time fixed effects.

(as of early September, only around 12 percent of the 850 million doses pledged by the G7 has been delivered). It is also crucial to *prioritize vaccine deliveries* to countries that still lack wide access—including by enhancing supply to collective procurement vehicles such as COVAX. Quickly *removing remaining restrictions on exports* of medical equipment, raw materials, and finished vaccines is another priority. *Diversifying and increasing vaccine production and distribution capabilities* (including via at-risk investments in doses on behalf of low-income developing countries) are important not only to speed up the broad coverage of the world population. Such actions would enhance readiness to react and adapt to unexpected turns in the pandemic, including the potential need for booster shots if either immunity wanes or new variants emerge. More generally, it remains crucial to increase funding for *testing, tracing, and therapeutics* to improve diagnostics and treatment, *while scaling up genomic surveillance* for early detection of new variants. Any actions that help contain and mitigate the health effects from SARS-CoV-2 increase further in importance as the likelihood that the virus becomes endemic rises with the persistence of the pandemic.

Mitigating and adapting to climate change. The past few months have witnessed a panoply of extreme weather-related events, including: the heat domes and intense wildfires in Canada and the United States, high precipitation and flooding in Europe, drought in Brazil, and floods in eastern and south Asia. Combined with evidence from the Intergovernmental Panel on Climate Change that the world is experiencing the warmest period in over 100,000 years, these events have further raised fears that the highly adverse consequences of climate change may arise sooner rather than later, increasing the urgency of actions to reduce these risks and improve resilience.

Figure 1.20. Gaps in Vaccination Rates Across Economies
(Percent)

About half of the countries in the world are not on track to reach the goal of vaccinating 40 percent of their population by the end of 2021.



Sources: Our World in Data; and IMF staff calculations.
Note: Data are as of September 9, 2021. *X*-axis shows daily vaccination rates needed to reach 40 percent of population fully vaccinated by end-2021, assuming two-dose vaccines. *Y*-axis shows average daily vaccination rates in the preceding seven days. Each square corresponds to a country. Countries that have already reached the 40 percent threshold are not shown. The dashed line indicates the 45-degree line.

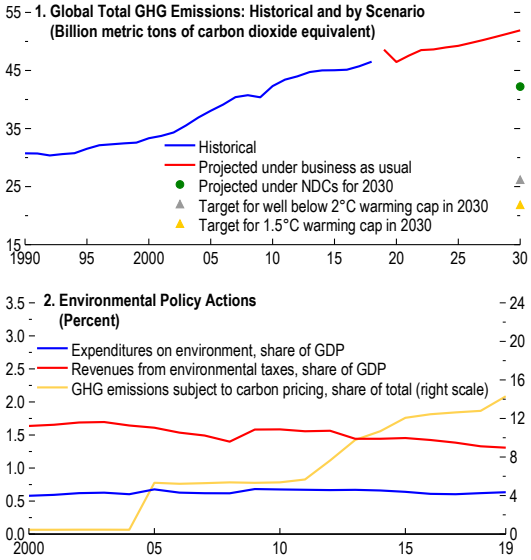
- Greenhouse gas (GHG) emissions due to human activity are on a steep upward trajectory—with the dip due to the acute pandemic rapidly reversing. Commitments and realized actions to reduce emissions must be ramped up. The existing nationally determined contributions (NDCs) for reductions in GHGs are insufficiently ambitious, remaining far above the level consistent with capping the average global temperature increase at 2 degrees Celsius above pre-industrial levels—a commonly agreed limit to contain the risks of catastrophic effects from warming (Figure 1.21, panel 1).
- Moreover, there are still few signs of concrete actions visible in aggregate policy measures—tax revenue related to environmental policy objectives as a share of GDP have tended to decline on average over the last 15 years, while public expenditures on environmental policy objectives as a share of GDP have stayed largely flat (Figure 1.21, panel 2). Similarly, even though there has been a sizeable increase in the coverage of GHG emissions subject to control under emissions trading schemes or similar carbon pricing measures in recent years,

only around one-fifth of emissions are covered, even after the adoption by China of its national emission trading scheme in July this year.

- The global and multifaceted nature of the climate change challenge requires a well-coordinated policy response, for which the upcoming United Nations Climate Change Conference (COP26) is an excellent opportunity to negotiate and make concrete. An ideal policy mix should include: (i) an international carbon price floor adjusted to country circumstances—a transparent and effective instrument that can tilt the balance of incentives away from the most polluting energy sources; (ii) a green public investment program and research subsidies to support the development and deployment of new clean energies and low-carbon technologies—from renewables to hydrogen, from longer-lasting and faster-charging batteries to carbon capture, utilization, and storage systems; and (iii) targeted transfer schemes that ensure a fair and equitable transition by channeling back some of the revenues from carbon pricing to households adversely affected by the climate policies implemented, while maintaining the behavioral incentives to shift their consumption bundle. As discussed in chapter 3 of the October 2020 WEO, a green infrastructure push at the current conjecture is a win-win strategy that can strengthen the recovery from the pandemic through investment with high returns—both in terms of output and employment—while tackling one of the major challenges of our times (also see Chapter 3 of the October 2021 *Global Financial Stability Report* on the role of sustainable finance in facilitating the energy transition). At the same time, multilateral support via cross-border technology transfer and climate finance initiatives can help ensure that the transition isn't limited only to countries that can afford such mitigation measures. An analysis of employment according to the tasks involved in occupations and whether they would be directly impacted by the green transformation of the economy suggests that the green task intensity of the average job has picked up slightly over the past ten years, to just under 2.5 percent. Green jobs are present in all sectors, but more so in industry, with workers in those jobs having higher skills and incomes, pointing to complementarities between investing in people and greening the economy (Box 1.2).

Figure 1.21. Climate Change Policy Gaps

World greenhouse gas emissions are far in excess of current national commitments to reduce emissions, which in turn are not ambitious enough to cap global temperature increase at two degrees Celsius.



Sources: IMF, Climate Change Indicators Dashboard; World Bank, Carbon Pricing Dashboard; and IMF staff calculations.
Note: Total GHG emissions are calculated excluding potential effects from land use, land-use change, and forestry. IMF estimates of NDCs are based on commitments as of August 2021. Expenditures and revenues related to environmental policies at the country level are aggregated using purchasing-power-parity GDP weights for a constant composition country sample, covering countries that account for about 30 percent (expenditures) and 65 percent (revenues) of world GDP. More detailed descriptions of all the variables in the figure and their calculations are included in Box A.2 in the Statistical Appendix. GHG = greenhouse gas; NDCs = nationally determined countributions.

Easing financial constraints to struggling countries and tackling debt vulnerabilities. The months of health emergency and subdued global economic activity have entailed substantial public finance interventions, stretching budgets and posing enormous challenges to countries that entered the pandemic with already limited fiscal space. The IMF has stepped in by providing more than $110

billion in emergency support to 86 countries since the early phases of the pandemic. A further boost to countries' reserve assets came from the *General Allocation of Special Drawing Rights (SDRs)* equivalent to US$650 billion that took place in late August, with emerging market and developing economies receiving about 40 percent of the allocation (and potentially more through voluntary channeling of SDRs from countries with stronger external positions). These and other initiatives by the IMF and the international community—including the Debt Service Suspension Initiative (DSSI) by the Group of 20, extended to December 2021—are helping countries avoid even larger reductions in essential health-related spending while meeting their external payment obligations (see the October 2021 *Fiscal Monitor*). Nevertheless, in cases where sovereign debt is not sustainable or where financing needs are large, liquidity relief may not be enough. The Common Framework for Debt Treatments beyond the DSSI endorsed by the Group of 20 last year aimed to provide a mechanism for timely and orderly debt restructurings that can avoid the higher costs of protracted debt crises, but its implementation in the initial country cases has been too slow, calling for urgent improvements in this area given the expiry of the DSSI at the end of 2021.

Defusing trade and technology tensions and instituting an international minimum corporate tax. Many of the cross-border trade and technology frictions that predate the pandemic continue to fester. The increased trade restrictions implemented in 2018-19 for example remain in place and risk impeding the recovery. Countries should cooperate to remove these restrictions, address the grievances at the root of long-standing disputes, and strengthen the rules-based multilateral trading system—including by resolving the impasse over appointments to the World Trade Organization's Appellate Body. In parallel, they should finalize an agreement on a global minimum for corporate taxes, avoiding a race to the bottom and helping bolster public finances to fund critical investments.

National level policies adjusted to pandemic conditions and policy space constraints

Quick and strong policy actions at the national level thwarted even worse economic outcomes through last year's recession and have fostered the recovery from that unprecedented collapse. As discussed in the April 2021 WEO, without the direct fiscal actions and liquidity support policies implemented across G20 economies in 2020, the contraction in global activity could have been at least three times worse than the actual outcome. Moreover, extraordinary monetary policy actions—including, for the first time, asset purchases by many emerging market central banks—and regulatory efforts to support credit helped prevent a systemic financial crisis.

Reduced policy space, tighter constraints. These actions have, however, reduced policy space in many countries, leaving them with limited room to address any further setbacks. Public debt has gone up significantly across all income groups (see the October 2021 *Fiscal Monitor*), while inflation has also increased sharply in many countries. However, the pandemic is far from over and its path subject to high uncertainty—the prospects for a protracted stop-and-go recovery cannot be excluded. National-level policies to support the recovery confront difficult choices in this environment and, especially for emerging market and developing economies, generally must work within tighter constraints than at the onset of the crisis.

A policy approach tailored to a country's pandemic and economic conditions… The priority must remain critical health spending—on the rollout of vaccines, testing, and treatments—with targeted

emergency support to households and firms most impacted by public health measures to contain the spread of the virus. International aid may be required in those economies where fiscal constraints or local capacities do not permit more action to safeguard lives. The longer the pandemic persists, resources will also need to be increasingly devoted to worker retraining and support for reallocation away from sectors struggling to regain pre-pandemic vitality. Even when the pandemic's ferocity abates, the steady rollout of vaccines and investments to fortify human health must proceed, to help secure the recovery against future resurgences. Broad-based demand support and remedial measures to address the scars from the shock can be deployed to further bolster the economy, as policy space allows. This will also be the time to invest in the future, taking the opportunity to advance long-term goals and improve the economy's potential and resilience. Indicators of the pandemic's intensity—such as infection, hospitalization, and mortality rates—along with measures of the population share protected by vaccines can help policymakers recognize how and when to adapt policies.

…recognizing the constraints by country. Beyond the recurring ups-and-downs of the pandemic, the uncharted nature of the recovery further complicates policymaking. Standard dashboard measures to assess the cyclical position—such as the output gap—are subject to even greater uncertainty than in a typical business cycle. Near-term macroeconomic policies should aim for the maximum level of employment without compromising the credibility of policymaking institutions, while ensuring fiscal sustainability and financial stability. At the same time, near-term policies should be designed to work seamlessly alongside measures to promote longer-term objectives of stronger and more equitable growth and resilience. Specifically:

Fiscal policies should be undertaken within medium-term frameworks to improve tradeoffs between providing cyclical support now, building buffers to address future shocks, and advancing long-term structural goals. Fiscal frameworks featuring a clear operational rule, a medium-term debt anchor reinforced with pre-approved revenue and expenditure measures to be implemented after the acute phase of the crisis fades, and well-articulated escape clauses can enhance countercyclical stabilization while strengthening credibility (October 2021 *Fiscal Monitor*).

- Fiscal policymakers should continue to prioritize spending to end the pandemic—including on vaccine production and distribution infrastructure, storage and dispensing facilities, campaigns to boost take-up, health workers to implement, testing, and therapies. The longer the pandemic persists, fiscal space constraints will bind tighter in some countries. Lifelines, transfers, and short-time work programs will need to become better targeted. To facilitate worker reallocation from shrinking to growing sectors, hiring subsidies, job search and matching assistance, and training, alongside critical income support for displaced workers, will need to be deployed. As the pandemic is brought under control, the emphasis can be shifted toward measures to secure the recovery and invest in the future, as fiscal space allows.
- Where fiscal space is more limited—particularly in some emerging market and developing economies—poorly-targeted subsidies and recurrent expenditure will need to be pared back to create room for needed health, social spending, and infrastructure outlays. These efforts can be reinforced with initiatives to strengthen tax compliance and improve revenue administration. As noted, strong international support, particularly for low-income developing economies, will be needed to supplement domestic initiatives.

Monetary policy should not lose sight of central bankers' hard-won credibility for maintaining price stability. As the recent experience with large-scale asset purchases has demonstrated, independent central banks with credible policy frameworks can implement countercyclical support more effectively in downturns, highlighting their value in responding to shocks (Box 1.3). The unprecedented conjuncture makes transparent and clear communication about the outlook for monetary policy even more critical. In particular, clear central bank communications about the persistence of inflation drivers, any changes in views about inflation, and the monetary policy outlook will continue to be critical to shaping expectations.

- Although central banks can generally look through transitory inflation pressures and avoid tightening until there is more clarity on underlying price dynamics, they should be prepared to act quickly if the recovery strengthens faster than expected—as the Bank of Canada did when they scaled back their asset purchase programs in April and July respectively. Early preemptive action will be required where there is a tangible risk of rising inflation expectations and more persistent price increases.
- Central banks with dual mandates in economies confronting rising inflation against the backdrop of still-subdued employment rates and labor market slack face particularly difficult choices. The response in such a setting, where the risks of inflation expectations de-anchoring rise significantly, may be to tighten monetary policy to get ahead of price pressures, even if that means the employment recovery is delayed. The alternative of waiting for stronger employment outcomes while allowing price pressures to build runs the risk that inflation increases in a self-fulfilling way, creating more uncertainty and undermining the credibility of the central bank—which could hold back private investment and lead to precisely the slower employment recovery that the central bank hopes to avoid by waiting to tighten policy.
- In economies where the recovery is strengthening, inflation has risen, and health protections—such as widespread vaccinations—are an effective bulwark against the pandemic, central banks can more forcefully signal forthcoming monetary policy normalization. In the United States, the baseline forecast is for a strong, sustained recovery with output expected to exceed potential over much of the forecast horizon. As this solidifies, the Federal Reserve should communicate a scaling back of asset purchases and begin tapering in late 2021 to prepare for a policy rate liftoff in late 2022. By contrast, where inflation pressures are contained, inflation expectations are still below the central bank target, and labor market slack remains--for instance in the euro area and Japan—monetary policy can remain accommodative.

