



# PEOPLE'S REPUBLIC OF CHINA

## SELECTED ISSUES

February 2023

This Selected Issues paper on the People's Republic of China was prepared by a staff team of the International Monetary Fund. It is based on the information available at the time it was completed on December 19, 2022.

Copies of this report are available to the public from

International Monetary Fund • Publication Services  
PO Box 92780 • Washington, D.C. 20090  
Telephone: (202) 623-7430 • Fax: (202) 623-7201  
E-mail: [publications@imf.org](mailto:publications@imf.org) Web: <http://www.imf.org>  
Price: \$18.00 per printed copy

**International Monetary Fund**  
**Washington, D.C.**



# PEOPLE'S REPUBLIC OF CHINA

## SELECTED ISSUES

December 19, 2022

Approved By  
**Asia and Pacific  
Department**

Prepared by a team led by Helge Berger with individual chapters authored by Anne Oeking, Henry Hoyle, Natalija Novta (all APD), Wenjie Chen (AFR), John Ralyea (FAD), Fan Zhang (RES), Phakawa Jeasakul (Resident Representative in Hong Kong SAR).

## CONTENTS

<b>RECALIBRATING THE COVID STRATEGY</b>	<b>3</b>
A. Introduction	3
B. Experiences from Other Countries	5
C. The Economic Cost of the ZCS	6
D. The Health Cost of a Sudden Lifting of All Containment Measures	8
E. Preparing for the Gradual Lifting of Remaining Restrictions	9
F. Conclusions	11
<b>APPENDIX</b>	
I. Data and Empirical Analyses	12
References	15
<b>SHORT-TERM FISCAL MULTIPLIERS IN CHINA</b>	<b>16</b>
A. Fiscal Multipliers	16
B. The “Bucket” Approach to Estimating the Overall Multiplier	17
C. A Model Simulation of China’s Fiscal Multipliers by Fiscal Instrument	22
D. Conclusion	24
References	25
<b>MONETARY POLICY AND THE ROLE OF CREDIT POLICIES</b>	<b>28</b>
A. Introduction	28
B. Monetary Policy Transmission and the Role of Quantity-Based Policies	30
C. Methodology and Data	32
D. Empirical Results	35
E. Policy Implications	38
F. Conclusion	41

**APPENDIX**

I. Additional Empirical Results	42
---------------------------------	----

References	49
------------	----

**MARKET REFORMS IN CHINA'S POWER SECTOR** 51

A. Introduction	51
-----------------	----

B. Brief History and the Challenges of China's Power Market Reforms	53
---	----

C. Power Market Reforms to Increase Efficiency	55
--	----

D. The Importance of Power Market Reform for China's Climate Ambitions	56
--	----

E. Policy Implications	61
------------------------	----

References	63
------------	----

**BOXES**

1. The Impacts of Intensity Targets on Climate and Energy	58
---	----

2. China's Power Crunch of 2021	59
---------------------------------	----

**FOSTERING THE DEVELOPMENT OF CLIMATE FINANCE** 64

A. Introduction	64
-----------------	----

B. China's Green Finance Landscape	64
------------------------------------	----

C. China's Policy Initiatives on Green Finance	69
--	----

D. Enhancing Market-oriented Climate Finance	70
--	----

E. Managing Climate-Related Financial Risks	75
---	----

F. Conclusion	78
---------------	----

References	80
------------	----

**FIGURES**

1. Green Finance Landscape	66
----------------------------	----

2. Selected Characteristics of Green Finance	68
--	----

3. Selected Characteristics of Green Bonds	74
--	----

**SUSTAINABLE AND BALANCED GROWTH IN THE LONGER TERM** 82

A. Introduction	82
-----------------	----

B. Background	82
---------------	----

C. Approach and Historical Decomposition	84
--	----

D. Forecast Scenarios	87
-----------------------	----

E. Conclusion	90
---------------	----

References	94
------------	----

# RECALIBRATING THE COVID STRATEGY<sup>1</sup>

*The Zero-COVID strategy served China well in the initial stages of the pandemic. The emergence of more transmissible but potentially less severe COVID variants and a significant rise in economic cost associated with frequent lockdowns have pointed to the importance of recalibrating the COVID strategy while balancing the still significant health risks. As a result, in late 2022, China started easing COVID restrictions. Experiences from other economies suggest that a prepared and orderly full reopening would help minimize the tradeoff between health consequences and economic costs.*

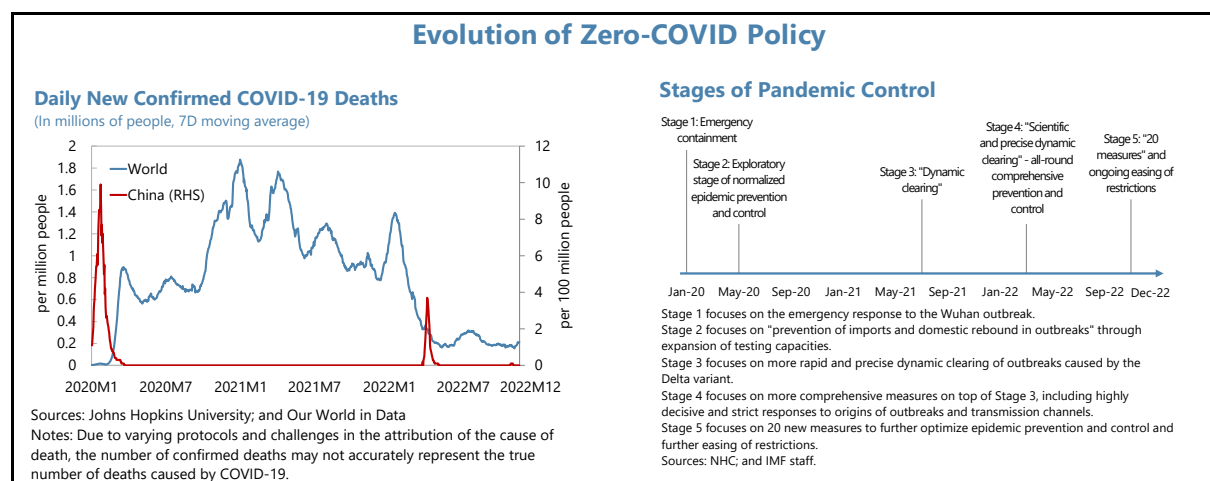
## A. Introduction

- 1. Throughout much of the COVID-19 pandemic, China has relied on a COVID suppression strategy**—Zero-COVID strategy (ZCS), for short. The strategy's goal of suppressing transmission as much as possible has been achieved by extensive reliance on non-pharmaceutical interventions such as rapid and sweeping lockdowns, mass testing, contact tracing, quarantine at government facilities for anyone infected or a close contact of an infected person, and largely closed international and sometimes domestic borders.
- 2. The ZCS served China well in the initial stages of the pandemic.** By quickly containing outbreaks and moving scarce health care resources to where they were most needed, the strategy helped keep Covid cases, hospitalizations, and death rates very low by international comparison despite limited medical resources.<sup>2</sup>
- 3. Successfully containing outbreaks also supported the gradual transition to more targeted and flexible containment measures,** refining the overall strategy in line with the evolution of the pandemic (Text Figure). After the emergency response to the Wuhan outbreak in early 2020, the zero-COVID policy started taking shape in the spring of 2020. Measures focused on preventing imported cases and containing any rebound of domestic outbreaks by suppressing them at the local level. As the Delta variant started to spread in mid-2021, the COVID policy shifted its focus to more rapid and targeted measures to avoid community spread while recognizing that cases would occur regularly ("dynamic clearing"). In March 2022, amid the Omicron variant and large outbreaks, China's COVID policy started emphasizing comprehensiveness and strict responses to cut off transmission channels over rapidity.
- 4. In late-2022, the authorities started easing COVID containment policies notwithstanding ongoing spikes in infections.** In November 2022, the COVID policy was significantly relaxed for the first time ("20 measures") by easing and lifting excessive restrictions imposed previously and those observed in implementation. Further meaningful easing of restrictions

<sup>1</sup> Prepared by Anne Oeking and Fan Zhang.

<sup>2</sup> For example, according to Phua et al. (2020): "Critical Care Bed Capacity in Asian Countries and Regions." *Critical Care Medicine* January 2020, China has 3.6 critical care beds per 100,000 population compared to 7.1 in Hong Kong, 7.3 in Japan, 10.6 in Korea, 11.4 in Singapore, or 12 intensive care beds per 100,000 population across OECD countries according to the OECD.

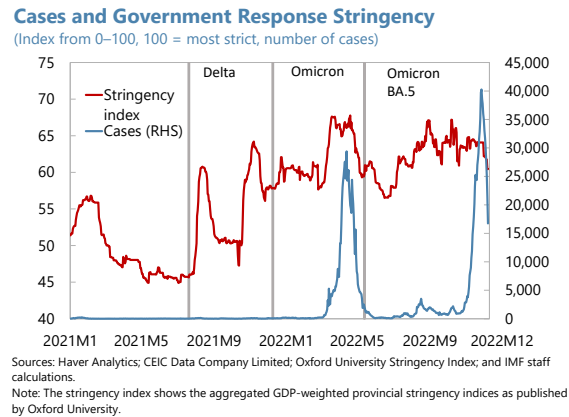
has since taken place, including allowing home quarantine, reducing mass testing, eliminating testing requirements to enter public places and transportation, and lifting of requirements for health codes for inter-regional travel in China. The discussion of public health preparations for an eventual full reopening, including targets for elderly vaccinations, has been elevated. At the same time, cases have surpassed earlier waves, suggesting a move away from the zero-COVID strategy towards accepting outbreaks.



**5. Even though the economy bounced back quickly from the 2020 outbreaks, the recovery of private consumption has been lagging—in part as a result of the need for recurring lockdowns and elevated uncertainty.** Real GDP rebounded to its pre-pandemic trend by end-2020 but has since lost ground again. While overall cumulative output losses—measured as the percentage share between actual outturns and the January 2020 WEO forecast—amounted to only 1.5 percent of GDP over 2020 and 2021, this performance was predominantly driven by surging exports and investment. Amid significant disruptions throughout 2022, these cumulative losses are estimated at more than 4½ percent by end-2022. Over 2020 and 2021, private consumption losses amounted to more than 5 percent, and are estimated to have increased to almost 13 percent by end-2022. Supply of services was almost 4 percent below its pre-crisis trend in 2020–21 and at more than 8 percent below its trend by Q3-2022. Consumption was impacted not only by income losses, but also by increased uncertainty under the ZCS. These developments have reversed progress towards a more consumption-based, higher-quality growth model, with the private consumption-to-GDP share falling to around 35 percent from its pre-pandemic share of around 37.

**6. Throughout 2022, the emergence of more transmissible variants put the zero-COVID strategy to test and outbreaks have significantly hurt domestic economic activity.** Amid these more transmissible variants, China experienced the largest and most persistent outbreaks since the original Wuhan outbreak in the first half of 2022. Under the ZCS, these outbreaks led to widespread and very strict containment measures that severely disrupted domestic economic activity, created significant challenges for the thus-far relatively resilient supply chains, and weakened employment and private consumption. Ever since, China has not returned to extended periods of close to zero

confirmed cases—as was the case before the arrival of the Omicron variant—leaving the economy facing frequent, though mostly local, outbreaks that had to be addressed with oftentimes economically painful containment measures under the ZCS (Text Figure), even as the strategy continued to be successful in slowing contagion. Since October 2022, new outbreaks have become larger and more widespread than ever before and have surpassed total daily case levels from earlier in the year—even before testing was rolled back and fewer cases recorded—estimated to significantly hurt economic activity in the near-term even as restrictions have been rolled back.



**7. Going forward, a full lifting of COVID containment measures should balance economic costs against still significant healthcare risks.** Vaccines remain effective against severe outcomes and should help mitigate health-related risks. The full lifting of the remaining restrictions should thus be preceded by urgent measures to contain the health impact. Specifically, increased vaccination coverage and better treatment options could mitigate some of the difficult tradeoffs between health concerns and economic growth under a durable recovery.

## B. Experiences from Other Countries

**8. Several other economies have in the meantime lifted their zero-COVID regimes, offering broad lessons for China.** Examples of countries removing ZCS-style COVID policies include Australia, New Zealand, Singapore, and Vietnam (see Text Figure). While each has charted a distinct exit path, most did so in the face of rising economic costs and more contagious, less-severe new variants. Some commonalities include the following:

- *Trigger:* Increasing economic costs under less lethal but more transmissible variants featured among the main reasons to abandon the strategy.
- *Communication:* In most cases, the eventual lifting of the ZCS was communicated well in advance, sometimes linked to vaccination goals, providing time for society to internalize the upcoming change.
- *Vaccinations:* For all former ZCS economies, the removal of some or all non-pharmaceutical restrictions has been preceded or accompanied by ongoing pharmaceutical interventions, in particular very high vaccination rates, including of boosters, especially for the elderly, as well as availability of treatment options and enhanced health care capacity.
- *Shifting goals:* Lifting zero-COVID implied shifting the main goal from trying to keep cases close to zero to accepting outbreaks, though the acceptable level of cases might depend on factors

such as health care capacity and the degree of protection afforded by the existing level of vaccination.

- *From strict lockdowns to more targeted measures:* Lifting zero-COVID has not implied an immediate end to all restrictions. Rather, countries ended hard lockdowns before sequentially lifting other restrictions. In some cases, voluntary social distancing by the population have complemented official rules.
  - Flexibility: Measures have been focused on supporting a reduction in the intensity of outbreaks instead of full prevention. In some cases, restrictions have been reimposed and eventually re-loosened as outbreaks worsened and improved. In several economies, some of these restrictions have been implemented differently across regions, depending on local conditions.
  - Transition measures: Transition measures have included continued safe distancing, mask wearing, quarantines for infected or close contacts (moving from mandatory government facilities to home quarantine), testing (including rapid tests), and group size or capacity restrictions. Contact tracing has been eased and eventually abandoned over time in several economies.
- *International reopening:* Accepting a certain level of domestic cases provided an important prerequisite for opening international borders, as the number of imported cases has often been small compared to local transmission.
- *Health consequences:* Opening up has allowed the virus to spread domestically and large waves of outbreaks have occurred, with high vaccination rates lowering the severity of cases but not preventing transmission, especially as there was very limited natural immunity. Several of the former-ZCS economies reached population infection levels close to levels observed in other countries around the world in a matter of a few months (though, of course, estimates of case numbers can vary considerably depending on the degree of testing). With high vaccination levels, healthcare systems have not been overburdened and death rates have been kept at relatively low levels.
- *Economic impact:* Amid less lethal variants, high vaccination rates (reducing the severity of health impacts), a well-prepared population (avoiding resorting to voluntary restrictions which could have significant economic impacts) and an oftentimes gradual versus sudden opening up, short-term economic costs appear to be mostly contained, and consumption recovered despite outbreaks.

## C. The Economic Cost of the ZCS

**9. Overdependence on non-pharmaceutical measures has an economic cost.** Since the onset of the COVID-19 pandemic in early 2020, China quickly introduced strict non-pharmaceutical interventions (NPIs) such as large-scale lockdowns, contact tracing and mass testing. The measures

formed an essential part of the policy package at the early stages of the pandemic when there were limited medical options. As the COVID virus mutated into more contagious, less-severe variants, the existing mitigation policies have been adjusted, primarily aiming at more rapid and targeted responses. However, the impact of non-pharmaceutical measures on economic recovery had been amplified by mobility restrictions taking place at a higher frequency and broader regions, tilting the balance of risk toward higher economic losses as the virus became more contagious and less lethal.

**10. A number of stylized facts characterize the economic impact of the ZCS.** We apply a panel regression on the congestion data from 95 major cities and a range of economic indicators for matching prefectures from January 2020 to July 2022, estimating elasticities for different levels of containment stringencies, virus variants, mobility, and economic activity.

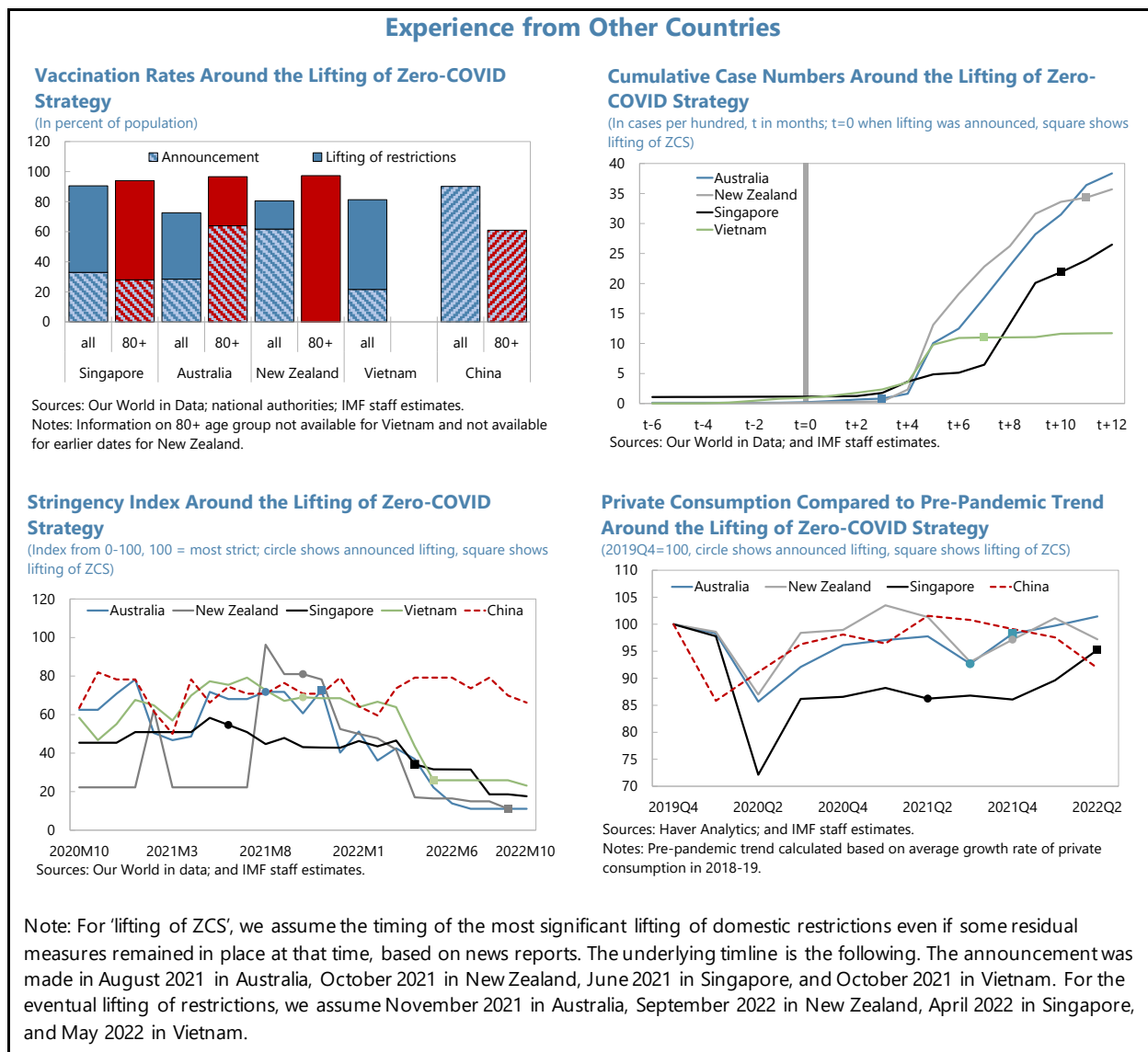
- *The ZCS approach evolved as the virus mutated.* Table 3 (see Appendix I) suggests that despite the strong average response by the local authorities to rises in cases and fatalities, tightness of the policy measures increased, on average, for the more infectious Delta variant and even more for the Omicron wave.
- *Voluntary mobility increased during the Omicron waves in the first half of 2022 in contrast to earlier waves.* Table 3 also suggests that average voluntary mobility decreased in response to rising cases and deaths. However, voluntary responses reacted negatively to the Delta variant, which was more infectious and lethal than the original Alpha variant. In contrast, voluntary activity increased amid the Omicron variant, which was even more infectious than the Delta, but less lethal than the original Alpha variant.<sup>3</sup> The shift in behavior likely reflects a combination of factors: an evolution of public confidence on the protection provided by the vaccines, a change in public perception of the virulence of the Omicron variant compared to earlier mutations, and potentially fatigue of repeated and prolonged lockdown measures.
- *The reduction in mobility has had a significant impact on economic cost.* Table 1 (Appendix I) suggests that, on average, a one percent drop in mobility led to a 2/3 percentage point decline in GDP over the past years since 2020. Due to the continuous adjustment to the NPIs since the initial wave in Hubei in 2020, the impact on GDP during the Delta wave in the second half of 2021 was on average about 1.3 percentage point smaller. Consumption was most heavily affected. With every percentage drop in mobility, retail sales were 1.6 percentage points lower compared to the pre-COVID trend. The impact on consumption was amplified by the subsequent Delta and Omicron waves, with further declines of 3.8 and 7.1 percentage points, respectively, due to the tightening of NPI measures, in line with Stage 3 and 4 of the Zero-COVID policy (Text Figure). Household disposable income was affected to a lesser degree compared to GDP and retail sales, with every one percent drop in mobility leading to 0.4 percent drop in disposable income per capita. The relatively high elasticity between retail sales and voluntary mobility may reflect the combined impact of a reduction in income and a rise in

<sup>3</sup> Lewnard and others (2022) show the relatively lower severity of the Omicron variant compared to Delta, beyond what can be explained by previous infections and vaccinations.



savings in light of elevated uncertainty. However, the Delta and Omicron waves posed additional 3.0 and 4.5 percent contraction in disposable income respectively.

- *Uncertainty could have an additional dampening economic effect.* While not directly captured in our estimates, uncertainty such as the one deriving from fear of lockdowns could provide an additional negative channel impacting economic indicators, especially consumption.