Financial sector policies and resolution frameworks: Measures to support credit and stabilize balance sheets—including credit guarantees, debt moratoria, and release of capital and liquidity buffers—should become more targeted (see the October 2021 *Global Financial Stability Report*). Support can be focused for example on smaller but viable banks and firms in sectors where the recovery is lagging because of ongoing health-related concerns. At the same time, policymakers should strengthen out-of-court mechanisms to expedite resolution of debt overhangs—facilitating capital reallocation and reducing the risk of keeping low-productivity zombie firms afloat.

Preparing for a possible tightening of external financial conditions: Although the exact timing may be hard to predict, the strengthening recovery in advanced economies presages an eventual end to the extraordinary monetary support and rising yields. Emerging market and developing economies should prepare for a possible increase in advanced economy interest rates through debt maturity extensions where feasible, thereby reducing their rollover needs. Regulators should also focus on limiting the buildup of balance sheet mismatches. In countries with deep financial markets and low balance sheet mismatches, exchange rate flexibility can help absorb shocks while also permitting monetary policy to address domestic macroeconomic conditions. Foreign exchange intervention and temporary capital flow management measures may be useful however in some circumstances in countries with balance sheet vulnerabilities and market frictions. These measures can increase the autonomy of monetary policy to respond to domestic inflation and output developments (Adrian, Gopinath and Pazarbasioglu 2020). But they should not substitute for needed macroeconomic adjustment.

Preparing and Investing for the Longer Term, Post-Pandemic Economy

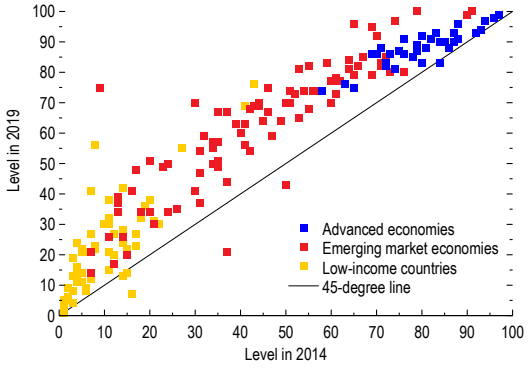
Even as the pandemic re-intensifies and its duration is highly uncertain, the challenges policymakers will face in the economy after the health crisis fades are becoming increasingly visible. If downside risks on the pandemic's evolution materialize, then there could be a need for permanently higher health spending (including medical infrastructure) to adapt to a more adverse disease environment. Outside of these potential changes, key challenges include facilitating new growth and productivity opportunities related to green technology and digitalization, reversing the setback to human capital accumulation, and containing increases in inequality. At the same time, elevated debt levels in many countries will require efforts to place public finances on a sustainable footing. Once economies are more firmly on durable recovery paths, policies will need to more strongly address these challenges.

- *Facilitating new growth opportunities: greening the economy and facilitating digitalization*. As discussed earlier, a green investment push would aid the transition to a cleaner economy while catalyzing new growth opportunities, for example in the construction and energy sectors. Moreover, investing in broadband to improve access to the internet can help bridge the digital divide (Figure 1.22). Building on the policies to secure the recovery, structural reforms that reduce labor market rigidities, repair balance sheets, and improve competition can also help reallocate resources toward growing sectors and raise long-term productivity.
- *Reversing the setback to human capital accumulation*. The pandemic-induced global loss of learning from temporary school closures (Figure 1.23) could potentially have long-lasting effects on individual earnings and aggregate productivity growth. To reverse the setback to human capital accumulation and long-term potential, policymakers may need to try a variety of strategies, including greater time in school over the next few years, additional teacher training on methods to aid catch-up, and expanding extracurricular tutoring programs (see J-PAL 2019 and World Bank 2020a for examples on strategies and tools). Furthermore, educational and vocational programs may need to be adapted to evolving post-pandemic labor demand, with facility with digital technologies becoming a feature of more jobs and greater anticipated employment needs in sectors requiring more specialized skills (like health care).

- *Reducing inequality.* The setback to human capital accumulation is one dimension along which inequality is likely to increase as a result of the pandemic. Beyond policies to improve educational achievement, spending measures that can improve the resilience of individuals and households and lower inequality include greater coverage of social assistance—via conditional cash transfers, in-kind food benefits, and medical coverage for low-income households–and expanded social insurance (including unemployment benefits for the self-employed and gig workers, greater availability of paid family and sick leave).
- *Addressing sovereign debt overhangs.* The room for initiatives to address the challenges of the post-pandemic economy is limited in many instances, particularly among emerging market and developing economies. Even with relatively low interest rates, overall debt service burdens are set to rise among emerging market economies because of the large increase in the stock of debt over the pandemic. Governments with large debt stocks and high interest burdens will need to institute both revenue and expenditure measures to alleviate the situation. On the revenue side, these include: increasing progressive income taxes, reducing loopholes and deductions, adopting well-designed value-added taxes, and expanding the tax base—by relying more on e-filing for instance and building capacity for property taxation. These initiatives can be complemented with efforts to scale back poorly targeted subsides and improve the governance of public investment (for instance through greater transparency and disclosure of procurements, instituting specific budget lines, and subjecting the projects to regular audits). Such measures will be particularly relevant for low-income developing countries where advancing toward their Sustainable Development Goals remains an overarching challenge. As noted earlier, the international community will need to play a more active role in supporting these countries, including through debt restructuring and reprofiling where needed.

Figure 1.22. Internet Access around the World
(Individuals using the internet, percent of population)

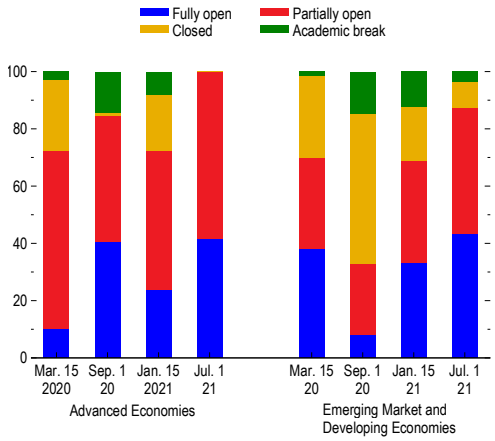
Although improving over the five years before the pandemic, there are still large gaps across economy groups in the share of individuals with internet access.



Sources: International Telecommunication Union, World Telecommunication/ICT Indicators Database; and IMF staff calculations.
Note: Each square in the figure corresponds to a country. For countries where data for 2019 are not available, the latest available value is shown on the *y*-axis, and the value for the preceding five years is shown on the *x*-axis.

Figure 1.23. School Closures and Enrollment
(Percent of students)

Although there have been recent increases in the share of schools open, the pandemic's impact on schooling persists, hurting students' future prospects.



Sources: UNESCO (https://en.unesco.org/covid19/educationresponse); and IMF staff calculations.

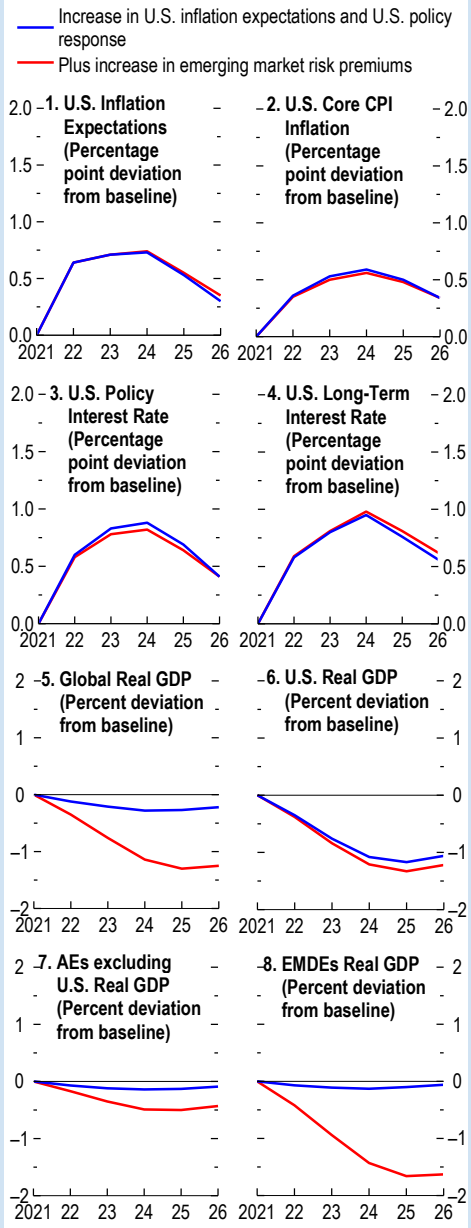
Scenario Box: Downside Scenarios

This box examines two downside scenarios: first, U.S. inflation expectations rising more than expected over the next three years; second, the implications of living with endemic COVID-19 well into the medium term.

Risk of rising US inflation expectations. Although inflation expectations have been relatively well anchored in most industrial countries for an extended period, a confluence of factors are starting to line up as discussed in Chapter 1 and 2. These factors appear to be particularly pressing in the case of the United States. High current US inflation, a real risk that inflation could remain persistently high, and some uncertainty about exactly how tolerant the Fed will be of this high inflation could lead to a persistent shift upwards in inflation expectations.

The IMF's G-20 Model is used here to consider the implications of a sequence of unexpected ½ percentage point shocks to U.S. inflation expectations over 2022-24. The shocks then fade out over 2025-26. The expectations-driven inflation surprises are assumed to overshoot the Fed's comfort zone suggested by its new average-inflation-targeting framework, causing it to respond. Higher policy rates and an increase in the term premium yield higher long-term rates in the US (almost 100 basis points above baseline at its peak). These are transmitted globally based on empirical spillover analysis. Monetary policy in Japan and the euro area is assumed not to respond (because space is exhausted); the same is assumed for emerging market economies (for fear of triggering capital outflows). The simulated impact is shown in the blue line Scenario Figure 1.1. Furthermore, country specific risk premiums are assumed to increase based on staff assessment of relative vulnerabilities (peaking at 150 basis points on average in 2024). The impact is shown in the red line.

Scenario Figure 1.1. Increase in United States Inflation Expectations



Source: G-20 model simulation; and IMF staff estimates.
Note: AEs = advanced economies; EMDEs = emerging market and developing economies.

These factors lead to US output below baseline by almost 1¼ percent by 2026. At the global level, output is also below baseline by roughly 1¼ percent by 2026. Emerging market economies suffer disproportionally: GDP falls by just over 1½ percent at its trough, roughly four times more than the decline in GDP in advanced economies excluding the United States.

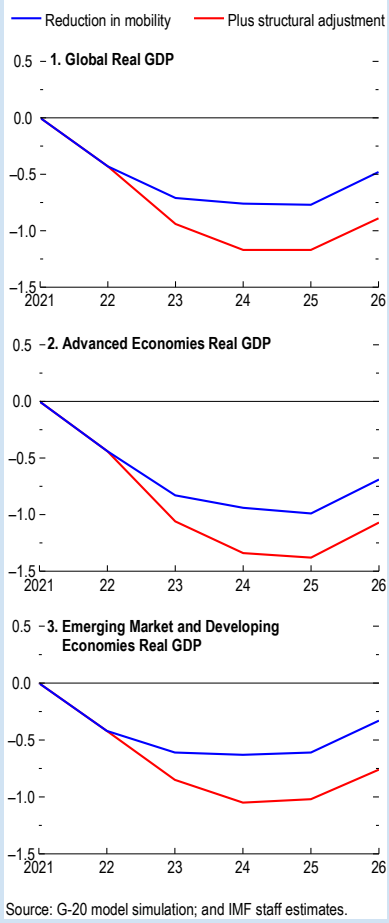
The authors of this box are Allan Dizioli, Keiko Honjo, Benjamin Hunt, and Susanna Mursula.

Endemic COVID. The second downside scenario explores the possible implications of having to live with COVID-19 well into the medium term. The motivation for this scenario is twofold. First, vaccinations, although critical in the fight, will not on their own put an end to the virus's circulation. Second, constraints on vaccine availability and vaccine hesitancy mean there is likely to be a significant number of unvaccinated people for an extended period.

Constantly having to live with COVID-19 means that activity in many contact-intensive sectors may never return to pre-pandemic levels and significant adjustments are likely to be required. To estimate how this adjustment might unfold, the standard SEIRD model with vaccines was extended in several dimensions to incorporate recent news about the effectiveness of vaccines and vaccine penetration.

The analysis assumes that vaccine efficacy against infections wanes over time to only 50 percent after six months; infected non-vaccinated people are 40 percent more infectious than infected vaccinated people; infectiousness of the virus is as high as the Delta variant; vaccines are 100 percent effective against deaths in the first six months and then 90 percent effective after that; and vaccine hesitancy will limit the fully vaccinated share even once the virus becomes endemic. Surveys are used to estimate final shares of populations fully vaccinated. Further it is assumed that people would voluntarily reduce their mobility so that deaths are 50 percent lower than they would be with pre-pandemic levels of mobility. Moreover, as companies improved their hybrid work models and teleworking technologies improve, the elasticity of GDP to mobility is further reduced and it is only one third of the elasticity we observed in 2021Q1.

Scenario Figure 1.2. Living with COVID-19
(Percent deviation from baseline)



Source: G-20 model simulation; and IMF staff estimates.

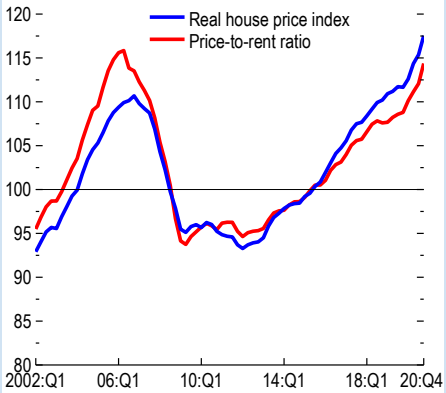
The estimated declines in domestic demand from the SEIRD model-based analysis under the above assumptions are mapped into the IMF's G-20 Model to estimate the global impact including spillovers via trade. The simulated results are presented in the blue line in Scenario Figure 1.2. In addition to the direct demand impact of reduced mobility, structural changes will be needed to minimize the impact of the virus in the medium term. Some of the existing capital stock will no longer be viable and new capital will need to be put in place. Productivity growth will be temporary reduced as firms adjust to the additional constraints. The natural rate of unemployment will likely rise as labor is reallocated. The scenario assumes these forces will be roughly half as large as has been assumed for baseline scarring effects. The estimated additional impact of these structural changes is given by the red line in Scenario Figure 1.2.

These factors are estimated to take over 1 percent off the level of global GDP by 2025, with a gradual recovery back toward baseline starting subsequently. Advanced economies are more negatively impacted than emerging economies owing to the estimates of vaccine hesitancy. [i]

Box 1.1 House Prices and Consumer Price Inflation

Steady as she goes. Contrary to the expectation that house prices would decline during recessions (Igan and others 2011; Duca, Muellbauer, and Murphy 2021), real house prices rose by 5.3 percent on average globally in 2020 as the pandemic-induced economic downturn took hold. Perhaps more strikingly, this has been the highest annual growth rate observed in the past 15 years (Figure 1.1.1). While house price growth has breezed ahead, residential rents have grown at a slower rate, rising by 1.8 percent on average across countries over the same period.[1]

Figure 1.1.1. Global Housing Indicators
(GDP-weighted indices, 2015 = 100)



Sources: Bank for International Settlements; Haver Analytics; and IMF staff calculations.
Note: The sample covers 57 countries. Nominal house price data are deflated by consumer price index.

Implications of a hot housing market for consumer prices. The house price surge comes at a time when questions are mounting over post-pandemic inflation dynamics (October 2021 WEO Chapter 2). House prices matter for inflation because—through an asset pricing equation—they are linked to two measures of housing costs that could enter the consumer price index (CPI). One is the actual rent paid by tenants. The other is the imputed rent, or owner's equivalent rent (OER), which is an estimate of how much homeowners would need to pay were they to rent their own house.[2,3] Overall, the rent component accounts on average for about 20 percent of the CPI.[4]

The authors of this box are Nina Biljanovska, Chenxu Fu, and Deniz Igan.

[1] Rents are proxied by the rent expenditure component of the national consumer price index (CPI) due to lack of data availability on market rents across countries. It is worth noting that the proxy used for the CPI could diverge from the rental rates asked by landlords. In the United States, for instance, the rent index (based on data from apartmentlist.com) recorded a monthly average increase of 0.18 percent in 2017-19, compared to the 0.3 percent average monthly increase in the rent of primary residence component in the CPI (as published by the BLS). The two series diverged considerably in 2020 with the rent index *declining* by 1.2 percent and the rent of primary residence component increasing by 1.8 percent. This large divergence in part may reflect the policy support measures banning evictions during the pandemic.

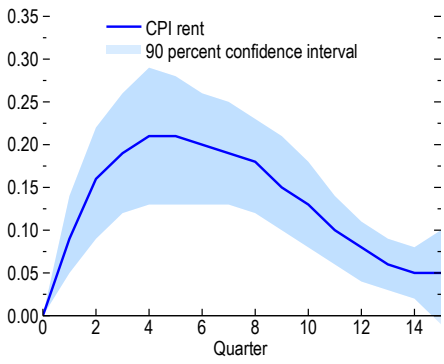
[2] There is variation in how different countries incorporate either of these components in their inflation measures. Some include only the actual rent; others also include imputed rent. Data on these sub-components of the national CPI series are available for 45 countries, of which only a third consider *imputed* rental cost in addition to *actual* rental costs in the calculation of the CPI. House prices themselves are not included in the CPI because house purchases are regarded as investment, not consumption. Also note that, while many countries use the rental equivalence method to estimate the cost of owner-occupied housing, a few (e.g., Australia and New Zealand) use the net acquisition approach with the aim to capture the cost of purchasing a dwelling, excluding the land component but including transfer, insurance, and maintenance costs.

[3] From a theoretical perspective, OER overstates the cost of owner-occupied housing because it fails to account for capital gains from and the favorable tax treatment of homeownership (Dougherty and van Order 1982; Muellbauer 2012). The theoretically superior alternative of *user cost* is difficult to implement in practice given challenges in measuring expected capital gains and risk premia.

[4] This weight ranges from 14 to 49 percent across countries, with 15 and 23 percent being the 25th and 75th percentiles, respectively. Note that, in most cases where owner-occupied costs are approximated by the rental equivalence method, this excludes other shelter-related expenditures such as maintenance and utilities.

How much of an increase in inflation is expected? To what extent house prices feed into the rent-based components in the CPI is a question of the nature and persistence of the observed dynamics.[5] A cross-country estimate of the link between nominal house price growth and CPI rent inflation suggests that a one percentage point year-on-year increase in nominal house prices in the quarter ahead is associated with a cumulative increase of 1.4 percentage points in annual rent inflation over a period of two years (Figure 1.1.2).[6] The effect is the strongest in the fourth quarter following the increase and persists for about three years. Then, considering that rent costs account for about 20 percent of the consumer basket, a 5.3 percent increase in nominal house prices—corresponding to the nominal house price growth rate over the period 2019Q4-2020Q4—would translate to a cumulative increase of 1.5 percentage points in inflation over a period of two years. The pass-through to overall inflation and the degree of persistence remain uncertain, and depends on how the factors behind house price increases will evolve: the ultra-low-for-long interest rate environment, which has pushed mortgage rates to very low levels; low housing inventory,[7] induced by production shortfalls and sellers' hesitancy to put houses on the market; and, shifts in consumption patterns toward housing and away from, for example, travel, dining, and entertainment (see October 2021 GFSR Chapter 1 for a discussion on house-prices-at-risk). And, beyond translation to inflation through the rent component, policymakers have other reasons to monitor and take actions in response to rising house prices where necessary: the impact on affordability and cost of living, potential resource misallocation and risk of overheating even in the absence of visible inflationary pressures, and implications for financial stability.

Figure 1.1.2. Response of CPI Rent Inflation to a 1 pp Shock to Nominal House Prices
(Percentage points)



Sources: Haver Analytics; national statistics offices; and IMF staff calculations.
Note: CPI = consumer price index; pp = percentage point.

[5] Rents are not as procyclical as prices, see, for example, Glaeser and Nathanson (2015). Plausible explanations include the non-forward-looking nature and stickiness of rents (e.g., due to long-term rental contracts or regulatory limits on annual rent increases to protect tenants).

[6] The econometric specification used to estimate the impact of movements in house prices on CPI rent inflation is: $\Delta ln(rent_{i,t}^{h}) = \sum_{k=1}^{4} \alpha_k^h \, \Delta ln(rent_{i,t-k}) + \sum_{k=1}^{4} \beta_k^h \, \Delta ln(nhp_{i,t-k}) + \sum_{k=1}^{4} \gamma_k^h \, \Delta ln(cpi\_exp_{i,t-k}) + \delta_i^h + \theta_t^h + \varepsilon_{i,t}^h$, where i indexes countries and t indexes quarters; $\Delta ln(rent_{i,t}^{h})$ is the annualized growth rate in CPI rent; $\Delta ln(nhp_{i,t-k})$ is the annualized growth rate in nominal house prices; $\Delta ln(cpi\_exp_{i,t-k})$ is inflation expectations for the current year; δ_i^h are country fixed effects; θ_t^h are time fixed effects; and $\varepsilon_{i,t}^h$ are standard errors clustered at the country level. The regression equation is estimated using local projections over a horizon $h = 14$, and the coefficient of interest is β_1^h, plotted in the figure. The sample is a (unbalanced) panel of 45 countries over the period 1970q1-2020q4.

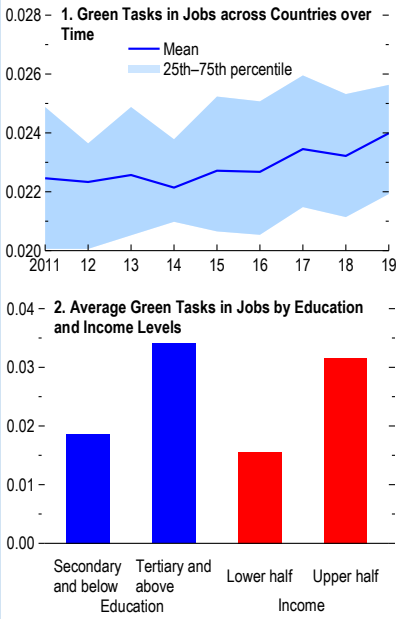
[7] In the United States, for example, days on market fell sharply in 2021 from about 45 days to 35 days for condos while the drop for single-family homes was even sharper to only 20 days.

Box 1.2. Jobs and The Green Economy

Achieving the reductions in greenhouse gas (GHG) emissions needed to mitigate global warming will require a transformation of the global economy. This green economic transformation will likely necessitate a shift of workers away from carbon-intensive and environmentally destructive production processes toward jobs that help reduce GHG emissions and improve environmental sustainability. These "green" or "greener" jobs include newer occupations using emerging technologies which are expected to see increased demand with the greening of the economy (such as jobs related to solar and wind power installation and maintenance), as well as existing occupations with markedly enhanced or changed skill sets required for a low-carbon economy (such as jobs in automotive repair, power plants, and mining operations).[1] But how prevalent are these jobs in the economy, what sectors and kinds of workers have them, and what have been the recent trends in their growth? This box examines these questions about green jobs and provides some perspectives on how the job market could be impacted by the green transition.

A key question for policy makers is how the transition to a greener economy will affect employment, both in the aggregate and across sectors and skill levels. A first step in answering this question is defining what green jobs are. In this box, green jobs are identified using the O*NET Center (2021) taxonomy of green occupations. This taxonomy enables occupations to be sorted into 3 categories: (i) new occupations based on tasks that use emerging technologies to green the economy; (ii) occupations that are expected to undergo significant changes in the kind and composition of tasks they do owing to greening of the economy; and (iii) other occupations, which do not involve green tasks. For each occupation, a green task intensity measure is computed as the ratio of green to total tasks, following Vona and others (2018). For remaining occupations (in the third category), their green task intensity is set to zero. Aggregate green task intensity indices are computed as employment-weighted averages for the relevant workforce. At the economy level, this index can be thought of as proxying the share of tasks undertaken by the workforce that are directly contributing to the green economic transition.[2]

Figure 1.2.1. Green Tasks in Jobs across Countries and Worker Groups
(Share of green tasks in employment)



Sources: European Union Labor Force Survey; Occupational Information Network (O*NET); US Current Population Survey; and IMF staff calculations.
Note: The figure shows the 25th percentile, mean, and 75th percentile across countries. The indicator for green tasks is computed as the employment-weighted average share of tasks that are green across occupations in an economy (Vona, Marin, and Consoli 2019). Sample comprises AUT, BEL, CHE, CYP, CZE, DEU, DNK, ESP, FIN, FRA, GBR, GRC, HRV, HUN, IRL, ISL, ITA, LTU, LUX, NLD, NOR, POL, PRT, ROU, SVK, SWE, and USA. International Organization for Standardization (ISO) codes are used to indicate the country. The share of workers with secondary education and below is 79 pecent. The share with tertiary and above is 21 percent.

The authors of this box are John Bluedorn and Niels-Jakob Hansen with support from Savannah Newman.

[1] See O*NET Center (2021) for details on the task-based classification of occupations according to the relationship to the greening of the economy. For examples of studies applying this taxonomy to the U.S., see Consoli and others (2016); Bowen, Kuralbayeva, and Tipoe (2018); and particularly Vona and others (2018).

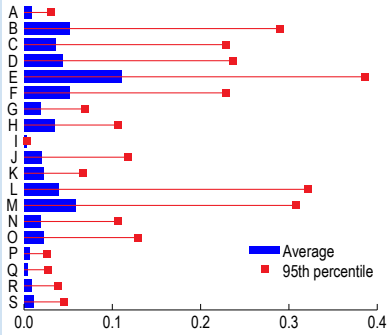
[2] Jobs that *only* do green tasks include: "Wind Energy Operation Managers," "Brownfield Redevelopment Specialists and Site Managers," "Hazardous Material Removal Workers," and "Weatherization Installers and Technicians." Examples of other jobs with high shares of green tasks (40–50 percent) include: "Automotive Specialty Technicians," "Civil Engineers," and "Plumbers."

Figure 1.2.1, panel 1 shows how the aggregate green task index has evolved during 2011–19. The index is computed using micro-level data for the United States and a selected group of European Union member countries. The figure suggests that the share of green tasks in the average job has increased marginally since 2014 from around 2.2 percent to around 2.4 percent, with some variation across countries. A growing proportion of workers are employed in greening occupations, caused by employment shifts either within or between sectors. But the pace of increase is slow with no marked evidence for greening of jobs. The urgency of the climate change threat suggests that a faster transformation will be needed going forward.

Figure 1.2.2 shows both the average green task index by sector and the distribution across occupations within each sector. The two sectors with the largest share of green tasks are "Water and Waste Management" and "Professional and scientific activities." However, green tasks are also being performed in other sectors, including those usually associated with higher carbon emissions, such as heavy industry. Moreover, jobs with workers at higher levels of educational attainment or income tend to involve more green tasks (Figure 1.2.1, panel 2).

Overall, the evidence presented in this box suggests that jobs have become greener over the last decade. In addition, green tasks are being performed across all sectors—an important nuance about the potential impact of the green transition only evident from examining employment through the lens of occupations and tasks. Finally, workers with higher educational attainment and higher incomes are more likely to be in jobs involving greener tasks. In other words, greener jobs tend to be higher skill and income jobs, highlighting the complementarity between investing in people and boosting the green economic transition. Lower-skilled workers should receive the training and support needed to ensure that the green transition is inclusive.

Figure 1.2.2. Green Tasks in Jobs across Sectors
(Share of green tasks in employment)



Sources: European Union Labor Force Survey; Occupational Information Network (O*NET); US Current Population Survey; and IMF staff calculations.
Note: The indicator for green tasks is computed as the employment-weighted share of tasks that are green across occupations by sector (Vona, Marin, and Consoli 2019). A: agriculture, forestry and fishing; B: mining and quarrying; C: manufacturing; D: electricity and gas, steam and air-conditioning supply; E: water supply and sewage, waste management and remediation; F: construction; G: wholesale and retail trade; H: transportation and storage; I: accommodation and food service; J: information and communication; K: financial and insurance; L: real estate; M: professional, scientific, and technical; N: administrative and support services; O: public administration and defence; P: education; Q: human health and social work; R: arts, entertainment, and recreation; S: other service activities. Sample includes: AUT, BEL, CHE, CYP, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HRV, HUN, IRL, ISL, ITA, LTU, LUX, LVA, NLD, NOR, POL, PRT, ROU, SVK, SWE, and USA.