## D. The Health Cost of a Sudden Lifting of All Containment Measures

**11. An immediate withdrawal of all non-pharmaceutical interventions could have severe health consequences,** given the relatively lower level of vaccination for the most vulnerable, a possible lack of antiviral treatments, and still limited medical capacities. The Omicron variant is more infectious and immune evasive than the previous variants, which could pose serious challenges to

China's health care system and existing capacity of hospital beds, especially in intensive care. Cai and others (2022) studied possible outcomes should NPIs be absent in the pandemic prevention and control framework. By maintaining the pace of vaccination as of March 1, 2022, a hypothetical 20 imported Omicron cases in the baseline could lead to a wave of 112 million symptomatic cases, 2.7 million ICU admissions, and 1.6 million deaths over a 6-month period, with three quarters of the deaths among unvaccinated individuals aged 60 and above. This compares to approximately 88 million people aged above 60 who have not yet been boosted and 41 million people aged above 60 who are not fully vaccinated as of July 23, 2022 (or around 23 million people above 80 who have not yet been boosted and 13 million people aged above 80 who are not fully vaccinated as of November 11, 2022). The study also finds that in the absence of NPIs:

- *Medical capacity would be quickly overwhelmed.* Despite enough hospital beds nationwide for respiratory illness, the demand for ICU beds would exceed the availability by 15.6 times during the peak of the wave.
- *Increasing vaccination and booster rates could lower deaths substantially.* Closing the vaccination gap for the elderly (i.e., all eligible individuals aged 60 and above would be vaccinated) would lead to a 33.8, 54.1 and 60.8 percent decrease in hospitalization, ICU admissions and deaths, respectively, compared to the baseline.
- *Effective antiviral treatment could also help lower the medical burden.* Using China's approved antiviral therapies, at an 80 percent effective rate, could lead to a 36.5, 39.9 and 40 percent decrease in hospitalization, ICU admission and deaths, respectively. In the best-case scenario, if all cases were treated by highly effective medicines, the decrease could be improved to 81.2, 88.8, and 88.9 percent, respectively.
- *In the absence of high vaccination coverage among the vulnerable and antiviral treatments, only strict NPIs could help lower the medical burden meaningfully.* NPI adoption would have to be able to reduce the reproduction number to values no larger than 2 in order to have a substantial decrease in health consequences. The strict NPIs are found only to be able to delay epidemics beyond the projected 6-month horizon, leaving the final impact uncertain.

**12. A comprehensive set of measures is needed.** The scenarios discussed by Cai and others (2022) suggest that no single measure can reduce the number of deaths to a level close to influenza related deaths in China. A combined effort would be needed to keep medical demand within capacity, for which increased vaccination among the elderly and wide availability of antiviral treatment hold the key.

## E. Preparing for the Gradual Lifting of Remaining Restrictions

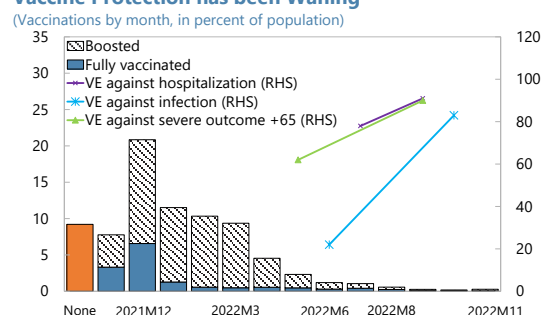
**13. A prepared and orderly strategy to fully lift remaining restrictions could minimize the tradeoff between health outcomes and the economic cost.** Any such approach would involve a further move away from the use of the most stringent non-pharmaceutical restrictions, such lockdowns of those not infected and stringent mobility restrictions on the vaccinated population,

and pandemic prevention and control mainly relying on the protection from effective vaccines, treatments, and the existing healthcare system, supported by a phased withdrawal of social distancing measures.

**14. Filling the vaccination gap, especially for the most vulnerable, is an essential precondition for a full easing of restrictions.** With lockdown measures fully lifted, the number of infections would be expected to rise but high vaccination levels would imply a high share of asymptomatic or mild cases which could be isolated at home for recovery without hospitalization. Severe cases and deaths would be expected to remain at low levels *if* vaccines fully protect the most vulnerable groups and sufficient treatment options are available. The rise in hospitalization and ICU demand could thus remain within the capacity of the medical system.

**15. China's vaccination campaign is well advanced, but important gaps remain for booster shots and vaccination of the elderly.** 90 percent of the population have received at least two shots and 63 percent have been boosted as of November 2022, but less than 6 percent of the population received a shot in the last six months. Waning immunity in the general population thus remains a concern (see Text Figure). In addition, vaccination rates among the elderly are still relatively low. Among the especially vulnerable over-80-year-old group, just over 65 percent have received two shots and around 40 percent have been boosted (see Text Figure).

**Vaccine Protection has been Waning**

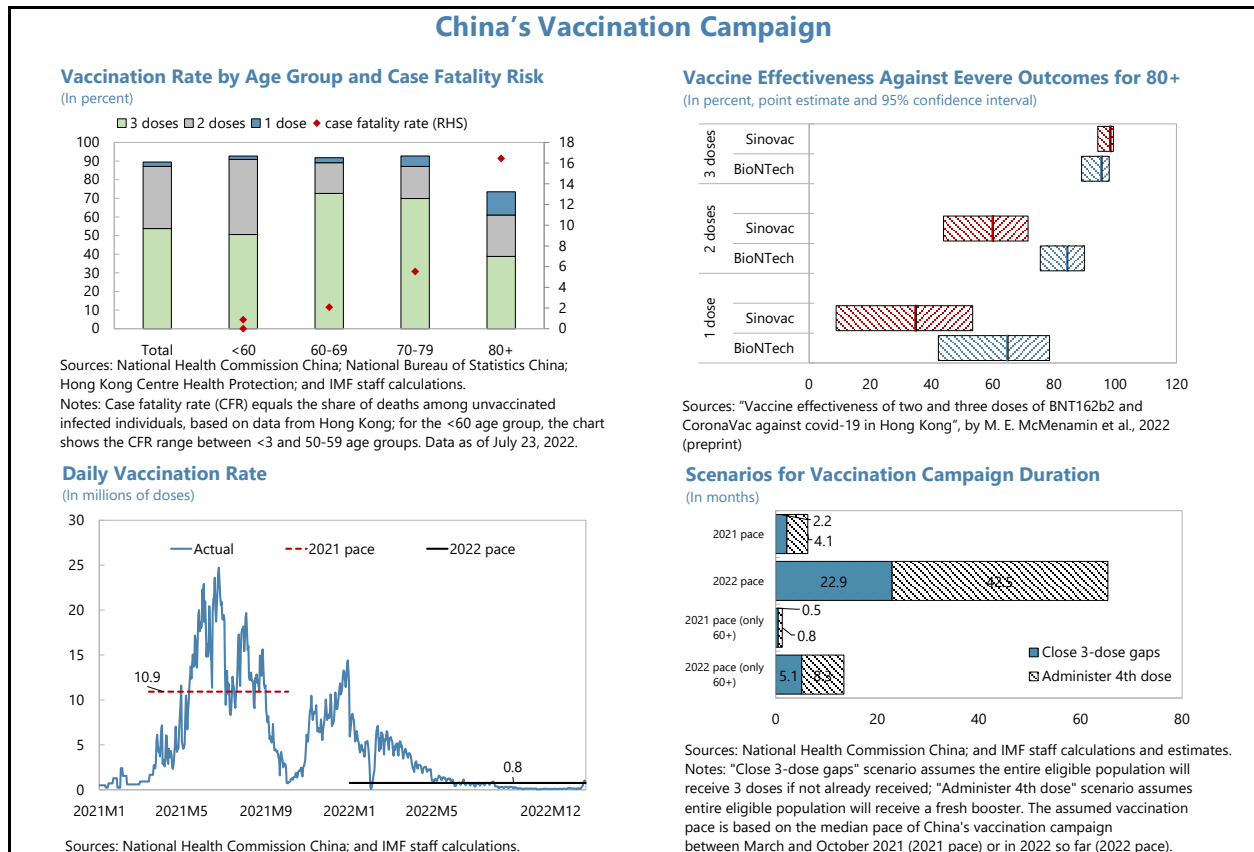


Sources: Our World in Data; BMC Infectious Diseases; The Lancet; and IMF staff estimates.  
Notes: Intertemporal vaccine efficacy (VE) in percent based on studies for US-approved vaccines. Due to irregular reporting intervals, some numbers are linearly interpolated. Numbers cannot account for people who have been both fully vaccinated and boosted in a given time period, so present an upper bound.

**16. The booster vaccination campaign remains vital considering recent academic research suggesting domestic vaccines' effectiveness against severe illness.** Despite lower efficacy of vaccines against infection, recent research—based on the large Omicron outbreak in Hong Kong SAR in the first quarter of 2022 (McMenamin and others, 2022)—suggests that three doses of Sinovac's domestic vaccine could be effective at preventing severe illness. While the study showed considerably higher efficacy for BioNTech's mRNA vaccine under a 1- or 2-dose regime, both vaccines were found to offer very high levels of protection against severe outcomes following a booster shot (above 95 percent across all age groups). Based on the vaccination pace observed across China's vaccination campaign so far, boosting the entire population could be achieved within few months if the pace went back to where it was during the initial vaccination campaign in 2021 (see Text Figure), assuming no supply constraints and no vaccine hesitancy. Data gaps remain on the impact of new variants and the waning of effectiveness, but ensuring protection is maintained would likely be contingent on repeated booster campaigns.

**17. Clear forward-looking communication would facilitate the transition and reduce uncertainty.** Communication could elaborate on the sequence and conditions for further withdrawal of measures toward a full normalization of activity. A well communicated strategy could

help anchor business and household expectations for the upcoming changes and reduce uncertainty in their decision making.



## F. Conclusions

**18. Going forward, China should further adjust its COVID strategy in a way that would both mitigate the impact on economic activity and continue to protect lives.** Doing so will require: (i) a well communicated strategy, (ii) ramping up the roll out of booster shots that are effective against new COVID variants and targeting the under-vaccinated elderly, (iii) making antiviral therapies—either domestically developed or sourced from abroad in line with the recent agreements to jointly produce antiviral drugs with foreign companies—widely available and (iv) scaling up health-care capacity as (v) containment measures continue to be gradually adjusted by making them more flexible and less restrictive for economic activity, while containing domestic transmission within healthcare capacity.

## Appendix I. Data and Empirical Analyses

### Data

**19.** The city level mobility data is taken from the Gaode 100-city congestion index. It measures mobility as a ratio between the time needed for a road trip and the time needed for the same trip without congestion. As a benchmark, average monthly mobility from 2017 to 2019 is treated as pre-COVID levels. Data since January 2020 is measured in percent deviation from the pre-COVID benchmark levels.

**20.** The city level economic data are nominal economic variables, sourced from the respective municipal statistic bureaus. The variables are nominal GDP, retail sales, and disposable income. For each city, the Compounded Annual Growth Rate between 2016 and 2019 is treated as the pre-COVID trend growth. The counterfactual benchmark for each variable is calculated by extrapolating using the pre-COVID trend growth. The actual turnouts since January/Q1 2020 are transformed into percent deviation from the counterfactual pre-COVID benchmark levels.