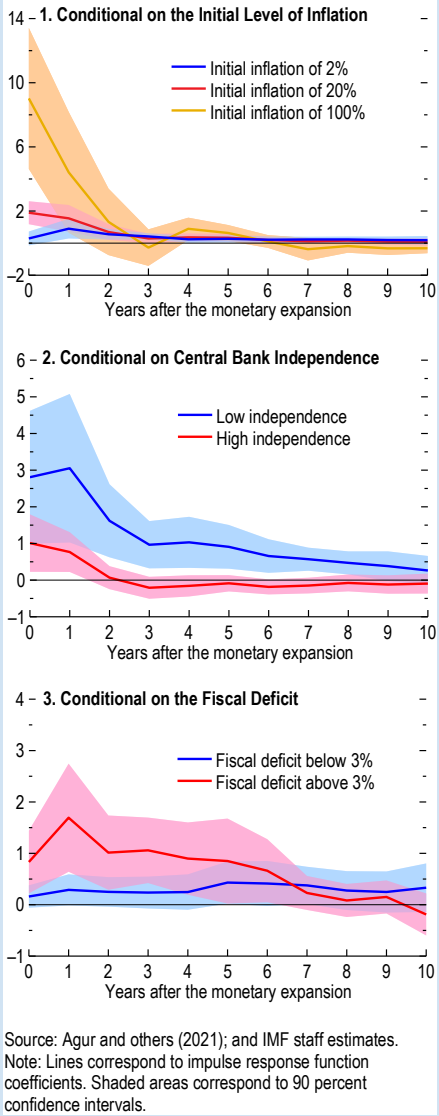
Box 1.3 Monetary Expansions and Inflationary Risks

The COVID-19 pandemic has prompted various central banks to cut policy rates close to zero and pushed fiscal authorities to massive fiscal expansions, leading to sharp increases in public debt and, in some countries, casting doubts about debt sustainability. Given the constraints faced by conventional monetary policy and fiscal policy, central banks in various countries will likely remain under pressure to use unconventional policy tools to support the economic recovery and react to possible adverse shocks.

Besides using forward guidance and in a few cases resorting to negative interest rates, central banks in advanced economies have increasingly relied on refinancing operations and large-scale purchases of government bonds and even private securities. During the pandemic, central banks in several emerging markets and developing economies have undertaken similar, albeit modest, asset purchases, sometimes with the explicit goal to provide fiscal support.

Asset purchases by central banks are generally financed through an expansion of the monetary base (MB). These operations have at times blurred the demarcation between monetary and fiscal policies, raising the specter of fiscal dominance. The concern is that monetary-base expansions may de-anchor inflation expectations and trigger severe price pressures if they are perceived as responding to fiscal pressures rather than to macroeconomic stabilization goals. To shed light on this issue, in Agur and others (2021) we analyze the association between increases in the monetary base and changes in inflation up to ten years in the future using a large panel of countries with data going back to the 1950s. The analysis uses local projections that control for the real growth rate of GDP and lagged values of money growth and inflation.

Figure 1.3.1. Change in Inflation after a 10 Percent Increase in the Monetary Base
(Percentage points)



Source: Agur and others (2021); and IMF staff estimates.
Note: Lines correspond to impulse response function coefficients. Shaded areas correspond to 90 percent confidence intervals.

The association between money growth and inflation depends heavily on economic conditions and institutional factors, especially in the first few years after the monetary expansion. An expansion of the monetary base is followed by only a modest increase in inflation if the initial level of inflation is low (panel1), the central bank operates under strong independence (panel 2), and the fiscal deficit is modest (panel 3). On the contrary, a monetary expansion tends to be

The authors of this box are Itai Agur, Damien Capelle, and Damiano Sandri.

followed by sharp increases in inflation if the initial level of inflation is high, central bank independence is weak, and the fiscal deficit is large.

These results suggest that asset purchases financed via an increase in the monetary base are unlikely to trigger sharp inflation responses if they are deployed by credible central banks when inflation is below target and the fiscal position is sustainable. Nonetheless, central banks should remain vigilant about the possible inflationary effects recent monetary expansions because their balance sheets have reached historically high levels in several countries and due to the concomitant effects of large fiscal stimulus during the COVID-19 pandemic. Central banks should instead refrain from asset purchases if they operate under weak independence and in the context of high inflation and precarious fiscal positions. In these circumstances, monetary expansions are much more likely to fuel sharp price responses, possibly reflecting heightened risks of fiscal dominance.

Commodity Special Feature: Market Developments and Forecasts

Primary commodity prices rose 16.6 percent between February and August 2021. The sharp, broad-based increase, led by metals and energy commodities, was buoyed by a strong recovery in commodity demand, loose financial conditions, and supply-side and weather disruptions. A resurgence of COVID-19 is the major risk factor. This special feature also analyzes how the soaring demand for metals may delay the energy transition.

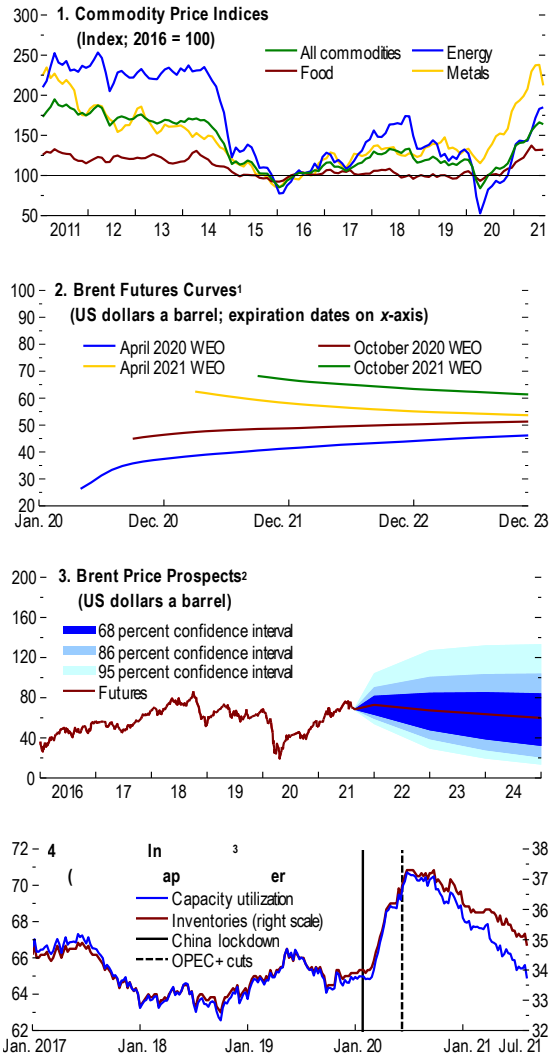
Market Developments

Oil prices rose 13.9 percent between February and August 2021 on the rapid economic recovery in advanced economies. In light of falling global inventories (Figure 1.SF.1 panel 4), OPEC+ (Organization of the Petroleum Exporting Countries, plus Russia and other non-OPEC oil exporters) agreed in July to gradually phase out their remaining 5.8 million barrel a day production curbs by September 2022.

Futures prices point to *backwardation* (a downward sloping curve), with oil prices at $65.7 a barrel in 2021—59 percent higher than the 2020 average—falling to $56.3 in 2026. Market tightness is expected to continue—in line with the International Energy Agency's oil demand recovery projections. Risks to oil prices are [balanced] in the near term. Upside risks include lower global production capacity (because investment has fallen over the past year) and prolonged price support by OPEC+. The rise of the Delta variant of SARS-CoV-2 and higher output from uncommitted OPEC+ members (Iran, Libya, Venezuela) and US shale oil producers are the major downside risks to oil prices in the near term (Figure 1.SF.1, panels 2 and 3).

Natural gas prices spiked globally. Asian liquefied natural gas prices rose 132.2 percent to $16.6 a million British thermal units (MMBTU), between February and August 2021, spilling over to European and US prices. The price spike was driven mainly by depleted natural gas stocks after a harsh winter, coupled with hot summer weather in the Northern Hemisphere, rebounding industrial activity, and idiosyncratic factors such as low hydropower output in Brazil. High natural gas prices sustained the power sector's

Figure 1.SF.1. Commodity Market Developments



Sources: Bloomberg Finance L.P.; IMF, Primary Commodity Price System; Kpler; Refinitiv Datastream; and IMF staff estimates.
Note: OPEC+ = Organization of the Petroleum Exporting Countries, including Russia and other non-OPEC oil exporters; WEO = *World Economic Outlook*.
1Baseline assumptions for each WEO and are derived from futures prices. October 2021 WEO prices are based on August 18, 2021 closing.
2Derived from prices of futures and options on August 18, 2021.
3Inventories are expressed in days of 2019 oil consumption.

demand for coal, although surging coal prices—caused in part by supply disruptions and China's restrictions on Australian coal imports—and higher carbon prices narrowed coal's cost advantage. Over the long term, phaseout plans and rising emission costs may negatively weigh on the demand outlook for coal, possibly benefiting natural gas demand in the coming years as the capacity for renewables ramps up.

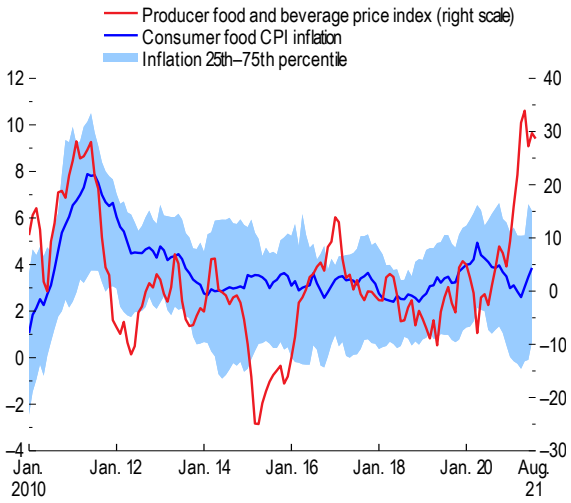
The IMF base metal price index rose 9.7 percent between February and August 2021, while precious metal prices decreased by 1.8 percent. Base metals reached a 10 year high in July but have retreated somewhat since then. Prices were buoyed by the recovery in global manufacturing, improved prospects for infrastructure investment in advanced economies, and supply disruptions due to COVID-19. Expectations of higher metal demand during the energy transition supported prices for copper, cobalt, and other metals. Loose financial conditions provided additional price support.

The base metal price index in 2021 is projected to be 57.7 percent higher than the previous year average and to decrease 1.5 percent in 2022. Risks to the outlook are balanced, but the rise of the Delta variant is a major source of uncertainty as the resurgence of the virus may suppress demand for metals as well as disrupt supply. The pace of the energy transition adds uncertainty to the demand for some metals (see below). Precious metal prices are expected to rise 5.1 percent in 2021 and 0.2 percent in 2022.

Food prices: During the first half of 2021 prices of many staple crops surged, continuing the trend noted in the April 2021 *World Economic Outlook*. The IMF's food and beverage price index rose 11.1 percent between February and August, peaking in May 2021 at the highest price in real terms since the 2010-11 world food price crisis—led by meat (up 30.1 percent), coffee (29.1 percent), and cereals (5.4 percent).

Continued increases in international food producer prices pose upside risks to consumer food price inflation (Figure 1.SF.2), especially in emerging markets, where the pass-through from producer to consumer prices is higher than in advanced economies (26 percent versus 14 percent). The lag and magnitude of the pass-through vary according to regional factors such as dependence of food imports and the strength of the local currency against the US dollar.

Figure 1.SF.2. Rising Pressure on Consumer Food Prices
(Percent)



Sources: Haver Analytics; and IMF staff calculations.
Note: Global food inflation represents the average level of consumer food price inflation in 91 countries. CPI = consumer price index.

Clean Energy Transition and Metals: Blessing or Bottleneck?

To limit global temperature increases from climate change to 1.5°C, countries and firms increasingly pledge to reduce carbon dioxide emissions to net zero by 2050. Reaching this goal requires a transformation of the energy system that could substantially raise the demand for

metals. Low-greenhouse-gas technologies—including renewable energy, electric vehicles, hydrogen, and carbon capture—require more metals than their fossil-fuel-based counterparts.

If metal demand ramps up and supply is slow to react, a multiyear price rally may follow—possibly derailing or delaying the energy transition. To shed light on the issue, this Special Feature introduces "energy transition" metals, estimates price elasticity of supply and presents price scenarios for major metals. It provides estimates for revenues and identifies which countries may benefit.

Critical Metals for Green Technologies

The metals required for the clean energy transition are quite diverse (Table 1.SF.1). Some, such as copper (Cu) and nickel (Ni) (major *established* metals), have been traded for more than a century on metal exchanges. Others like lithium (Li) and cobalt (Co) (minor but *rising* metals), are thinly or not yet traded on metal exchanges but have gained popularity because they are used in energy transition technologies. In addition, the demand for some metals would increase with more certainty, because they are used across a range of low-carbon technologies (copper, nickel, and manganese, for example), while the use of others, such as cobalt and lithium, is limited to one main technology, such as batteries.

Table 1.SF.1. Key Indicators for Energy Transition Metals

Metal	Exchange Traded	Energy Transition Usage				Production (2020, $ billion)
		Renewable	Network	Battery	Hydrogen	
Copper	✓	✓	✓	✓		123.0
Aluminum	✓	✓	✓	✓	✓	107.0
Nickel	✓	✓		✓	✓	28.0
Zinc	✓	✓				28.0
Lead	✓	✓		✓	✓	26.0
Silver	✓	✓				13.0
Manganese	No	✓		✓	✓	25.0
Chromium	Recent	✓				19.0
Silicon	No	✓				14.0
Molybdenum	Recent	✓			✓	5.0
Cobalt	Recent			✓		4.1
Lithium	Recent			✓		1.8
Vanadium	No			✓		1.3
Graphite	No			✓		1.3

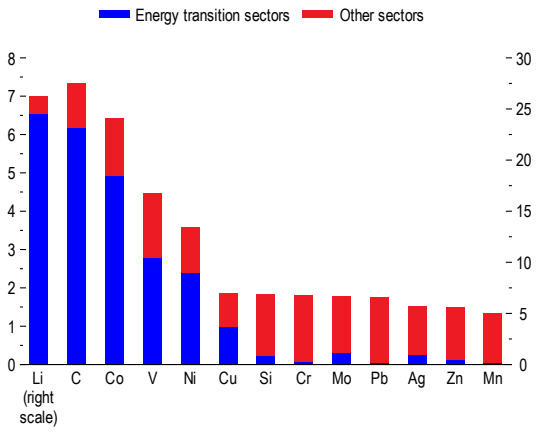
Sources: International Energy Agency (2021); World Bank (2020); and IMF staff calculations.
Note: The column "Production" is the value of refined and unrefined mining production.

The four representative metals chosen for in-depth analysis are copper, nickel, cobalt, and lithium. Copper and nickel are well-established metals. Cobalt and lithium are probably the most promising *rising* metals.

In the net zero emissions scenario of the International Energy Agency (IEA), total consumption of lithium and cobalt rises by a factor of more than six, driven by clean energy demand, while Copper shows a twofold and nickel a fourfold increase in total consumption (see Figure 1.SF.3).[1]

The IEA's net-zero scenario also implies that the growth in metal demand would initially be very high, between now and 2030and slow down over time, because the switch from fossil fuels to renewables requires large initial investments (Figure 1. SF.4). The increases in demand for the metals are more modest in the Stated Policies Scenario.

Figure 1.SF.3. Demand for Critical Energy Transition Metals May Increase Sharply in the Next Two Decades
(Ratios, 2030s average consumption relative to 2010s average)



Sources: International Energy Agency; Schwerhoff and Stuermer (2020); and IMF staff estimates.
Note: The bars represent decade ratios: consumption of each metal in the 2030s divided by consumption in the 2010s, under the IEA's Net Zero scenario. See Online Annex 1.SF.1 for the selection of metals and abbreviations.

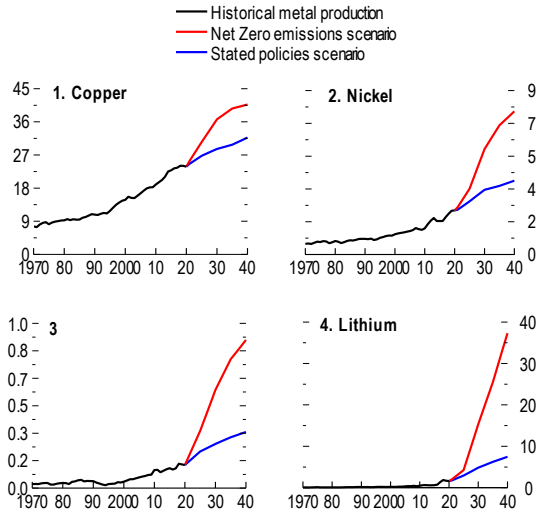
[1] The IEA's Net -Zero by 2050 Scenario assumes that policies and behavioral changes bring carbon emissions to net zero by 2050. The IEA's Stated Policies Scenario assumes a more gradual energy transition, resulting in insufficient action on climate change (IEA2021, p. 11).

Where Will Energy Transition Metals Be Produced? Who Will Benefit?

The supply of metals is quite concentrated, implying that a few top producers may stand to benefit. In most cases, countries that have the largest production have the highest reserves and, thus, are likely prospective producers. The Democratic Republic of the Congo, for example, accounts for about 70 percent of global cobalt output and 50 percent of reserves (Figure 1.SF.5). Other countries that stand out in production and reserves include Australia (for lithium, cobalt, and nickel), Chile (for copper and lithium), and, to lesser extent, Peru, Russia, Indonesia, and South Africa.

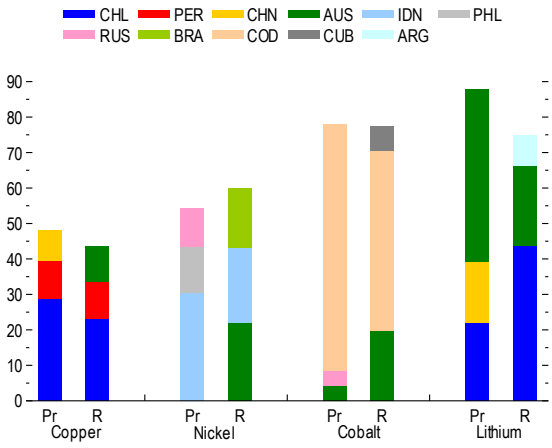
The economic benefits of higher prices for metal exporters could be substantial. Econometric analysis identifies the impact of price shocks, exploiting the different responses of GDP and government balances between the 15 largest metal exporters and importers. A 15 percent persistent increase in the IMF metal price index adds an extra 1 percentage point of real GDP growth (fiscal balance) for metal exporters compared with metal importers (Figure 1.SF.6).

Figure 1.SF.4. Historical Metal Production and IEA Energy Transition Scenarios
(Million metric ton)



Sources: International Energy Agency; Schwerhoff and Stuermer (2020); US Geological Survey; and IMF staff calculations.
Note: Copper and nickel refer to refined production, while cobalt and lithium refer to mine production. IEA = International Energy Agency.

Figure 1.SF.5. Top Three Countries by Share of Global Production and Reserves for Selected Metals
(Percentage points)



Sources: United States Geological Survey; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. Pr = Production; R = Reserves.

Metal Prices and Supply Elasticities in a Net-Zero Scenario[2]

Supply elasticities summarize how fast firms raise output in reaction to a price increase. In the short term, supply grows thanks to more recycling and higher utilization rates of mining capacity. In the long term, firms build new mines, innovate in extraction technologies, and conduct exploration.[3] To estimate the elasticity at different horizons, data are used for global economic activity, output, and real prices from 1879 to 2020, where available.

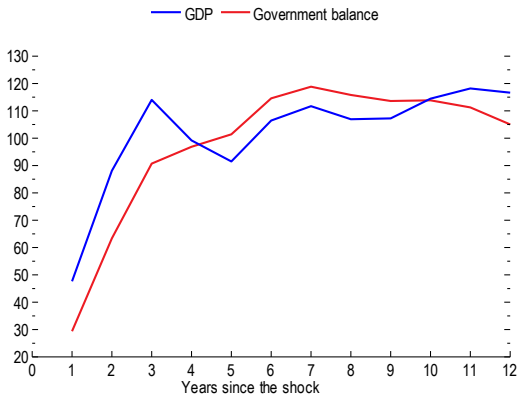
[2] The econometric analysis of this section and subsequent sections is based on Boer, Pescatori, and Stuermer (2021).

[3] Geological reserves are not fixed but dynamic. Firms can increase their reserves by investing in exploration and extraction technologies. The amount of metals in the Earth's crust is quite abundant compared to human extraction in any time frame relevant for economic considerations (see Schwerhoff and Stuermer, 2020).

Results show that supply is quite inelastic over the short term but more elastic over the long term (Figure 1.SF.7). A demand-induced positive price shock of 10percent increases the same-year output of copper 3.5 percent, nickel 7.1 percent, cobalt 3.2 percent and lithium 16.9 percent. After 20 years, the same price shock raises the output of copper 7.5 percent, nickel 13.0 percent, cobalt 8.6 percent, and lithium 25.5 percent.

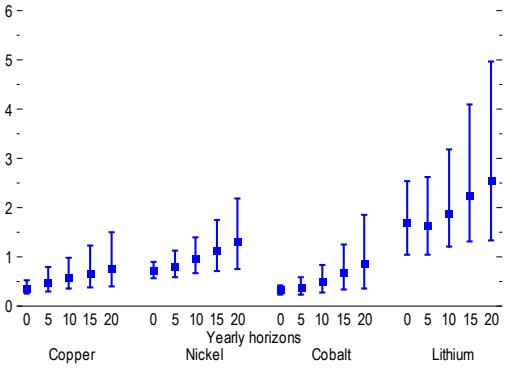
The elasticities correspond to the four metals' different production methods. Copper, nickel, and cobalt are extracted in mines, which often require capital intensive investment and take as long as 19 years to construct. In contrast, lithium is often extracted from mineral springs and brine as salty water is pumped from the earth. As such, lead times to open new production facilities – up to seven years – are shorter. Innovation in extraction technology, market concentration and regulations also influence supply elasticities.

Figure 1.SF.6. Impact of Metal Price Shocks on Exporters
(Basis points)



Source: IMF staff calculations.
Note: The figure shows panel vector autoregression generalized impulse responses following Pesaran and Shin (1998) for the differences in GDP growth and the general government-balance-to-GDP ratio of the 15 largest metals exporters relative to the 15 largest importers for a 1 standard deviation shock to metal prices (about 15 percent).

Figure 1.SF.7. Supply Elasticities for Selected Metals



Sources: Schwerhoff and Stuermer (2020); and IMF staff calculations.
Note: Supply elasticities are the ratio of the change in price and output, from horizon 0 to 20 years, derived from metal-specific demand shocks. Lower and upper bounds are the 16th and 84th percentiles, respectively. See Online Annex 1.SF.1 for methodology.

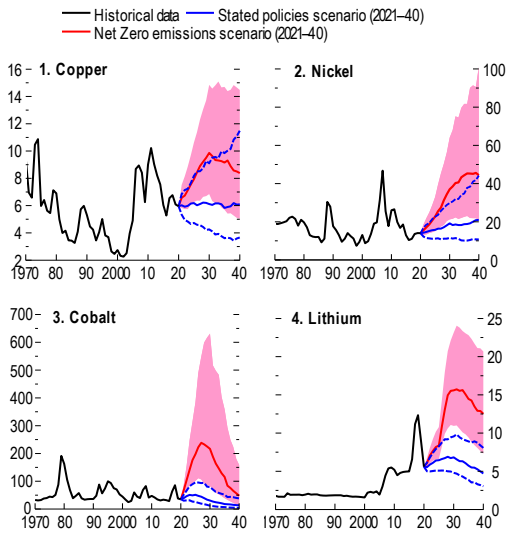
Metal Price Scenarios

Based on historical data and the estimated supply elasticities, the algorithm by Antolin-Diaz, Petrella, and Rubio-Ramirez (2021) pins down a series of exogenously given demand-driven price shocks that incentivize the production path needed for the energy transition in the IEA scenarios (see Online Annex 1.SF.1). A price path implied by these shocks is then derived. Compared with conditional forecasts, this methodology can distinguish between demand and supply shocks driving the price.

Results show that prices would reach historical peaks for an unprecedented, sustained period in a net zero emissions scenario. The prices of cobalt, lithium, and nickel would rise several hundred percent from 2020 levels and could delay the energy transition (Figure 1.SF.8). In contrast, copper is less in danger of a bottleneck as it faces less steep demand increases. Estimated prices reach a peak roughly like the one in 2011, although for a longer period. Prices for all four metals would broadly stay in the current range in the Stated Policies Scenario. Results are subject to high uncertainty, reflected in the large bounds.

Prices peak mostly around 2030 for two reasons: first, the steep rises in demand are frontloaded in the net-zero scenario. Unlike fossil-fuel-based energy production, renewable energy production uses metals up-front; for example, to build wind turbines or batteries. Second, the price boom induces a supply reaction, reducing market tightness after 2030.

Figure 1.SF.8. Price Scenarios for the Stated Policies Scenario and the Net Zero Emissions Scenario
(Thousands of 2020 US dollars a metric ton)



Sources: International Energy Agency; Schwerhoff and Stuermer (2020); US Bureau of Labor Statistics; US Geological Survey; and IMF staff calculations.
Note: Prices were adjusted for inflation using the US Consumer Price Inflation Index. The scenarios are based on a metal-specific demand shock. See Online Annex 1.SF.1 for the data descriptions and methodology.

Revenue and Policy Implications

In the net zero emissions scenario, the demand boom would lead to a sixfold increase in the value of metal production—totaling $12.9 trillion over the next two decades for the four energy transition metals alone, providing significant windfalls to producers. This would rival the potential value of global oil production in that scenario (see Table 1.SF.2).

High uncertainty surrounds the demand scenarios. First, technological change is hard to predict. Second, the speed and direction of the energy transition depend on policy decisions.

High policy uncertainty, in turn, may hinder mining investment and increase the chances that high metal prices will derail or delay the energy transition. A credible, globally coordinated climate policy; high environmental, social, labor, and governance standards; and reduced trade barriers and export restrictions would allow markets to operate efficiently, directing investment to sufficiently expand metal supply—thus avoiding unnecessarily increasing the cost of low-carbon technologies and supporting the clean energy transition.

Table 1.SF.2 Estimated Cumulated Real Revenue for the Global Production of Selected Energy Transition Metals: 2021-40
(Billions of 2020 dollars)

	Historical (1999 to 2018)	Stated Policies Scenario	Net Zero Scenario
Selected Metals	**3,043**	**4,974**	**13,007**
Copper	2,382	3,456	6,135
Nickel	563	1,225	4,147
Cobalt	80	152	1,556
Lithium	18	141	1,170
Fossil Fuels	**70,090**	**…**	**19,101**
Oil	41,819	…	12,906
Natural Gas	17,587	…	3,297
Coal	10,684	…	2,898

Sources: International Energy Agency; and IMF staff calculations.
Note: For 2021–2040, prices of $30 a barrel for oil, $1.50 a million British thermal unit for natural gas, and $40 a metric ton for coal are assumed.

Finally, a new international institution focused on metals—analogous to the IEA for energy and the Food and Agricultural Organization for agricultural goods—could play a pivotal role in data dissemination and analysis, industry standards and international cooperation.