**21.** The stringency index is sourced from Oxford COVID-19 Government Response Index for each Chinese province. The index collects government's non-pharmaceutical interventions in response to the COVID outbreaks and translates into a numerical index between 0 and 100 for which a higher value indicates stricter policy.

**22.** The confirmed cases and death numbers are from the National Health Commission of China. The dominant variant of the COVID virus is assumed to be the Delta variant for the period between Q3/July 2021 and Q4 2021/February 2022; and Omicron since Q1/March 2022.

### Empirical Strategy

**23.** For the economic impact, we apply the following panel regression:

$$y_{j,t} = \beta_j + \alpha_0 \text{mobility}_{j,t} + \alpha_1 \text{variant}_t + \alpha_2 \text{seasonal factor}_t + \epsilon_{j,t}$$

**24.** In the equation above, economic variables ( $y_{j,t}$ ) measured in percent deviation from pre-COVID trend for city (j) are regressed on the decline in mobility, adjusted for the major virus variants and seasonal factors.

**25.** To better analyze the sources of changes in mobility, mobility is decomposed into policy stringency and voluntary mobility using the following equation, where the voluntary part is proxied as the residual.

$$\text{mobility}_{j,t} = \beta_j + \alpha_0 \text{stringency}_{j,t} + \epsilon_{j,t}$$

**26.** The decomposed mobility measures are used as explanatory variables for the economic activities.

$$y_{j,t} = \beta_j + \alpha_0 \text{mobility}_{j,t} + \alpha_1 \text{voluntary mobility}_t + \alpha_2 \text{variant}_t + \alpha_3 \text{seasonal factor}_t + \epsilon_{j,t}$$

The regression results are shown below, with 95 percent confidence intervals shown in the brackets underneath each parameter.

## Empirical Results

<b>Table 1. China: Activity</b>			
<i>Dependent variable:</i>			
	GDP (1)	Retail sales (2)	Disposable income (3)
Mobility	0.66*** (0.53, 0.80)	1.16*** (0.96, 1.35)	0.37*** (0.13, 0.61)
Delta variant	1.31* (-0.22, 2.84)	-3.84*** (-6.04, -1.65)	-2.99** (-5.79, -0.20)
Omicron variant	0.48 (-1.05, 2.01)	-7.24*** (-9.31, -5.18)	-4.46*** (-7.21, -1.71)
Individual fixed effects	Yes	Yes	Yes
Seasonality adjusted	Yes	Yes	Yes
Observations	896	815	566
R <sup>2</sup>	0.58	0.38	0.47
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01		

<b>Table 2. China: Activity</b>			
<i>Dependent variable:</i>			
	GDP (1)	Retail sales (2)	Disposable income (3)
Stringency	-0.23*** (-0.31, -0.16)	-0.28*** (-0.39, -0.17)	-0.31*** (-0.45, -0.18)
Voluntary Mobility	0.63*** (0.49, 0.77)	1.14*** (0.94, 1.34)	0.30** (0.06, 0.54)
Delta variant	4.84*** (3.15, 6.53)	1.69 (-0.76, 4.15)	0.06 (-2.99, 3.10)
Omicron variant	3.52*** (1.91, 5.13)	-3.18*** (-5.36, -1.00)	-1.24 (-4.04, 1.55)
Individual fixed effects	Yes	Yes	Yes
Seasonality adjusted	Yes	Yes	Yes

Observations	896	815	566
R <sup>2</sup>	0.58	0.38	0.48
Note:	* p<0.1; ** p<0.05; *** p<0.01		

**Table 3. China: Policy Response and Voluntary Mobility**

	<i>Dependent variable:</i>	
	Stringency Voluntary mobility	
	(1)	(2)
confirmed cases (log diff)	0.02***	-0.002***
	(0.02, 0.03) (-0.004, -0.001)	
deaths (log diff)	0.05***	-0.02***
	(0.03, 0.06) (-0.03, -0.02)	
Delta	3.46***	-1.13***
	(2.51, 4.41) (-1.60, -0.66)	
Omicron	4.68***	1.48***
	(3.50, 5.86) (0.92, 2.04)	
Individual fixed effects	Yes	Yes
Seasonality adjusted	Yes	Yes
Observations	2,779	2,587
R <sup>2</sup>	0.36	0.21
Note:	* p<0.1; ** p<0.05; *** p<0.01	

## References

Cai, J., and others, 2022, "Modeling transmission of SARS-CoV-2 Omicron in China", *Nature Medicine* 28, 1468–1475 (2022). <https://doi.org/10.1038/s41591-022-01855-7>

McMenamin, M. E., and others, 2022, "Vaccine effectiveness of two and three doses of BNT162b2 and CoronaVac against Covid-19 in Hong Kong", *The Lancet, Infectious Diseases*, July (2022). [https://doi.org/10.1016/S1473-3099\(22\)00345-0](https://doi.org/10.1016/S1473-3099(22)00345-0)

Lewnard, J.A., and others, 2022, "Clinical outcomes associated with SARS-CoV-2 Omicron (B.1.1.529) variant and BA.1/BA.1.1 or BA.2 subvariant infection in Southern California", *Nature Medicine*. <https://doi.org/10.1038/s41591-022-01887-z>

Liu, Y., Rocklöv, J., 2021, "The reproductive number of the Delta variant of SARS-CoV-2 is far higher compared to the ancestral SARS-CoV-2 virus", *Journal of Travel Medicine*, Volume 28, Issue 7, October 2021, taab124 (2021). <https://doi.org/10.1093/jtm/taab124>

Liu, Y., Rocklöv, J., 2022, "The effective reproductive number of the Omicron variant of SARS-CoV-2 is several times relative to Delta", *Journal of Travel Medicine*, Volume 29, Issue 3, April 2022, taac037 (2022), <https://doi.org/10.1093/jtm/taac037>



# SHORT-TERM FISCAL MULTIPLIERS IN CHINA<sup>1</sup>

*Fiscal policy is an essential tool for Chinese policymakers, not only as an instrument to manage macroeconomic demand but also as an element of the larger quest to rebalance China's economy. This paper finds that means-tested transfers to households have a significantly higher short-term stabilization impact than other fiscal policy measures while contributing to securing high-quality, balanced growth.*

## A. Fiscal Multipliers

**1. China has traditionally relied heavily on increasing public investment to offset exogenous shocks to demand.** In response to the Global Financial Crisis, the government turned to investment to support demand. Following the pandemic, the authorities have also relied disproportionately on investment to boost growth. This raises the question whether relying on public investment to boost short-term demand is the best use of fiscal resources.

**2. Fiscal multipliers measure the impact of a discretionary changes in government spending or tax revenue (i.e., fiscal shocks) on output.** Good estimates of fiscal multipliers are essential for fiscal policy to play an effective role in supporting economic stabilization and fiscal policy credibility as well as for more accurate macroeconomic forecasting. Overestimating multipliers could result in a government providing insufficient stimulus to offset a negative shock to the economy. Underestimating multipliers may lead countries to miscalculate the amount of adjustment necessary to curb their debt ratio.

**3. Estimation of fiscal multipliers is challenging.** Changes in the government balance and its revenue and expenditure components affect aggregate demand and changes in aggregate demand, in turn, affect the government balance and its components. This dynamic endogeneity complicates empirical estimates of multipliers from observed changes in fiscal aggregates and output. For example, a discretionary increase in income tax rates, aimed at lowering a fiscal deficit, reduces aggregate disposable income. The drop in income will reduce aggregate consumption—especially if many households lack access to credit or savings to smooth the negative shock—inducing layoffs and a fall in aggregate taxable income. The smaller income tax base translates, in turn, into lower tax revenue which can offset some or all of the initial effort to increase tax revenue.<sup>2</sup>

**4. Estimated multipliers vary with a country's structural characteristics and the conjunctural setting.** Izquierdo and others (2019) offer a succinct review of the academic literature on how the government spending multiplier depends on:

<sup>1</sup> Prepared by Anh Nguyen (FAD), John Ralyea (FAD) and Fan Zhang (RES).

<sup>2</sup> The aggregate change in tax revenue depends on the tax multiplier, the elasticity of tax revenue to output, and capacity to administer taxes.

- the state of the economy, with multipliers being larger in recessions than in expansions (e.g., Auerbach and Gorodnichenko, 2012 and 2013; Riera-Crichton, Vegh, and Vuletin, 2015);
  - the exchange rate regime, with multipliers being larger under fixed regimes (e.g., Ilzetki, Mendoza, and Vegh, 2013);
  - the degree of indebtedness, with multipliers being larger when debt is low (e.g., Ilzetki, Mendoza, and Vegh, 2013; Huidrom et al., 2019);
  - the degree of accommodation of monetary policy, with multipliers being larger when monetary policy is loose and/or close to the zero lower bound (Christiano, Eichenbaum, and Rebelo, 2011; Coenen, Straub, and Trabandt, 2013); and
  - the degree of openness of the economy, with multipliers being smaller in economies more open to trade (e.g., Ilzetki, Mendoza, and Vegh, 2013; Gonzalez-Garcia, Lemus, and Mrkaic, 2013).
- Moreover, studies indicate that the output effect of public investment falls when efficiency is low (Leeper, Walker, and Yang, 2010; Cavallo and Daude, 2011; Furceri and Li, 2017).

**5. Against this backdrop, it is perhaps not surprising that estimates of the size of multipliers for China cover a wide range.** Estimates of short-term spending multipliers in China range between 0.3 – 1.7 (Text Table). While these differences may reflect differences in sample periods, techniques used to identify fiscal shocks, and estimation approaches, they point to the difficulty in arriving at point estimates for multipliers, particularly in emerging markets such as China.

**6. This paper employs two methodologies to further explore the size of short-term multipliers in China.** First, we apply the “bucket” approach developed by Batini, Eyraud, and Weber (2014) to derive an indicative range for the overall fiscal multiplier. The “bucket” approach yields a range for the average multiplier. Second, we model multipliers for various fiscal instruments in responses to recessionary shocks using an estimated New Keynesian model with detailed fiscal specifications and accounting for fiscal and monetary policy interaction.

China: Estimates of Fiscal Multipliers: China and Emerging Markets					
Country	Term	G	T	Notes	Source
<b>Empirical Estimates of Multipliers</b>					
China	ST	1.7		Consumption multiplier	Wang and Wen (2013)
China	LT	1.6/1.0		Economic upturn/downturn	Zhang, Zhang, Zheng, and Zhang (2019)
China	ST	0.5/0.6		Depending on sample period	Jeong, Kang, and Kim (2017)
China	ST	0.6		Based on annual data from China's prefectures	Guo, Liu, and Ma (2016)
EMs	ST	0.2	0.3	Panel, 17 EMs	Ilzetki (2011)
<b>Model-based Estimates of Short-Term Multipliers</b>					
China	ST	0.3/1.1	0.4	G Increase/Decrease	Ducanes and others (2006)
Emerging Asia	ST	1	0.5	Averages of expenditures (ex. transfers) and tax instruments	Freedman and others (2009) based on GIMF
Note: G = government spending; T = tax revenue					

## B. The “Bucket” Approach to Estimating the Overall Multiplier

**7. The “bucket” approach provides a framework for thinking about the likely impact of discretionary fiscal policy on output.** It synthesizes the extensive literature on fiscal multipliers into a granular approach to develop a range estimate of a country’s overall multiplier—that is, the

output response to a change in the fiscal balance generated by a discretionary fiscal policy choice. The range estimate is indicative and a starting point for quantifying the impact of fiscal shocks on activity. The “bucket” approach employs a three-step process.

### Step one: Assess China’s Structural Characteristics that Influence Level of Multiplier

#### 8. China’s structural characteristics influence how its economy responds to fiscal shocks.

Based on the literature, Batini, Eyraud, and Weber (2014), identify six structural factors that either enhance or reduce the magnitude of a country’s overall fiscal multiplier compared to “normal” times.<sup>3</sup>

- *Trade openness:* Countries with a lower propensity to import (i.e., large countries and/or countries only partially open to trade) tend to have higher fiscal multipliers because the demand leakage through imports is less pronounced. China’s imports over the five-year period from 2015-19 averaged about 18 percent of domestic demand. This is lower than the weighted-average value for G20 emerging market economies over the same period of 22 percent.
- *Labor market rigidity:* Countries with more rigid labor markets (i.e., with stronger unions, and/or with stronger labor market regulation) have larger fiscal multipliers if such rigidity implies reduced wage flexibility, since rigid wages tend to amplify the response of output to demand shocks. China’s labor market rigidity is not high. For example, Botero and others (2004) assess China to have an index value of about 0.5 on a scale of from 0 – 1. An index value greater than 0.8 is indicative of high labor market rigidity.
- *Automatic stabilizers.* Larger automatic stabilizers reduce fiscal multipliers, since mechanically the automatic response of transfers and taxes offsets part of the initial fiscal shock, thus lowering its effect on GDP. China’s automatic stabilizers fall below the threshold of 40 percent, above which stabilizers are considered large under the “bucket” approach. China’s public expenditure relative to nominal GDP over the five-year period from 2015-19 averaged about 33 percent, similar to the weighted-average value for G20 emerging market economies over the same period of 31 percent. In addition, direct taxes, particularly the personal income tax, are low, averaging about 1.1 percent over the last several years.
- *Exchange rate regime.* Countries with flexible exchange rate regimes tend to have smaller multipliers because exchange rate movements can offset the impact of discretionary fiscal policy on the economy. The IMF’s 2020 Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) classifies China’s de facto exchange rate regime as “other managed” arrangement, effective March 3, 2022 (see China: 2022 Article IV Consultation – Informational

---

<sup>3</sup> In “normal” times, a country’s output gap is close to zero and its monetary policy is unconstrained (e.g., not at the zero-lower bound). Since the onset of the COVID-19 pandemic, China’s actual output has fallen short of its potential output (i.e., it has a negative output gap) as in many emerging markets, but its monetary policy has remained unconstrained.

Annex. A not less-than-fully-flexible exchange rate tend to enhance the magnitude of fiscal multipliers compared to a fully flexible one.

- *Debt level.* High-debt countries generally have lower multipliers, as fiscal stimulus (consolidation) undertaken when debt is high is likely to have negative (positive) credibility and confidence effects on private demand and the interest rate risk premium. China's overall level of general government debt stands at around 110 percent of GDP.<sup>4</sup> This significantly exceeds the average debt-to-GDP ratio for emerging markets, excluding China, of 59 percent of GDP in 2021. However, the impact of the high debt ratio on interest rate premium in China is somewhat muted by a largely closed capital account, which limits investment opportunities for domestic savers.
- *Public expenditure management and revenue administration.* Multipliers are expected to be smaller when difficulties to collect taxes and expenditure inefficiencies, including coordination of expenditure among different levels of government, undermine the transmission of fiscal policy on output. To our knowledge, there is no objective measure of the effectiveness of China's public financial management (PFM) system. One possible source for assessing its effectiveness is the Public Expenditure and Financial Accountability (PEFA) performance measurement framework. However, China's PFM system has not been assessed through PEFA.

## Step two: Assign China to a Short-Term Multiplier Bucket

### 9. Overall, China's structural characteristics suggest multiplier of low to medium size.

Text Table summarizes the analysis (above) of China's structural characteristics relative to the threshold values for each characteristic. If the characteristic is above the relevant threshold China received a score of "1." If not, its score is zero. All structural characteristics receive an equal weight given the limited empirical evidence on the relative importance of the factors determining the level of the multiplier. China's total score of "3" reflects its relatively low trade openness, small automatic stabilizers, and crawl-like exchange rate regime, all of which tend to enhance the magnitude of its overall fiscal multiplier.

#### China: "Score" Under the "Bucket" Approach

Structural characteristics	Metric	China	Score
Low trade openness	Imports < 30 percent of domestic demand	17.5	1
High labor market rigidity	Index > 0.8 (Botero and others, 2004)	0.51	0
Small automatic stabilizers	Spending < 40 percent of GDP	33	1
Fixed/Quasi FX regime	AREAER classification	Crawl-like	1
Low public debt level	Debt < 70 percent of GDP	110	0
Strong PFM/Revenue admin	PEFA/ Revenue "gaps"	N/A	0
		Total	3

Source: Batini, Eyraud, and Weber 2014

<sup>4</sup> Estimated debt level based on the augmented debt concept, which reflects the fiscal stance and the government's role in the economy. A reconciliation of the augmented concept figures with the authorities' figures, can be found in the published China Article IV reports.

**10. Based on China's structural characteristics, fiscal multipliers are neither unusually high nor low during normal times.**

Batini, Eyraud, and Weber (2014) developed a schematic for placing countries in low, medium, and high short-term multiplier buckets based on their scores (Text Table). With a score of 3, China falls in either the low or medium multiplier bucket. We place China in the low multiplier bucket, which is broadly in line with other emerging markets (Ilzetzki, Mendoza, and Vegh 2013).

China: First-year Overall Multipliers		
(Normal times)		
Country category	Structural score	Multiplier ranges
Low multiplier	0 - 3	0.1 - 0.3
Medium multiplier	3 - 4	0.4 - 0.6
High multiplier	4 - 6	0.7 - 1.0
Source: Batini, Eyraud, and Weber 2014		

**Step three: Adjust "Normal Times" Multiplier for Conjunctural Situation**

**11. The stage of the business cycle effects the size of fiscal multipliers.** Discretionary fiscal stimulus is less effective during an expansion than a contraction, particularly when the output gap is positive. In this case, the increase in output is likely to be marginal as there are few underutilized labor and capital resources to employ to increase supply. Conversely, a fiscal consolidation is more costly in terms of output in a downturn than an upturn because credit-constrained agents cannot borrow to maintain or smooth their consumption. To account for the impact of the business cycle on fiscal multipliers, under the "bucket" approach the "normal times" multiplier is decreased by up to 40 percent if the economy is at its cyclical peak and increased by up to 60 percent if an economy is at a cyclical trough.

**12. Monetary policy also influences the magnitude of a fiscal multiplier.** Expansionary monetary policy enhances the output response to a discretionary fiscal stimulus, such as an increase in spending on goods and services, by offsetting upward pressure on interest rates due to the fiscally induced boost in aggregate demand (i.e., there is no crowding out of private sector demand due to higher interest rates). Similarly, when fiscal policy is tightened through, for example, a cut in public investment, a tighter monetary policy offsets any tendency for interest rates to fall in response to the decrease in public-sector demand. The "bucket" approach accounts for the monetary policy stance by adjusting the "normal times" multiplier by up to 30 percent depending on the degree to which monetary policy is constrained by other considerations. For example, if monetary policy is at the zero-lower bound the overall multiplier would be increased by 30 percent.

**13.** A simple equation summarizes the impact of conjunctural factors on the "normal times" multiplier:

$$M = M_{NT} * (1 + Cycle) * (1 + Mon)$$

where:

$M$  = final overall multiplier estimate  
 $M_{NT}$  = "Normal times" multiplier (Step 2)  
*Cycle* = cyclical adjustment  
*Mon* = monetary policy stance factor

**14. China's economy is estimated to be operating below potential and monetary policy is somewhat accommodative during 2022-23.** These conjunctural factors suggest that the impact of an expansionary fiscal policy on economic activity would be enhanced. China's "normal times" overall multiplier ( $M_{NT}$ ) range is between 0.0 – 0.3. With a negative output gap exceeding two percent of potential GDP, there is slack in the economy. This suggests the cyclical adjustment factor (*Cycle*) should be about 40 percent (0.4). Monetary policy is somewhat accommodative but could be more so. With this in mind, a reasonable value for the monetary stance factor (*Mon*) is about 20 percent (0.2). Bringing the structural and conjunctural factors together, the "bucket" approach provides a potential range for China's short-term overall multiplier of 0.2 – 0.5, at the current juncture (Text Table).

China: "Bucket" approach: Final range estimate for the short-term overall multiplier					
	Step 1	Step 2	Step 3		Estimate
	Score	Multiplier range	Cycle adjustment	Monetary factor	Final range
China	3	Low (0.1 - 0.3)	0.4	0.2	<b>(0.2 - 0.5)</b>

Source: IMF staff calculations.

**15. Other factors can introduce variation in the multiplier around the average value identified through the "bucket" approach.**

- *Policy uncertainty.* Other policies that can induce a high degree of uncertainty into daily economic life such as the potential for repeated lockdowns under China's zero-COVID strategy likely lower fiscal multipliers as mobility is restricted and economic agents are likely to increase savings to offset the potential for income losses.
- *Public investment vs consumption.* For example, the use of different fiscal instruments can amplify or detract from the average multiplier. A meta-analysis of the literature on fiscal multipliers points to average estimates for public spending on goods and services (government purchases) of about 1, with that for public investment slightly higher than that for public consumption, although there is a large degree of variability (April 2020 WEO). For China, we applied a DSGE model to simulate how the multiplier may vary with the use of different fiscal instruments (see next section).
- *Green investment.* "Green" investment may have higher multipliers than other types of investment.

**16. Public support for households may be a particularly effectful policy instrument.** A significant portion of China's households face liquidity constraints. Public spending through means-

tested transfers to households with higher marginal propensities to consume generates higher fiscal multipliers than transfers to other households (Jappelli and Pistaferri 2014; McKay and Reis 2016). A discretionary policy that targets cash transfers to these households is likely to have an outsized impact on output. The following section follows up on these considerations.

### C. A Model Simulation of China's Fiscal Multipliers by Fiscal Instrument

**17. We apply a DSGE model to further study the relative implications of various discretionary fiscal policy shocks (measures) on output under the current cyclical position for China.** We focus on the short-term implication of the fiscal expansion as a stabilization instrument. Three policy scenarios are analyzed to understand the differences between the public investment and household support measures, in terms of stabilizing output and their effects on supporting a more balanced recovery. The model estimates complement the “bucket” approach which does not consider potential differences in multipliers among fiscal instruments.