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ANNEX TABLES

Annex Table 1.1.1. European Economies: Real GDP, Consumer Prices, Current Account Balance, and Unemployment

(Annual percent change, unless noted otherwise)

	Real GDP			Consumer Prices 1/			Current Account Balance 2/			Unemployment 3/		
		Projections			Projections			Projections			Projections	
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Europe	**–5.0**	**5.4**	**4.1**	**2.0**	**4.2**	**3.5**	**1.7**	**2.3**	**2.3**	. . .	. . .	. . .
Advanced Europe	**–6.5**	**5.2**	**4.3**	**0.4**	**2.1**	**1.7**	**2.0**	**2.4**	**2.5**	**7.0**	**7.3**	**7.2**
Euro Area 4/, 5/	–6.3	4.8	4.3	0.3	2.1	1.5	2.2	2.5	2.7	7.9	8.1	8.1
Germany	–4.6	3.2	4.5	0.4	2.9	1.5	6.9	6.7	6.8	3.8	3.7	3.6
France	–8.0	6.3	3.9	0.5	2.0	1.6	–1.9	–1.7	–1.4	8.0	8.1	8.3
Italy	–8.9	5.8	4.2	–0.1	1.6	1.3	3.5	3.7	3.5	9.3	10.3	11.6
Spain	–10.8	6.2	5.8	–0.3	2.0	1.4	0.7	0.1	1.7	15.5	15.4	14.8
The Netherlands	–3.8	3.8	3.2	1.1	1.9	1.7	7.0	7.9	8.7	3.8	3.6	4.0
Belgium	–6.3	5.6	3.1	0.4	2.4	2.2	–0.2	0.0	–0.6	5.6	6.3	6.1
Austria	–6.3	3.5	4.5	1.4	2.1	1.8	2.5	2.0	2.3	5.3	5.5	5.3
Ireland	5.9	13.0	3.5	–0.5	1.9	1.9	–2.7	11.1	8.8	5.8	7.8	7.0
Portugal	–7.6	4.4	4.9	–0.1	1.2	1.3	–1.1	–1.7	–2.1	7.0	6.9	6.7
Greece	–8.2	3.3	5.4	–1.3	–0.3	0.8	–7.4	–6.6	–3.5	16.4	16.5	15.2
Finland	–2.9	3.0	3.0	0.4	1.9	1.6	0.8	–0.1	0.4	7.8	7.8	6.8
Slovak Republic	–4.8	4.4	5.2	2.0	2.4	3.0	–0.4	–0.9	–1.3	6.7	6.8	6.1
Lithuania	–0.9	4.7	4.1	1.1	3.0	2.8	8.3	6.7	4.7	8.5	6.5	6.1
Slovenia	–4.2	6.3	4.6	–0.1	1.4	1.8	7.4	6.4	6.3	5.0	4.5	4.3
Luxembourg	–1.3	5.5	3.8	0.0	2.7	1.4	4.3	4.7	4.3	6.3	5.6	5.5
Latvia	–3.6	3.6	5.2	0.1	2.1	2.7	3.0	–0.2	–1.0	8.1	7.7	7.2
Estonia	–2.9	4.0	4.2	–0.6	2.0	2.6	–0.6	0.2	0.1	6.8	6.5	6.0
Cyprus	–5.1	4.2	3.4	–1.1	1.7	1.0	–11.9	–7.6	–5.9	7.6	7.0	6.5
Malta	–8.3	5.7	6.0	0.8	0.7	1.8	–3.5	–2.4	–0.3	4.3	3.6	3.5
United Kingdom	–9.8	6.8	5.0	0.9	2.2	2.6	–3.7	–3.4	–3.4	4.5	5.0	5.0
Switzerland	–2.5	3.7	3.0	–0.7	0.4	0.6	3.8	7.2	7.5	3.1	3.1	3.0
Sweden	–2.8	4.0	3.4	0.7	2.0	1.6	5.7	4.8	4.3	8.3	8.9	7.9
Czech Republic	–5.8	3.8	4.5	3.2	2.7	2.3	3.6	1.6	0.8	2.5	3.4	3.2
Norway	–0.8	3.0	3.6	1.3	2.6	2.0	1.9	5.6	5.0	4.6	4.3	4.0
Denmark	–2.1	3.8	3.0	0.3	1.4	1.6	8.2	7.0	6.8	5.6	5.4	5.3
Iceland	–6.5	3.7	4.1	2.9	4.3	3.1	0.9	1.0	1.2	6.4	7.0	5.0
Andorra	–12.0	5.5	4.8	0.3	1.7	1.5	14.3	14.7	15.7	2.9	3.1	2.2
San Marino	–6.5	5.5	3.7	0.2	0.8	0.9	1.8	1.1	1.0	7.3	6.7	6.4
Emerging and Developing Europe 6/	**–2.0**	**6.0**	**3.6**	**5.4**	**8.4**	**7.1**	**0.1**	**1.5**	**0.9**	. . .	. . .	. . .
Russia	–3.0	4.6	3.0	3.4	5.9	4.8	2.4	5.3	4.2	5.8	4.9	4.6
Turkey	1.8	9.0	3.3	12.3	17.0	15.4	–5.2	–2.4	–1.6	13.1	12.2	11.0
Poland	–2.7	5.1	5.1	3.4	4.4	3.3	3.4	2.3	1.6	3.2	3.5	3.2
Romania	–3.9	7.0	4.8	2.6	4.3	3.4	–5.2	–5.7	–5.5	5.0	4.9	4.9
Ukraine 7/	–4.0	4.0	3.4	2.7	9.5	7.1	4.0	–0.5	–2.3	9.2	9.7	8.7
Hungary	–5.0	7.6	5.1	3.3	4.5	3.6	–0.1	0.6	0.9	4.1	4.1	3.8
Belarus	–0.9	0.8	0.6	5.5	9.1	8.0	–0.4	0.2	–1.6	4.1	4.3	4.2
Bulgaria 5/	–4.2	4.5	4.4	1.2	2.1	1.9	–0.7	0.5	0.3	5.2	5.2	4.7
Serbia	–1.0	6.5	4.5	1.6	3.0	2.7	–4.3	–4.1	–4.4	9.5	9.3	9.3
Croatia	–8.0	6.3	5.8	0.1	2.0	2.0	–0.4	–0.1	–0.8	9.0	8.4	8.0

Source: IMF staff estimates.

Note: Data for some countries are based on fiscal years. Please refer to Table F in the Statistical Appendix for a list of economies with exceptional reporting periods.

1/ Movements in consumer prices are shown as annual averages. Year-end to year-end changes can be found in Tables A5 and A6 in the Statistical Appendix.

2/ Percent of GDP.

3/ Percent. National definitions of unemployment may differ.

4/ Current account position corrected for reporting discrepancies in intra-area transactions.

5/ Based on Eurostat's harmonized index of consumer prices except for Slovenia.

6/ Includes Albania, Bosnia and Herzegovina, Kosovo, Moldova, Montenegro, and North Macedonia.

7/ See country-specific note for Ukraine in the Country Notes section of the Statistical Appendix.

Annex Table 1.1.2. Asian and Pacific Economies: Real GDP, Consumer Prices, Current Account Balance, and Unemployment

(Annual percent change, unless noted otherwise)

	Real GDP			Consumer Prices 1/			Current Account Balance 2/			Unemployment 3/		
		Projections			Projections			Projections			Projections	
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Asia	**–1.3**	**6.5**	**5.8**	**2.5**	**2.1**	**2.4**	**2.6**	**2.2**	**2.0**	. . .	. . .	. . .
Advanced Asia	**–2.9**	**3.8**	**3.5**	**0.2**	**1.0**	**1.2**	**4.6**	**4.9**	**4.5**	**3.6**	**3.5**	**3.1**
Japan	–4.6	2.4	3.2	0.0	–0.2	0.5	3.3	3.5	3.3	2.8	2.8	2.4
Korea	–0.9	4.3	3.3	0.5	2.2	1.6	4.6	4.5	4.2	3.9	3.8	3.7
Australia	–2.4	3.5	4.1	0.9	2.5	2.1	2.7	3.6	1.3	6.5	5.4	4.9
Taiwan Province of China	3.1	5.9	3.3	–0.2	1.6	1.5	14.2	15.6	15.2	3.9	3.8	3.6
Singapore	–5.4	6.0	3.2	–0.2	1.6	1.5	17.6	15.9	15.7	3.0	2.7	2.5
Hong Kong SAR	–6.1	6.3	3.5	0.3	1.7	2.0	6.5	6.3	5.2	5.9	5.5	4.4
New Zealand	–2.9	5.5	2.9	1.7	2.9	2.1	–0.8	–3.5	–2.9	4.6	4.5	4.3
Macao SAR	–56.3	20.4	37.6	0.8	–0.3	2.0	–34.2	–18.5	8.9	2.6	2.9	2.5
Emerging and Developing Asia	**–0.8**	**7.3**	**6.3**	**3.1**	**2.3**	**2.8**	**1.6**	**1.1**	**0.9**	. . .	. . .	. . .
China	2.3	8.0	5.6	2.4	1.1	1.8	1.8	1.6	1.5	4.2	3.8	3.7
India 4/	–7.3	9.5	8.5	6.2	5.6	4.9	0.9	–1.0	–1.4	. . .	. . .	. . .
ASEAN-5	**–3.4**	**3.1**	**6.0**	**1.4**	**2.0**	**2.5**	**2.0**	**0.6**	**0.5**	. . .	. . .	. . .
Indonesia	–2.1	3.2	5.9	2.0	1.6	2.8	–0.4	–0.3	–1.0	7.1	6.6	6.0
Thailand	–6.1	1.0	4.5	–0.8	0.9	1.3	3.5	–0.5	2.1	2.0	1.5	1.0
Vietnam	2.9	5.1	7.5	3.2	2.2	2.8	3.7	1.6	1.7	3.3	2.7	2.4
Philippines	–9.6	3.2	6.3	2.6	4.3	3.0	3.6	0.4	–1.8	10.4	7.8	6.8
Malaysia	–5.6	3.5	6.0	–1.1	2.5	2.0	4.2	3.8	3.7	4.5	4.7	4.5
Other Emerging and Developing Asia 5/	**–1.3**	**1.6**	**6.4**	**5.2**	**4.9**	**5.6**	**–1.9**	**–2.1**	**–2.2**	. . .	. . .	. . .
Memorandum												
Emerging Asia 6/	**–0.8**	**7.5**	**6.3**	**3.0**	**2.2**	**2.6**	**1.7**	**1.2**	**1.0**	. . .	. . .	. . .

Source: IMF staff estimates.

Note: Data for some countries are based on fiscal years. Please refer to Table F in the Statistical Appendix for a list of economies with exceptional reporting periods.

1/ Movements in consumer prices are shown as annual averages. Year-end to year-end changes can be found in Tables A5 and A6 in the Statistical Appendix.

2/ Percent of GDP.

3/ Percent. National definitions of unemployment may differ.

4/ See country-specific note for India in the Country Notes section of the Statistical Appendix.

5/ Other Emerging and Developing Asia comprises Bangladesh, Bhutan, Brunei Darussalam, Cambodia, Fiji, Kiribati, Lao P.D.R., Maldives, Marshall Islands, Micronesia, Mongolia, Myanmar, Nauru, Nepal, Palau, Papua New Guinea, Samoa, Solomon Islands, Sri Lanka, Timor-Leste, Tonga, Tuvalu, and Vanuatu.

6/ Emerging Asia comprises the ASEAN-5 economies, China, and India.

Annex Table 1.1.3. Western Hemisphere Economies: Real GDP, Consumer Prices, Current Account Balance, and Unemployment
(Annual percent change, unless noted otherwise)

	Real GDP			Consumer Prices 1/			Current Account Balance 2/			Unemployment 3/		
		Projections			Projections			Projections			Projections	
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
North America	**–4.0**	**6.0**	**5.0**	**1.4**	**4.3**	**3.4**	**–2.6**	**–3.0**	**–3.1**	**. . .**	**. . .**	**. . .**
United States	–3.4	6.0	5.2	1.2	4.3	3.5	–2.9	–3.5	–3.5	8.1	5.4	3.5
Mexico	–8.3	6.2	4.0	3.4	5.4	3.8	2.4	0.0	–0.2	4.4	4.1	3.7
Canada	–5.3	5.7	4.9	0.7	3.2	2.6	–1.8	0.5	0.2	9.6	7.7	5.7
Puerto Rico 4/	–3.9	–0.6	–0.3	–0.5	4.0	1.9	. . .	. . .	. . .	8.9	8.7	8.5
South America 5/	**–6.6**	**6.3**	**2.4**	**8.1**	**11.4**	**9.4**	**–0.9**	**–0.7**	**–1.3**	**. . .**	**. . .**	**. . .**
Brazil	–4.1	5.2	1.8	3.2	7.7	5.3	–1.8	–0.5	–1.8	13.5	13.8	13.1
Argentina	–9.9	7.5	2.5	42.0	46.8	. . .	0.9	1.2	0.8	11.6	10.0	9.2
Colombia	–6.8	7.6	3.8	2.5	3.2	3.5	–3.4	–4.4	–4.0	16.1	14.5	13.8
Chile	–5.8	11.0	2.5	3.0	4.2	4.4	1.4	–2.5	–2.2	10.8	9.1	7.4
Peru	–11.0	10.0	4.6	1.8	3.1	2.5	0.8	0.4	0.1	13.9	9.6	7.4
Ecuador	–7.8	2.8	3.5	0	0	2	2.5	1.7	1.7	5.3	4.6	4.2
Venezuela	–30.0	–5.0	–3.0	2,355.1	2,700.0	2,000.0	–4.3	0.3	–0.7	. . .	. . .	. . .
Bolivia	–8.8	5.0	4.0	0.9	1.3	2.7	–0.5	–2.2	–2.8	8.3	7.8	6.0
Paraguay	–0.6	4.5	3.8	1.8	3.5	4.0	2.2	3.5	2.1	6.5	6.1	5.9
Uruguay	–5.9	3.1	3.2	9.8	7.5	6.1	–0.7	–1.3	–0.3	10.4	10.4	9.2
Central America 6/	**–7.1**	**7.6**	**4.6**	**2.0**	**4.4**	**3.4**	**1.3**	**–0.9**	**–1.1**	**. . .**	**. . .**	**. . .**
Caribbean 7/	**–4.2**	**3.8**	**11.0**	**8.0**	**8.4**	**8.3**	**–4.0**	**–3.1**	**1.3**	**. . .**	**. . .**	**. . .**
Memorandum												
Latin America and the Caribbean 8/	–7.0	6.3	3.1	6.4	9.2	7.4	0.0	–0.6	–1.0	. . .	. . .	. . .
Eastern Caribbean Currency Union 9/	–15.6	0.7	10.7	–0.6	1.6	1.8	–14.8	–16.7	–11.9	. . .	. . .	. . .

Source: IMF staff estimates.

Note: Data for some countries are based on fiscal years. Please refer to Table F in the Statistical Appendix for a list of economies with exceptional reporting periods.

1/ Movements in consumer prices are shown as annual averages. Year-end to year-end changes can be found in Tables A5 and A6 in the Statistical Appendix. Aggregates exclude Venezuela.

2/ Percent of GDP.

3/ Percent. National definitions of unemployment may differ.

4/ Puerto Rico is a territory of the United States, but its statistical data are maintained on a separate and independent basis.

5/ See country-specific notes for Argentina and Venezuela in the Country Notes section of the Statistical Appendix.

6/ Central America refers to CAPDR (Central America, Panama, and the Dominican Republic) and comprises Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.

7/ The Caribbean comprises Antigua and Barbuda, Aruba, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

8/ Latin America and the Caribbean comprises Mexico and economies from the Caribbean, Central America, and South America. See country-specific notes for Argentina and Venezuela in the Country Notes section of the Statistical Appendix.

9/ Eastern Caribbean Currency Union comprises Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines as well as Anguilla and Montserrat, which are not IMF members.