**18. The model is an extension of Traum and Yang (2015) and Leeper, Plante, and Traum (2010):**

- The model features two types of households: liquidity-constrained (also known as “non-savers” representing low-income households) and unconstrained (aka. savers representing high-income households). The liquidity-constrained households do not have access to financial or capital markets and consume all their disposable income each period. The liquidity-unconstrained households are forward-looking with access to complete asset and capital markets.
- The model includes an extensive set of fiscal instruments including transfers, public investment, differentiated labor income taxes, capital income taxes, and consumption tax. Debt is stabilized by adjusting non-distortionary lump-sum taxes to the higher income households.
- The inclusion of liquidity-constrained households, who have a higher marginal propensity to consume, allows stronger short-run demand effects following expansionary fiscal policy than in models with a representative non-constrained household.
- The model features a central bank that sets policy interest rate based on a Taylor rule specification. In addition, we also model the implicit interest rate the government pays on its debt, which depends on the average maturity structure of sovereign debt as in line with Veld et al. (2012).

#### Model Calibration

**19. Our parameter choices reflect data availability and the standards of the literature.**

- On the structure of the economy, the share of government consumption, investment, and transfer to households relative to GDP is estimated based on official data for the period between 2016 and 2019 to avoid the disruptions caused by the pandemic.

- While the share of capital in the Cobb-Douglas production function is not readily available, a wide range of estimates is available in the literature, from a low of 0.36 estimated by Ge and others (2022), to a high of 0.45 estimated by Zhang, Liu, and Huang (2019). The literature gravitates toward the view that China's capital share is higher than the 0.3 commonly used for other countries. In our simulation, the share of capital is assumed to be 0.4, in which the share of public and private capital in the production function is about 0.14 and 0.26, respectively.
- For the household sector, the effective labor income tax rate, which includes personal income tax and social security contributions, for liquidity unconstrained households is estimated to be between 10 and 20 percent and around 10 percent for constrained households, based on the current tax statutes.
- The data for the proportion of liquidity constrained households is not available and difficult to estimate. The share ranges from 25 to 40 percent for advanced economies and is much higher for emerging economies according to estimates by Barrail (2020). For China, Xie and Jin (2015) show that the poorest half held 8 percent of total national wealth. However, most of the wealth is concentrated in illiquid assets, e.g., land and houses, which provide relatively limited buffers for smoothing consumption. In our analysis, the share of liquidity constrained households in China is assumed to be around 50 percent.<sup>5</sup>

## Model Results

**20. To best depict the current state of the Chinese economy, a number of fiscal policy scenarios are layered on top of large negative demand shocks** (i.e., preferences shocks and investment-specific technology shocks) which lower output, consumption, and private investment. As a result, the pre-policy level of output is three percent below potential output. The public debt to GDP ratio is calibrated to 81.6 percent, the level in 2019<sup>6</sup>.

**21. We analyze three fiscal policy scenarios:** 1) an increase in the means-tested transfer to lower income households, 2) an increase in the untargeted transfer to all households, and 3) an increase in public investment.<sup>7</sup> In each case, the fiscal expansion is normalized to one percent of GDP in the first year, and then gradually phases out.<sup>8</sup> In the meantime, monetary policy remains broadly unresponsive. The fiscal expansion is assumed to be in the form of public investment and transfers to all households or to liquidity constrained households only. We then estimate the respective fiscal multipliers as the cumulative change of output or consumption for each yuan spent in the fiscal package over the same horizon.

---

<sup>5</sup> Our calibration is in line with the GIMF model for emerging Asia (Kumhof et al., 2010), which is smaller than the 70 percent assumed in Cosa, Pisani, and Rebucci (2011).

<sup>6</sup> Augmented debt level published in Article IV staff reports.

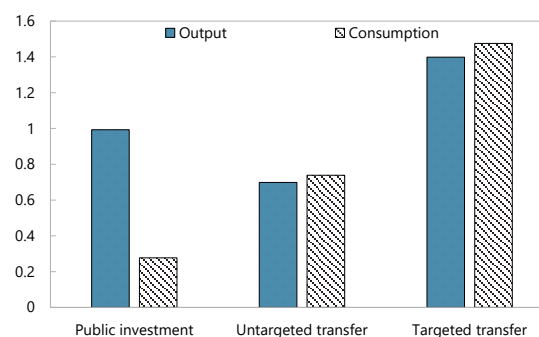
<sup>7</sup> Investment spending efficiency is assumed to be 0.75.

<sup>8</sup> The fiscal impulses are assumed to phase out following an AR(1) process.



**22. All three fiscal spending measures raise output, but the size of the multipliers varies significantly.** As a fiscal response to stabilize economy in the short term, means-tested government transfers to households with liquidity constraints, who have a higher marginal propensity to consume, are the most effective in closing the output gap, particularly when interest rates remain largely unchanged, therefore limiting the crowding-out effects of government support, which is typically the case in a recession. The short-term multiplier estimate derived from the model for means-tested transfers is 1.5. For the same fiscal cost, the untargeted transfer result in a multiplier below 1, reflecting the fact that unconstrained households save part of the transfers. Finally, a public investment-driven fiscal expansion would generate a short-run output multiplier of 1.<sup>9</sup> While public investment, if deployed efficiently, eventually increases the stock of future public capital, this takes time. The impact of public investment—operating indirectly through income effects—is significantly lower than the impact of direct transfers to the households, especially when the latter are means-tested and targeted.

Fiscal Multipliers



Source: IMF staff estimates.

**23. The estimate on means-tested transfers is within the range of estimates for government spending multipliers for China found in the academic literature.**<sup>10</sup> While the estimate for the cash transfer is significantly higher than the top range of 0.5 for the overall multiplier from the “bucket” approach, the divergence is not necessarily surprising. The overall multiplier represents an average across fiscal instruments and the multiplier on some revenue and expenditure instruments can be quite low.

## D. Conclusion

**24. A focus of fiscal measures on targeted, means-tested household support promises a higher growth impact and will help the economy rebalance.** The authorities should reprioritize spending away from infrastructure investment and towards spending that boosts private consumption—for example, means-tested direct income support to vulnerable households who have a higher propensity to consume—which would lower high household savings, help rebalance the recovery, and help close the negative output gap.

<sup>9</sup> These multipliers are in line with IMF (2020, Fiscal Monitor October).

<sup>10</sup> The multipliers are in line with estimates of government spending multipliers when monetary policy is constrained in other studies (e.g., Christiano, Eichenbaum, and Rebelo 2011; Klein and Winkler 2021).

## References

- Auerbach, A. and Y. Gorodnichenko. 2012. "Measuring the Output Responses to Fiscal Policy." *American Economic Journal. Economic Policy* 2012, 4(2): 1-27.
- Barrail, Z., (2020). "Business cycle implications of rising household credit market participation in emerging countries". *Journal of Economic Dynamics and Control*. Vol 116. 103917.
- Batini, N., L. Eyraud, and A. Weber. 2014. "A Simple Method to Compute Fiscal Multipliers." IMF Working Paper WP/14/93.
- Canzoneri, M., Collard, F., Dellas, H. and Diba, B., 2016. Fiscal multipliers in recessions. *The Economic Journal*, 126(590), pp.75-108.
- Cavallo, E., and C. Daude. 2011. "Public Investment in Developing Countries: A Blessing or a Curse?" *Journal of Comparative Economics* 39 (2011), 65-81.
- Christiano, L., M. Eichenbaum, and S. Rebelo. 2011. "When Is the Government Spending Multiplier Large?" *Journal of Political Economy*, 2011, vol. 119, no. 1.
- Coenen, G., R. Straub, and M. Trabandt. 2013. "Gauging the effects of fiscal stimulus packages in the euro area." *Journal of Economic Dynamics & Control*, Vol.37 (2), 367-386.
- Cova, P., Pisani, M. and Rebucci, A., 2011. Macroeconomic effects of China's fiscal stimulus. In *Asia and China in the Global Economy* (pp. 321-349).
- Ducanes, G., M.A. Cagas, D. Qin, P. Quising, and M.A. Razaque, 2006, "Macroeconomic Effects of Fiscal Policy: Empirical Evidence from Bangladesh, China, Indonesia, and the Philippines," Queen Mary, University of London Working Paper No. 564 (London: University of London).
- Freedman, C., M. Kumhof, D. Laxton, and J. Lee, 2009, "The Case for Global Fiscal Stimulus," IMF Staff Position Note 09/03 (Washington: International Monetary Fund).
- Furceri, D., and B. Li, 2017. "The Macroeconomic (and Distributional) Effects of Public Investment in Developing Economies." IMF Working Paper 17/217.
- Ge, X., Li, X., Li, Y. and Liu Y., (2022). "The driving forces of China's business cycles: Evidence from an estimated DSGE model with housing and banking", *China Economic Review*, Vol 72,
- Gonzalez-Garcia, J., A. Lemus, and M. Mrkaic. 2013. "Fiscal Multipliers in the ECCU." IMF Working Paper 13/117.
- Guo, Q., Liu, C. and Ma, G. (2016). 'How large is the local fiscal multiplier? Evidence from Chinese counties', *Journal of Comparative Economics*, Vol. 44, pp. 343-352.

International Monetary Fund (IMF). 2020. "Fiscal Monitor: Policies for the Recovery", International Monetary Fund, Washington, DC.

Ilzetki, E., 2011, "Fiscal Policy and Debt Dynamics in Developing Countries," Policy Research Working Paper Series 5666 (Washington: The World Bank).

Ilzetki E., E. G. Mendoza and C. A. Vegh, 2013, "How Big (Small?) Are Fiscal Multipliers?" *Journal of Monetary Economics*, Vol. 60, pp. 239–54.

Izquierdo, A, R. Lama, J. Medina, J. Puig, D. Riera-Crichton, C. Vegh and G. Vuletin. 2019. "Is the Public Investment Multiplier Higher in Developing Countries? An Empirical Investigation. National Bureau of Economic Research. Working Paper 26478. Cambridge, MA.

Jappelli, T. and L. Pistaferri. 2014. Fiscal Policy and MPC Heterogeneity. *American Economic Journal. Macroeconomics*, 2014. Vol. 6(4), p.107-136.

Jeong, M., Kang, J. and Kim, S. 2017. 'Effects of government spending shocks in China, Japan, and Korea', *China Economic Journal*, Vol. 10, pp. 194–225.

Klein, M. and R. Winkler. 2021. "The government spending multiplier at the zero lower bound: International evidence from historical data. *Journal of Applied Econometrics*, 2021; 36: 744-759.

Kumhof, M.M., Muir, M.D., Mursula, S. and Laxton, M.D., 2010. *The global integrated monetary and fiscal model (GIMF)–theoretical structure*. International Monetary Fund.

Leeper, E., Plante, M. and Traum, N., 2010. Dynamics of fiscal financing in the United States. *Journal of Econometrics*, 156(2), pp.304-321. Leduc and Wilson, 2012

Leeper, E., T. Walker, and S. Yang. 2010. "Government investment and fiscal stimulus." *Journal of monetary economics*. Vol.57 (8), p.1000-1012.

McKay, A. and R. Reis. 2016. "The Role of Automatic Stabilizers in the U.S. Business Cycle." *Econometrica*, 2016, Vol.84 (1), p.141-194.

Mineshima, A., M. Poplawski-Ribeiro, and A. Weber, 2014, "Fiscal Multipliers," in *Post-Crisis Fiscal Policy*, ed. by C. Cottarelli, P. Gerson, and A. Senhadji (Cambridge: MIT Press, forthcoming).

Riera-Crichton, D., C. Vegh, and G. Vuletin. 2014. "Procyclical and Countercyclical Fiscal Multipliers: Evidence from OECD Countries." National Bureau of Economic Research Working Paper 20533. Cambridge, MA.

Traum, N., and S. Yang. 2015. "When Does Government Debt Crowd Out Investment?" *Journal of Applied Econometrics* 30: 24-45 (2015).

Wang, X., and Y. Wen, 2013, "Is Government Spending a Free Lunch? — Evidence from China, Federal Reserve Bank of St. Louis Working Paper Series, Working Paper 2013-013A (St. Louis: U.S. Federal Reserve Bank).

Zhang, W., Y. Zhang, X. Zheng, and L. Zhang. 2019. "China's fiscal multiplier and its state dependence." *The Manchester School* Vol 87 No. 2. 205-227.

Zhang, S., Liu Y., and Huang D., (2019). "Contribution of factor structure change to China's economic growth: evidence from the time-varying elastic production function model". *Economic Research-Ekonomska Istraživanja*, 33:1, 2919-2942.

# MONETARY POLICY AND THE ROLE OF CREDIT POLICIES<sup>1</sup>

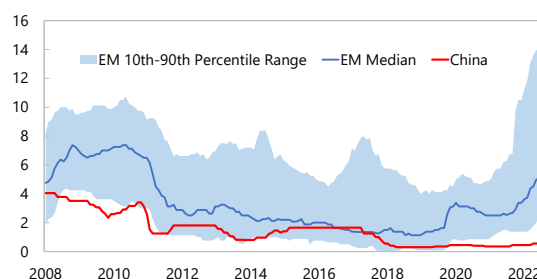
*China's evolving monetary policy framework has recently increased its emphasis on quantity-based monetary policy tools relative to the use of traditional interest rate tools. Firm-level investment data from China suggests that these supply-driven policies may however face challenges in reproducing the relatively broad-based demand-side impacts of interest rate policies, especially in reaching smaller and more cyclically vulnerable firms. This suggests that while well-designed and market-based quantity-based policy tools have a role in China's monetary policy framework, they should not replace interest rate policies as the primary policy instrument.*

## A. Introduction

**1. China's continuously evolving monetary policy framework features both price- and quantity-based policy instruments.** Up until 2012, the People's Bank of China (PBC) primarily relied on a quantity-based monetary policy framework that emphasized managing credit aggregates through window guidance and loan growth targets, augmented with strict deposit and loan rate regulations. About a decade ago, the PBC began gradual liberalization of interest rate regulations and implementation of a price-based monetary policy framework which sought to maintain short-term risk-free rates within a defined interest rate corridor.<sup>2</sup>

**2. Quantity-based targets have continued to play an important role in overall monetary policy, however.** Credit growth targets have become more tailored to bank-based characteristics like capital and asset quality, with target compliance an important criterion in the Macroprudential Assessment (MPA) framework. In 2018, maintaining stable credit growth that matched the level of nominal GDP growth was elevated to a key objective of monetary policy, reflecting the importance assigned to controlling the growth of debt relative to GDP. In the last five years, quantity-based credit policies (hereafter, "credit policies") have proliferated at the borrower-segment level, bolstering credit to preferred groups such as micro and small enterprises, privately owned firms, or advanced manufacturing firms.<sup>3</sup> Some of these use market-based mechanisms to incentivize such lending, like PBC

**Selected Emerging Markets: Monetary Policy Usage**  
(In percentage points, three-year rolling sum of changes in policy interest rate)



Sources: Haver Analytics; and IMF staff calculations.  
Note: Data is calculated using rolling sums of absolute values of policy rate changes.

<sup>1</sup> Prepared by Henry Hoyle, Phakawa Jeasakul, and Fan Zhang

<sup>2</sup> See Harjes (2016), Harjes (2017), McMahon, Schipke et al (2018), Hoyle (2021), and (Das (2022) for recent IMF staff analysis on China's evolving monetary policy framework.

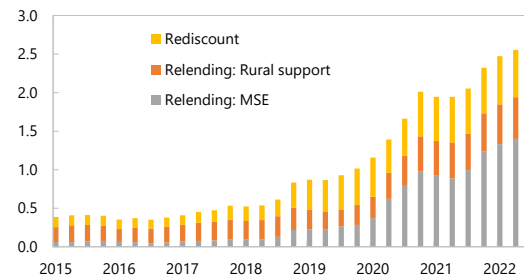
<sup>3</sup> Reserve requirement ratio adjustments are considered quantity-based tools but are not credit policies for this purpose of this analysis.

relending facilities, but others are policy requirements, like the State Council's financial inclusion lending growth requirements for large banks.

### 3. The PBC's usage of price-based monetary policy tools has recently become less frequent.

Adjustments to key policy interest rates have become smaller and less frequent in recent years, particularly in contrast to other emerging market economies without currency pegs (see figure). While there are no simple quantitative indicators to summarize the frequency or intensity of credit policies, the growth in PBC relending and rediscount facilities, as well as the proliferation of industry-targeted relending facilities in April 2022, are indicative of how credit policy tools have once again become a more prominent feature of monetary policy. In recent policy communications, the PBC has characterized the benefits of credit policies as providing precisely targeted and direct support to small firms and sectors experiencing difficulties, as well as providing stabilization to the overall macroeconomy.<sup>4</sup> More broadly, the use of credit policies has gained traction due to their perceived financial stability benefits, insofar as they enable "targeted" economic support while avoiding the excesses of what policymakers have characterized as the "flood-like" credit stimulus that followed the 2008 crisis.

**PBC Rediscount and Relending Facility Credit Outstanding**  
(In trillions of RMB)



Source: CEIC Data Company Limited.  
Note: MSE = micro and small enterprise

figure). While there are no simple quantitative indicators to summarize the frequency or intensity of credit policies, the growth in PBC relending and rediscount facilities, as well as the proliferation of industry-targeted relending facilities in April 2022, are indicative of how credit policy tools have once again become a more prominent feature of monetary policy. In recent policy communications, the PBC has characterized the benefits of credit policies as providing precisely targeted and direct support to small firms and sectors experiencing difficulties, as well as providing stabilization to the overall macroeconomy.<sup>4</sup> More broadly, the use of credit policies has gained traction due to their perceived financial stability benefits, insofar as they enable "targeted" economic support while avoiding the excesses of what policymakers have characterized as the "flood-like" credit stimulus that followed the 2008 crisis.

### 4. The increased reliance on quantity-based tools could weaken monetary policy's countercyclical impact and bring other macroeconomic costs.

Interest rate adjustments have a variety of powerful and self-reinforcing effects on financial conditions and activity. The analysis laid out below provides evidence of this for China and, at the same time, finds that policy interventions aimed at controlling the supply of aggregate credit appear to fall short in reproducing the same effects. Empirically, credit policy appears to have comparatively more muted capacity to stimulate activity among smaller and younger firms. This may reflect bank risk aversion in allocating additional credit to risky firms, other factors segmenting risky credit markets, or the frequent use of this tool during periods of interest rate-based tightening. As these smaller and younger firms tend to be the most financially constrained and vulnerable to cyclical fluctuations, credit policy therefore may have limited effectiveness for countercyclical demand management. The benefits of credit policy are somewhat clearer for larger, more established firms, which may also exacerbate disparities in credit availability for smaller firms and could drag on authorities' macro-critical task of raising medium-term productivity growth.

### 5. This paper uses local projections to directly compare the impact of different monetary policy tools on firm-level investment.

Interest rate tools are identified using the monetary policy shock approach used in Kamber and Mohanty (2018) and Das and Song (2022). To assess credit

<sup>4</sup> People's Bank of China Monetary Policy Department. "The Precise Targeting of Structural Monetary Policies to Reduce Difficulties Among Market Entities and Help Real Economic Development." The People's Bank of China Policy Research Journal No. 18 (2022).

policy interventions, which are much more challenging to measure, this paper introduces a novel identification technique that quantifies the amount of credit growth unexplained by macroeconomic and financial factors, including monetary policy shocks. The relative impact of these shocks—traditional monetary policy shocks and unexplained shocks to total credit—are then jointly estimated across a cross-section of 14,000 firms captured in a proprietary database of firm-level financial statements.

**6. The remainder of the paper is organized as follows.** The next section reviews some of the literature on monetary policy transmission and the more recent role of quantity-based policy instruments. The subsequent section explains the methodology and data behind the analysis and the fourth section lays out the empirical findings. The fifth section discusses implications for policy and the final section concludes.

## B. Monetary Policy Transmission and the Role of Quantity-Based Policies

### 7. Monetary policy operates through multiple channels to smooth the business cycle.<sup>5</sup>

The *interest rate channel* affects output via the impact of interest changes on interest-sensitive components of aggregate demand such as housing and consumer durable goods. The *credit channel* amplifies the impact of changes in short-term interest rates via larger effects on borrowers' external financing costs. This occurs partially through what is called the *balance sheet channel*, as lower interest rates boost the value of borrower's assets and reduce their interest expenses, easing market frictions that normally drive lenders to charge a credit risk premium. This channel is often included within a broader *risk-taking channel* of monetary policy, which focuses on how rising asset prices, expanding credit, and reduced financial volatility can create procyclical feedback loops in part by reducing financial institutions' perception of risk (Adrian and Shin, 2010).<sup>6</sup> Finally, the credit channel is also considered to operate through a *bank lending channel*, by boosting the supply of intermediated credit.

**8. Transmission via the credit channel is generally thought to be asymmetric at the firm-level, disproportionately benefiting smaller and more cyclically exposed firms.** Theories of financial frictions imply that smaller or younger firms are more financially constrained relative to larger, more established firms, with weaker and more variable access to credit. This reflects lenders' comparatively higher costs in monitoring their credit risks, higher business failure rates during cyclical downturns, and generally more limited access to credit markets, factors which tend to increase lenders' demand for collateral. As monetary policy eases the supply of credit and reduces credit risk premiums, these financially constrained firms see the largest improvement in their access to credit. A wide range of empirical studies across a number of countries provide evidence for the

<sup>5</sup> Cecchetti 1995, Bernanke and Gertler, 1995; Gertler and Karadi, 2015

<sup>6</sup> Adrian and Shin, 2010.

higher relative sensitivity of financially constrained firms to business cycle fluctuations and to monetary policy shocks.<sup>7</sup>

**9. Quantity-based tools with resemblance to those used in China have been deployed around the world to stimulate the bank lending channel of monetary policy transmission.**

Particularly in the years following the Global Financial Crisis, many advanced economy central banks used quantity-based policies in the form of “funding-for-lending” schemes to stimulate bank lending, most notably the European Central Bank’s Targeted Long-Term Refinancing Operations (TLTRO) facilities. These facilities varied but generally introduced mechanisms to lower a bank’s funding cost in exchange for meeting certain quantitative credit supply goals.<sup>8</sup> These aimed to boost bank lending during a period when bank balance sheet constraints weighed on credit supply and further policy rate cuts were limited by the zero lower bound.