Annex Table 1.1.4. Middle East and Central Asia Economies: Real GDP, Consumer Prices, Current Account Balance, and Unemployment
(Annual percent change, unless noted otherwise)

	Real GDP			Consumer Prices 1/			Current Account Balance 2/			Unemployment 3/		
		Projections			Projections			Projections			Projections	
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Middle East and Central Asia	**–2.8**	**4.1**	**4.1**	**10.1**	**11.7**	**8.5**	**–2.4**	**1.7**	**1.5**	. . .	. . .	. . .
Oil Exporters 4/	**–4.2**	**4.5**	**3.9**	**8.1**	**10.8**	**8.2**	**–1.9**	**3.5**	**3.4**	. . .	. . .	. . .
Saudi Arabia	–4.1	2.8	4.8	3.4	3.2	2.2	–2.8	3.9	3.8	7.4	. . .	. . .
Iran	3.4	2.5	2.0	36.4	39.3	27.5	–0.1	1.3	1.0	9.6	10.0	10.5
United Arab Emirates	–6.1	2.2	3.0	–2.1	2.0	2.2	3.1	9.7	9.4	. . .	. . .	. . .
Algeria	–4.9	3.4	1.9	2.4	6.5	7.6	–12.7	–7.6	–5.5	14.0	14.1	14.7
Kazakhstan	–2.6	3.3	3.9	6.8	7.5	6.5	–3.7	–0.9	–1.4	4.9	4.8	4.7
Iraq	–15.7	3.6	10.5	0.6	6.4	4.5	–10.8	6.2	4.0	. . .	. . .	. . .
Qatar	–3.6	1.9	4.0	–2.7	2.5	3.2	–2.4	8.2	11.6	. . .	. . .	. . .
Kuwait	–8.9	0.9	4.3	2.1	3.2	3.0	16.7	15.5	13.3	1.3	. . .	. . .
Azerbaijan	–4.3	3.0	2.3	2.8	4.4	3.2	–0.5	7.8	7.7	7.2	6.4	6.3
Oman	–2.8	2.5	2.9	–0.9	3.0	2.7	–13.7	–5.8	–0.9	. . .	. . .	. . .
Turkmenistan	–3.4	4.5	1.7	7.6	12.5	13.0	–2.6	0.6	–1.2	. . .	. . .	. . .
Oil Importers 5/	**–0.6**	**3.6**	**4.3**	**13.2**	**13.1**	**8.9**	**–3.7**	**–3.8**	**–4.1**	. . .	. . .	. . .
Egypt	3.6	3.3	5.2	5.7	4.5	6.3	–3.1	–3.9	–3.7	8.3	9.3	9.2
Pakistan	–0.5	3.9	4.0	10.7	8.9	8.5	–1.7	–0.6	–3.1	4.5	5.0	4.8
Morocco	–6.3	5.6	3.9	0.6	1.4	1.2	–1.5	–3.5	–4.0	12.2	11.4	10.8
Uzbekistan	1.7	6.1	5.4	12.9	11.0	10.9	–5.0	–6.0	–5.6	. . .	. . .	. . .
Sudan	–3.6	0.9	3.5	163.3	194.6	41.8	–17.5	–10.1	–9.4	26.8	28.0	27.7
Tunisia	–8.6	3.0	3.3	5.6	5.7	6.5	–6.8	–7.3	–8.4	17.4	. . .	. . .
Jordan	–1.6	2.0	2.7	0.4	1.6	2.0	–8.0	–8.9	–4.4	22.7	. . .	. . .
Lebanon 6/	–25.2	–9.0	. . .	84.9	123.9	. . .	–17.6	–13.5	. . .	. . .	. . .	. . .
Afghanistan 6/	–2.4	. . .	. . .	5.6	. . .	. . .	11.2	. . .	. . .	. . .	. . .	. . .
Georgia	–6.2	7.7	5.8	5.2	9.3	5.4	–12.5	–10.0	–7.6	18.5	. . .	. . .
Armenia	–7.4	6.5	4.5	1.2	6.0	5.4	–3.8	–3.5	–4.3	18.0	19.8	19.5
Kyrgyz Republic	–8.6	2.1	5.6	6.3	13.0	7.8	4.5	–7.7	–7.6	6.6	6.6	6.6
Tajikistan	4.5	5.0	4.5	8.6	8.0	6.5	4.2	1.9	–1.9	. . .	. . .	. . .
Memorandum												
Caucasus and Central Asia	–2.2	4.3	4.1	7.5	8.5	7.5	–3.4	–1.0	–1.4	. . .	. . .	. . .
Middle East, North Africa, Afghanistan, and Pakistan	–2.9	4.1	4.1	10.5	12.1	8.6	–2.3	2.0	1.8	. . .	. . .	. . .
Middle East and North Africa	–3.2	4.1	4.1	10.5	12.7	8.6	–2.4	2.1	2.2	. . .	. . .	. . .
Israel 7/	–2.2	6.5	4.2	–0.6	1.4	1.8	5.0	4.2	3.7	4.3	5.1	4.6
Maghreb 8/	–7.9	14.0	3.0	2.3	6.0	5.5	–8.0	–4.3	–3.9	. . .	. . .	. . .
Mashreq 9/	1.4	2.7	4.7	8.3	8.0	7.8	–4.3	–4.9	–3.9	. . .	. . .	. . .

Source: IMF staff estimates.

Note: Data for some countries are based on fiscal years. Please refer to Table F in the Statistical Appendix for a list of economies with exceptional reporting periods.

1/ Movements in consumer prices are shown as annual averages. Year-end to year-end changes can be found in Tables A5 and A6 in the Statistical Appendix.

2/ Percent of GDP.

3/ Percent. National definitions of unemployment may differ.

4/ Includes Bahrain, Libya, and Yemen.

5/ Includes Djibouti, Mauritania, Somalia, and West Bank and Gaza. Excludes Syria because of the uncertain political situation. See country-specific note for Lebanon in the Country Notes section of the Statistical Appendix.

6/ See country-specific notes for Afghanistan and Lebanon in the Country Notes section of the Statistical Appendix.

7/ Israel, which is not a member of the economic region, is included for reasons of geography but is not included in the regional aggregates.

8/ The Maghreb comprises Algeria, Libya, Mauritania, Morocco, and Tunisia.

9/ The Mashreq comprises Egypt, Jordan, Lebanon, and West Bank and Gaza. Syria is excluded because of the uncertain political situation.

Annex Table 1.1.5. Sub-Saharan African Economies: Real GDP, Consumer Prices, Current Account Balance, and Unemployment
(Annual percent change, unless noted otherwise)

	Real GDP			Consumer Prices 1/			Current Account Balance 2/			Unemployment 3/		
		Projections			Projections			Projections			Projections	
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Sub-Saharan Africa	**–1.7**	**3.7**	**3.8**	**10.3**	**10.6**	**8.4**	**–2.9**	**–2.3**	**–2.8**	**. . .**	**. . .**	**. . .**
Oil Exporters 4/	**–2.5**	**2.1**	**2.5**	**13.8**	**16.9**	**12.8**	**–3.5**	**–1.9**	**–1.3**	**. . .**	**. . .**	**. . .**
Nigeria	–1.8	2.6	2.7	13.2	17.0	13.3	–4.0	–3.2	–2.2	. . .	. . .	. . .
Angola	–5.4	–0.7	2.4	22.3	24.4	14.9	1.5	7.3	5.7	. . .	. . .	. . .
Gabon	–1.8	1.5	3.9	1.3	2.0	2.0	–6.0	–3.8	–2.0	. . .	. . .	. . .
Chad	–0.8	0.9	2.3	4.5	2.6	2.8	–8.1	–5.7	–4.6	. . .	. . .	. . .
Equatorial Guinea	–4.9	4.1	–5.6	4.8	0.5	3.1	–6.3	–4.2	–5.2	. . .	. . .	. . .
Middle-Income Countries 5/	**–4.2**	**4.8**	**3.6**	**4.3**	**5.4**	**5.2**	**–0.5**	**0.1**	**–1.8**	**. . .**	**. . .**	**. . .**
South Africa	–6.4	5.0	2.2	3.3	4.4	4.5	2.0	2.9	–0.9	29.2	33.5	34.4
Ghana	0.4	4.7	6.2	9.9	9.3	8.8	–3.1	–2.2	–3.5	. . .	. . .	. . .
Côte d'Ivoire	2.0	6.0	6.5	2.4	3.0	2.5	–3.5	–3.8	–3.4	. . .	. . .	. . .
Cameroon	–1.5	3.6	4.6	2.4	2.3	2.0	–3.7	–4.0	–3.5	. . .	. . .	. . .
Zambia	–3.0	1.0	1.1	15.7	22.8	19.2	10.4	13.5	14.9	. . .	. . .	. . .
Senegal	1.5	3.7	5.5	2.5	2.0	2.0	–10.2	–12.3	–11.7	. . .	. . .	. . .
Low-Income Countries 6/	**1.9**	**4.3**	**5.9**	**13.3**	**10.3**	**7.7**	**–5.2**	**–5.8**	**–5.8**	**. . .**	**. . .**	**. . .**
Ethiopia 7/	6.1	2.0	. . .	20.4	22.4	. . .	–4.6	–2.9	. . .	. . .	. . .	. . .
Kenya	–0.1	6.3	6.4	5.3	5.5	5.0	–4.5	–6.1	–6.6	. . .	. . .	. . .
Tanzania	4.8	4.0	5.1	3.3	3.2	3.4	–1.8	–3.2	–3.8	. . .	. . .	. . .
Uganda	–1.0	5.3	5.2	3.8	4.9	5.0	–8.6	–8.1	–6.6	. . .	. . .	. . .
Democratic Republic of the Congo	1.7	4.9	5.6	11.4	9.4	6.4	–2.2	–2.1	–1.8	. . .	. . .	. . .
Mali	–1.6	4.0	5.3	0.5	3.0	2.0	–0.2	–5.3	–5.0	. . .	. . .	. . .
Burkina Faso	1.9	6.7	5.6	1.9	3.0	2.6	–0.1	–2.5	–4.1	. . .	. . .	. . .

Source: IMF staff estimates.

Note: Data for some countries are based on fiscal years. Please refer to Table F in the Statistical Appendix for a list of economies with exceptional reporting periods.

1/ Movements in consumer prices are shown as annual averages. Year-end to year-end changes can be found in Table A6 in the Statistical Appendix.

2/ Percent of GDP.

3/ Percent. National definitions of unemployment may differ.

4/ Includes Republic of Congo and South Sudan.

5/ Includes Botswana, Cabo Verde, Eswatini, Lesotho, Mauritius, Namibia, and Seychelles.

6/ Includes Benin, Burundi, Central African Republic, Comoros, Eritrea, The Gambia, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mozambique, Niger, Rwanda, São Tomé and Príncipe, Sierra Leone, Togo, and Zimbabwe.

7/ See country-specific note for Ethiopia in the Country Notes section of the Statistical Appendix.

Annex Table 1.1.6. Summary of World Real per Capita Output

(Annual percent change; in constant 2017 international dollars at purchasing power parity)

	Average									Projections	
	2003–12	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
World	**2.5**	**2.0**	**2.1**	**2.1**	**1.9**	**2.5**	**2.4**	**1.7**	**–4.3**	**4.8**	**3.8**
Advanced Economies	**1.0**	**0.9**	**1.5**	**1.7**	**1.2**	**2.0**	**1.8**	**1.3**	**–4.9**	**5.0**	**4.2**
United States	1.0	1.1	1.6	2.0	0.9	1.6	2.4	1.8	–3.8	5.7	4.8
Euro Area 1/	0.5	–0.4	1.2	1.7	1.6	2.4	1.6	1.3	–6.6	4.9	4.2
Germany	1.3	0.2	1.8	0.6	1.4	2.3	0.8	0.8	–4.6	3.0	4.4
France	0.6	0.1	0.5	0.6	0.8	2.2	1.5	1.6	–8.2	6.0	3.6
Italy	–0.7	–2.1	–0.1	0.9	1.5	1.8	1.2	0.5	–8.6	5.9	4.3
Spain	–0.2	–1.1	1.7	3.9	2.9	2.8	2.0	1.1	–10.9	6.1	5.3
Japan	0.7	2.2	0.5	1.7	0.8	1.8	0.8	0.2	–4.3	2.7	3.6
United Kingdom	0.7	1.5	2.1	1.6	0.9	1.1	0.6	0.9	–10.2	6.4	4.4
Canada	0.8	1.3	1.8	–0.1	0.0	1.8	1.0	0.4	–6.4	5.1	3.8
Other Advanced Economies 2/	2.6	1.8	2.2	1.5	1.8	2.5	2.0	1.3	–2.6	4.2	3.2
Emerging Market and Developing Economies	**4.8**	**3.5**	**3.1**	**2.8**	**3.0**	**3.3**	**3.3**	**2.3**	**–3.4**	**5.1**	**4.0**
Emerging and Developing Asia	7.4	5.8	5.8	5.9	5.8	5.7	5.6	4.5	–1.7	6.4	5.6
China	9.9	7.1	6.7	6.5	6.2	6.4	6.3	5.6	2.0	7.7	5.4
India 3/	6.3	5.1	6.2	6.8	7.1	5.7	5.4	2.9	–8.0	8.4	7.5
ASEAN-5 4/	4.1	3.7	3.4	3.7	3.9	4.3	4.3	3.7	–4.6	2.2	4.9
Emerging and Developing Europe	4.5	2.8	1.5	0.5	1.6	3.9	3.3	2.3	–1.9	5.8	3.4
Russia	4.9	1.5	–1.1	–2.2	0.0	1.8	2.9	2.1	–2.6	4.7	3.0
Latin America and the Caribbean	2.6	1.8	0.1	–0.7	–1.8	0.2	0.2	–1.3	–8.2	5.5	2.3
Brazil	2.7	2.1	–0.3	–4.4	–4.1	0.5	1.0	0.6	–4.8	4.8	1.2
Mexico	0.8	0.1	1.6	2.1	1.5	1.0	1.1	–1.2	–9.2	5.3	3.1
Middle East and Central Asia	2.5	0.3	0.5	0.5	2.3	0.0	0.0	–0.5	–5.0	1.7	2.2
Saudi Arabia	2.2	0.0	2.5	1.7	–0.6	–3.3	0.0	–2.0	–6.3	1.5	2.8
Sub-Saharan Africa	2.7	2.2	2.3	0.5	–1.2	0.3	0.6	0.5	–4.3	1.2	1.4
Nigeria	4.9	2.6	3.5	0.0	–4.2	–1.8	–0.7	–0.4	–4.3	0.1	0.1
South Africa	2.0	0.9	–0.1	–0.2	–0.8	–0.3	0.0	–1.3	–7.8	3.4	0.6
Memorandum											
European Union	1.0	–0.1	1.5	2.1	1.9	2.8	2.1	1.7	–6.0	4.9	4.2
Emerging Market and Middle-Income Economies	1.7	–0.4	–0.1	0.2	2.6	–0.9	–0.7	–1.0	–5.6	1.6	2.3
Low-Income Developing Countries	5.1	3.7	3.2	3.0	3.3	3.6	3.5	2.5	–3.3	5.7	4.3
Middle East and North Africa	3.6	3.5	3.8	2.1	1.5	2.6	2.7	3.0	–2.1	1.0	3.3

Source: IMF staff estimates.

Note: Data for some countries are based on fiscal years. Please refer to Table F in the Statistical Appendix for a list of economies with exceptional reporting periods.

1/ Data calculated as the sum of individual euro area countries.

2/ Excludes the Group of Seven (Canada, France, Germany, Italy, Japan, United Kingdom, United States) and euro area countries.

3/ See country-specific note for India in the Country Notes section of the Statistical Appendix.

4/ Indonesia, Malaysia, Philippines, Thailand, Vietnam.

ONLINE ANNEX

Annex 1.SF.1.

A1. Metals and Minerals

The special feature mentions the following metals:

Aluminum (Al), chromium (Cr), copper (Cu), cobalt (Co), graphite, lead (Pb), lithium (Li), manganese (Mn), molybdenum (Mo), nickel (Ni), platinum group metals (PGM), rare earth elements (REE) silicon (Si), silver (Ag), vanadium (V), zinc (Zn) and the mineral: graphite (C).

Rare earth elements (REE) and platinum group metals are beyond the scope of our present analysis. These metals are quite heterogeneous. REE refer to 17 metals and PGM to 6 metals. Some REE are important for wind turbines and electric vehicles, while some PGM are relevant for hydrogen. The energy transition is expected to have a modest contribution to their demand growth, especially for REE.

We do not consider graphite or vanadium as one of the four representative metals, because their consumption is expected to increase significantly, albeit from a much lower base than the one for lithium and cobalt. For aluminum, while important, there are no comparable estimates available from the IEA for their usage in the energy transition.

A2. Methodology for Effects of Metal Price Shocks on Exporters and Importers

To evaluate the effects of metal price shocks on countries' GDP and government revenues, we estimate a panel VAR model with each country's real GDP growth, its government balance-to-GDP ratio, current account-to-GDP ratio, the Commodity Research Bureau's real metal price index (year-on-year growth rate), and with world GDP growth and real oil prices (year-on-year growth rate) as additional control variables. To reduce multicollinearity, oil prices and metal prices were orthogonalized vis-à-vis world GDP growth prior to the VAR estimation (although the results were very similar without such filtering), as metals and oil prices tend to correlate with world GDP (as a proxy for the global business cycle).

We use generalized impulse responses following Pesaran and Shin (1998), to estimate the effects of a 1 standard deviation shock to real metal prices (which amounts to about 15 percentage points) on GDP growth and the government balance-to-GDP ratio. Doing so gives an orthogonal set of innovations that do not depend on the VAR ordering. Figure 1.SF.7 shows the differences of the impulse responses for the 15 largest metals exporters and the 15 largest metals importers in 2020.

Data are from the IMF WEO and cover the period 1960-2020 (annual data). The 15 largest metals exporters (in trade value, from UN Comtrade statistics, consistent with the extended list listed in A1) included in the sample are Australia, Brazil, Chile, Peru, South Africa, Canada, Mexico, United States, Ukraine, Guinea, Sweden, Kazakhstan, Mongolia, Indonesia, and Russian Federation". The 15 largest metals importers in the sample are China, Japan, Korea, Germany, Taiwan POC, Spain, United Kingdom, France, Finland, Netherlands, Austria, Vietnam, Bulgaria,

Italy, Malaysia. In another iteration, the group of importers also included Poland, Egypt, Czech Republic, Bahrain, and Slovak Republic.

A3. Methodology for Long-term Demand, Supply and Price Projections

We set up separate VAR models for each metal. Each reduced form model includes three endogenous variables $y_t = (\Delta Y_t, \Delta Q_t, \log(P_t))'$, namely the percentage change of global real GDP (ΔY_t), the percentage change of global production of the respective metal (ΔQ_t), and the log of the real price of the respective metal (P_t). We estimate

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + \Pi^* D_t + u_t \qquad (1)$$

where A_i are the reduced-form VAR coefficients and u_t the reduced-form forecast errors. These errors have no economic interpretation. The matrix of deterministic terms D_t consists of a constant and dummies for the years around the world wars. For copper and nickel, we add a linear trend to the regression. The analysis is performed at annual frequencies. The reduced-form VAR can be expressed in a structural form given by

$$B_0 y_t = B_1 y_{t-1} + \cdots + B_p y_{t-p} + \Pi^* D_t + \epsilon_t. \qquad (2)$$

In equation *(2)*, ϵ_t are independent structural shocks with an economic interpretation, e.g., aggregate metal demand and metal supply shocks. The structural shocks are related to the reduced-form errors via the linear transformation $u_t = B_0^{-1}\epsilon_t$. Thus, B_0^{-1} contains the impact effects of the structural shocks on the three endogenous variables in y_t. By assuming a unit variance for the uncorrelated structural shocks, i.e., $E(\epsilon_t \epsilon_t')$ is an identity matrix, the reduced-form covariance matrix Σ_u is related to the structural impact multiplier matrix as $\Sigma_u = E(u_t u_t') = B_0^{-1} E(\epsilon_t \epsilon_t') B_0^{-1\prime} = B_0^{-1} B_0^{-1\prime}$.

Without further information it is not possible to identify B_0^{-1} and thereby the structural form in *(2)*. The literature has come up with different restrictions that can be assumed to solve this identification problem. We apply sign restrictions (e.g., Faust, 1998, Canova and Nicolo, 2002, and Uhlig 2005) on the elements in B_0^{-1}, i.e., we assume that the structural shocks affect the endogenous variables either in a positive or negative way based on economic intuition as specified in Table 1: The first shock increases global real GDP, the global production of the respective metal, and the respective metal's real price on impact. We interpret it as an aggregate demand shock that is related to the global business cycle. The shock also includes periods of industrialization, which drive up the demand for copper and other metals. We assume that this is the type of shock that characterizes most closely the energy transition in our structural scenario analysis.

The second shock is assumed to drive up global real GDP and global production of the respective metal, but to decrease the real price. We interpret this shock as a metal supply shock, capturing for example, strikes or other production outages. We assume that the third shock increases metal production and price, similar to the aggregate metal demand shock, but decreases global real GDP. We interpret it as a metal inventory-demand shock, capturing unexpected changes in inventories due to shifts in expectations about future metal demand or supply.

Annex 1.SF.Table 1. Sign Restrictions on Impact Effects

	Global Real GDP	Global Metal Production	Real Metal Price
Aggregate metal demand shock	+	+	+
Metal supply shock	+	+	–
Metal inventory demand shock	–	+	+

Our object of interest is a conditional forecast $y_{T+1,T+h}$ over the next *h=20* years for the endogenous variables where *T* denotes the year 2020. The conditional forecast restricts some of the variables in $y_{T+1,T+h}$ and a subset of the future shocks $\epsilon_{T+1,T+h}$, thereby linking the path of future variables directly to certain shocks. Antolin-Diaz, Petrella, and Rubio-Ramirez (2021) provide a formal framework of this structural scenario analysis. We briefly lay out the underlying intuition tailored to the IEA's scenarios.

We take the IEA's scenarios for each metal as given, thus prespecifying the future metal production in the conditional forecasts $y_{T+1,T+h}$. We set global consumption equal to global metal production in the IEA's forecast, assuming that there are no short-term changes in inventories. The levels of future GDP growth and the metal's price are left unspecified. Concerning the path of future shocks, we constrain the metal supply shock and the inventory demand shock to their unconditional distributions. The algorithm then finds a series of aggregate metals demand shocks that incentivizes the metal production path needed for the energy transition. From these shocks we derive the implied price and revenue paths.

Compared to traditional conditional forecasts, the chosen methodology has the advantage that it can attribute the future path of endogenous variables to a certain set of structural shocks. As we deem the energy transition as a scenario resulting from future shocks that are similar to aggregate metal demand shocks, it is important to specify this directly and not attribute the energy transition to exogenous increases in metal supply or some combination.

Estimation and inference are based on standard Bayesian techniques laid out in Waggoner and Zha (1999), Rubio-Ramirez, Wagonner, and Zha (2010), and Antolin-Diaz, Petrella, and Rubio-Ramirez (2021). We use a standard Minnesota-type prior in combination with a sum-of-coefficients prior (Doan, Litterman, and Sims 1984) and a dummy-initial-observation prior (Sims 1993) to estimate equation *(1)* and the conditional forecasts. Identification via sign restrictions does not yield point estimates but instead sets of possible parameter intervals for the different elements in B_0^{-1}. We obtain a set of 1000 admissible draws, where each draw consists of a conditional forecast, future shocks, and an associated B_0^{-1} matrices that satisfies the sign restrictions. These draws are also used for inference, i.e., they yield an indication of the uncertainty around the point-wise median estimates. It is common to report point-wise median

and percentiles of impulse responses for set-identified structural VAR models (Antolín-Díaz and Rubio-Ramírez, 2018), although the median does not represent one of the structural models.

Finally, we obtain the supply elasticities from the B_0^{-1} matrix of structural impact effects and the reduced-form parameters A_i from equation *(1)*. The responses of the variables in y_t to the structural shocks ϵ_t can be traced over time via $\Theta_h = \Phi_h B_0^{-1}$ for *h = 1,2,…* where Θ_h is an (*n x n*) matrix of structural impulse responses for the horizon *h* and $\Phi_h = \sum_{j=1}^{h} \Phi_{h-j} A_j$ and Φ_0 is an identity matrix (Lütkepohl 2005, chapter 2). The impact supply elasticity η_S is calculated as the ratio of the metal production response to an aggregate metal demand shock (*AD*) relative to the price response to the same shock written as $\eta_S = (B_0^{-1})_{AD,Prod} / (B_0^{-1})_{AD,Price}$. Demand shocks shift the metal demand curve along the metal supply curve and thereby trace out its shape which gives the supply elasticity. Elasticities over longer horizons are based on the cumulative output response and the cumulative price change response and calculated as $\eta_{S,h} = \sum_{i=1}^{h}(\Theta_i)_{AD,Prod} / \sum_{i=1}^{h}(\Theta_i)_{AD,Price}$. The 1000 different draws again allow for the construction of credible sets by estimating an elasticity for each draw and then calculating percentiles.

A4. Data Descriptions

We use historical annual data for global real GDP, global production and real prices of the respective four metals. Employing long sample periods, partly going back to 1840 for copper, 1900 for nickel, 1925 for cobalt and 1955 for lithium, allows us to estimate the long-run relationships between the variables. This is particularly important due to the long investment cycles in the industry.

However, historical data can come with measurement problems. This is particularly a concern for the cobalt and lithium market data. These commodities were not traded on public exchanges for a long time. Its value chain and pricing are more complex than for copper and nickel. We have ensured that the data is as consistent as possible over time. We have also checked the history of these markets for signs of structural changes, which may be a moderate issue for the cobalt market. We attribute some of the relatively broad sets of admissible draws in our results to some remaining measurement errors.

A4.1 Global Real GDP Data

We construct a series for global real GDP data by using data for 1840 to 2007 from Schwerhoff and Stuermer (2020), which build on Maddison (2010). We expand the data to 2020 based on growth rates of global real GDP from the International Monetary Fund's World Economic Outlook database.

A4.2 Copper Market Data

Copper has a long track record of trade and production. We use annual price data from the London Metal Exchange, which has been and still is the major exchange for the global price settlement of the metal. The data for the period from 1840 to 2014 is sourced from Stuermer (2018) and the one from 2015 to 2020 from the US Geological Survey (2021). We use the U.S. all urban consumers price index to adjust prices for inflation.

Production data refer to refined copper production, including production from recycled materials. We source the data from Stuermer (2018) for the period 1840 to 2010. For 2011 to 2019, we obtain data from the International Copper Study Group (2021) and for 2020 from the World Bureau of Metals (2021). Note that the data points for 2019 and 2020 are preliminary.

A4.3 Cobalt Market Data

Cobalt has a far shorter history than copper and was not traded on metal exchanges for a long time. For the period from 1925 to 2015, we use price data from the US Geological Survey (2017) computed based on the quantities and value of US import data. Starting in 2016, we use U.S. spot price data for cobalt cathodes from the US Geological Survey (2021). As cobalt has a relatively high value compared to weight and can be traded relatively freely, we assume that changes in US prices are a good approximation for global price movements.

Cobalt production data refer to the cobalt content of mine or refined production depending on the producing country and year. Recycling does not play an important role in cobalt supply. We source the data for the period from 1925 to 2017 from Schwerhoff and Stuermer (2020) and for 2018 to 2020 from the US Geological Survey (2021).

A4.4 Lithium Market Data

Lithium is the least mature market across the four metals. Price data from 1955 to 2000 refer to lithium carbonate and from 2001 to 2015 to prices derived from U.S. import data by the US Geological Survey (2017). For 2016 to 2020, we use battery grade lithium carbonate for large contracts as provided in US Geological Survey (2019, 2021). We have made sure that the price series are consistent across time by splicing series on each other and using adjustment factors. As lithium has a relatively high value compared to weight and can be traded relatively freely, we assume that US price changes are a good approximation for global price movements.

We source world mine production data for the years 1955 to 2017 from Schwerhoff and Stuermer (2020). The data are in metric tons of gross product of lithium minerals and brine. For the years 1967 to 2015 it is reported as gross product of ore and ore concentrates from mines and lithium carbonate from brine deposits. For the years 2017 to 2020, the U.S. Geological Survey (2019, 2021) reports lithium content of mine production. This data series is spliced on the earlier lithium ore series to come up with a consistent series over time. The source for the data from 2018 to 2020 are US Geological Survey (2020, 2021).

A4.5 Nickel Market Data

Nickel price data refer to US prices until 1978 and from 1979 onwards to U.S. dollar prices at the London Metal Exchange. The data from 1900 to 2017 is sourced from Stuermer and Schwerhoff (2020) and from 2018 to 2020 from the US Geological Survey (2021).

Global nickel production data is mine production data from 1900 to 1962 from the US Geological Survey (2017). From 1963 to 2020, the data are from the World Bureau of Metal Statistics (2021) and are described as refined production data, including recycled materials.

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