**10. The impact of quantity-based tools in benefiting financially constrained firms however is not well established.**

Banks can be induced to lend more via market-based incentives like subsidized funding, but it remains ambiguous how banks allocate this extra lending. Traditional theory suggests a higher supply of loans might lead to lower lending costs across the borrower risk spectrum, but balance sheet effects and other factors that might increase bank risk-taking under interest rate-based monetary policy transmission may not be present. If banks’ pre-intervention supply of lending was constrained by capital constraints or underwriting standards, banks may prefer to allocate additional credit to lower-risk borrowers. The empirical literature on the effect of funding-for-lending schemes on bank risk-taking is only emerging, with some early findings suggesting that the ECB’s most recent TLTRO facility induced banks to lend but not to scale up the risk profile of their loan portfolios.<sup>9</sup> Other work found banks responded to TLTRO funding via a “flight to quality” response, consistent with weak effects on bank risk-taking.<sup>10</sup>

**11. In China’s case, the suitability of a monetary policy framework centered on quantity-based tools will, in part, depend on its capacity to generate strong credit channel effects for more vulnerable firms.**

Quantity-based policies have historically played an important role in supporting the countercyclical investment role of state-owned firms, providing credit for large-scale infrastructure investment while minimizing crowding-out effects for private borrowers. Scope for this form of economic support has however narrowed in recent years as economy-wide leverage has risen to risky levels and productive state-owned projects have become scarcer. The remainder of this paper will assess empirically the relative effectiveness of interest rate and credit policy shocks in easing borrowing conditions for more cyclically exposed, financially constrained firms, which will be

<sup>7</sup> Gertler and Gilchrist 1994; Ehrmann 2005, Cloyne et al 2018, Durante et al 2021,

<sup>8</sup> The Bank of England’s Funding for Lending Scheme launched in 2012 also linked funding rates to banks’ overall loan portfolio growth. The Federal Reserve’s Main Street Lending facility launched in 2020 provided low-cost funding for bank loans to SMEs but did not incorporate additional quantity-based incentives to boost aggregate loan growth.

<sup>9</sup> <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2682~c88eac6aca.en.pdf>  
[https://www.ecb.europa.eu/pub/economic-bulletin/articles/2021/html/ecb.ebart202106\\_02~35bf40777b.en.html](https://www.ecb.europa.eu/pub/economic-bulletin/articles/2021/html/ecb.ebart202106_02~35bf40777b.en.html)

<sup>10</sup> Matteo Benettona Davide Fantino. Targeted monetary policy and bank lending behavior. *Journal of Financial Economics*, vol 142 iss. 1, Oct. 2021, pp.404-429



key for maintaining monetary policy effectiveness. While the following analysis is limited in its capacity to empirically examine the effect of recent credit policies that are designed to directly benefit these segments (via financial inclusion or micro and small enterprise lending), the findings have important implications for the effectiveness of these policies.

## C. Methodology and Data

**12. The differential impacts of interest rate and credit policy shocks are explored using panel local projections.** In line with recent works such as Cloyne (2018) and Durante et al (2021), the impact of policy shocks on firm-level investment are estimated via impulse response functions using Jorda's (2006) approach. The estimations are performed for selected groupings of firms, which facilitates exploration of the cross-sectional heterogeneity in the sensitivity of investment to monetary policy shocks.

**13. Interest rate-based monetary policy shocks are derived from a standard identification strategy in the literature.** Unexpected innovations in monetary policy are proxied by using changes in short-term interest rate swaps on days of monetary policy announcements. This is in line with Gertler and Karadi (2015) and later extended to the Chinese context in Mohanty and Kamber (2018) and Das and Song (2022).

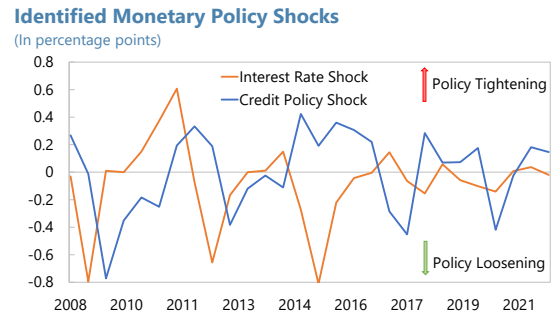
**14. Credit policy-based monetary policy shocks are proxied by changes in credit growth that are unexplained by macroeconomic fundamentals and interest rate shocks.** Using a simple model of equilibrium credit growth based at quarterly frequency, changes in the gap between a broad measure of private credit growth and its trend level are explained by the Taylor rule-based expected interest rate (which proxies credit demand and is derived from activity and inflation variables) and the policy interest rate shock series described above.<sup>11</sup> The residual is assumed to be explained by policy interventions to either slow or accelerate total credit growth relative to a counterfactual market-driven outcome (hereafter "credit policy").

**15. This identification strategy generates a useful proxy for measuring the impact of quantity-based policy interventions.** The use of the interest rate shock variable as a control helps address the endogeneity problem between interest rate shocks and credit growth, resulting in a series that captures the intended properties of quantity-based policies' additional impact via the bank lending channel. The identified credit policy shock generates periods of both tightening as well as loosening, which is in line with authorities' periodic interventions to limit credit growth, most notably during the deleveraging campaign in the years before the COVID crisis. As credit growth becomes more stable after 2014, the identified shocks are assumed to capture the policy interventions necessary to maintain stable credit growth amid fluctuations in output and interest rate levels. This is desirable as it links to authorities' stated policy goal of broadly matching credit

---

<sup>11</sup> The credit measure is total social financing excluding government bonds and equity. The activity indicator is a gap between a proprietary current activity indicator and its trend level. The inflation indicator is the National Bureau of Statistics' Consumer Price Index. The use of the interest rate shock as a control in the credit shock identification equation precludes the use of narrative-based monetary policy shocks or other identification strategies that could capture the impact of credit policies as well as interest rate policies.

growth to nominal GDP growth and allows for investigation of the empirical effects of such interventions. The policy-induced stability of credit growth results in a period where credit shocks move in the opposite direction to interest rate shocks for several years (see chart). This is in contrast to the positive co-movement seen during earlier and later periods, when more concerted efforts at policy stimulus drove interest rate and credit policy coordination.



Sources: Haver Analytics; CEIC Data Company Limited; and IMF staff calculations.  
Note: Data are at semi-annual frequency. Interest rate shocks are unexpected policy-induced changes in 1-year interest rate swaps. Credit shocks are sums of unexplained quarterly deviations of nominal private credit from trend.

**16. The credit policy shock has its limitations as a proxy for actual policy interventions.**

Shifts in observed credit growth outcomes are potentially driven by omitted variables, for instance bank or firm leverage, or external shocks, or may reflect structural breaks in demand and supply functions. These factors can bias the residual and thus the identified shock. By design it cannot address sector- and segment-level credit policies which have become an important component of the credit policy toolkit, although the sample period has reasonable coverage of the early years of those policies. Nevertheless, it provides a reasonable proxy for the direction and magnitude of credit policy shocks.

**17. The baseline equation that applies the policy shocks to the firm-level data (see below) is as follows:**

$$\Delta Y_{i,t+h} = \alpha_{i,h} + \sum \beta_{1,h} \text{shock}^{IR}_t * D_{g,i} + \sum \beta_{2,h} \text{shock}^{CP}_t * D_{g,i} + \Gamma'_1 X_{i,t-1} + \Gamma'_2 X_{i,t-2} + \varepsilon_{i,t+h}$$

The left-hand variable is year-on-year growth in net property, plants and equipment for a given firm  $i$  at the time  $h$  periods after the shock. The variables  $\text{shock}^{IR}_t$  and  $\text{shock}^{CP}_t$  are the interest rate and credit policy shocks, respectively.  $D_{g,i}$  is a dummy variable specifying the firm grouping. Controls include one and two period lagged year-on-year growth of firm-level revenue, investment, liquidity, and leverage, plus one and two period lags on the policy shocks. Firm-level fixed effects and Driscoll-Kraay standard errors are used to control for spatial correlation as well as autocorrelation and heteroscedacity, in line with Cloyne (2018).

<b>China: Descriptive Statistics of the Level Dataset</b>				
	SOE	POE	Other	Total
<b>Year-on-year growth in net property plants and equipment</b>				
	(percent)			
median	5.2	4.2	4.5	4.6
mean	24.0	27.9	27.3	26.8
sd	105.0	111.3	114.4	109.5
<b>Assets (RMB mn)</b>				
median	13,569	661	1,955	1,767
mean	37,648	6,265	6,861	15,543
sd	96,606	38,791	23,236	63,249
<b>Firm age (years)</b>				
median	18	16	19	17
mean	23	18	22	20
sd	16	10	13	12
Obs.	40,867	94,676	2,879	138,422
N. firms	3,613	9,288	229	13,130
Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.				
Note: SOE = state-owned enterprise. POE = privately owned enterprise. Other = ownership not established				

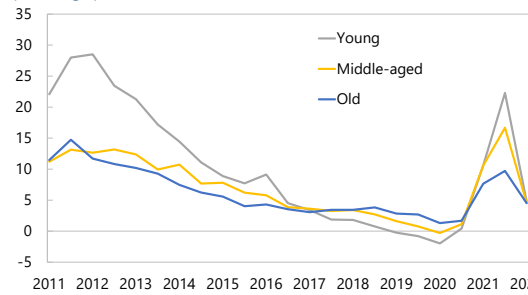
**18. Firm-level data come from a unique 14,000-firm database with strong coverage of private firms.** The financial data is sourced from Capital IQ with additional firm-level identification and classification information obtained from WIND and Bloomberg. The data is semi-annual, covering the period from 2011 to 2021, and is primarily drawn from financial statements required by public equity or bond issuance, which strictly limits the coverage of firms that count as micro and small enterprises by official definitions. That said, of the 138,422 firm-period observations with complete data, about 95,000 are private firms, many of which have been listed on specialized small and medium-sized enterprise (SME) bourses.<sup>12</sup> The firm coverage is unbalanced. Additional descriptive statistics are provided in Text Table.

**19. The firm sample source and the limited time period coverage presents challenges for empirical analysis.** The fact that firm data is collected based on SME equity exchanges biases it towards dynamic and relatively well-funded small and medium firms, and skews the observation count larger for years after 2014, when more of these firms' data becomes available. The persistently

<sup>12</sup> The data were cleaned to remove observations without complete data needed to compute firm investment growth, size, age, leverage (debt to assets), liquidity (cash and equivalents to assets), and revenue growth. Observations were further trimmed by discarding observations with investment values below the first and 99<sup>th</sup> percentiles or outside the bounds of -99 to 2000 percent.

high investment growth among some of these firms, as well as the noisiness in some firms' investment, requires special attention in interpreting the econometric results. The time period is also relatively short for analyses of this kind and does not capture a large economic downturn except the first half of 2020. That said, the investment growth of smaller and younger firms declines notably relative to more established firms in the years leading up to 2020, and in general appear more cyclical, suggesting there is cyclical variation captured within the sample.<sup>13</sup> These various challenges are addressed through robustness tests and do not affect the overall findings.

**Median Investment Growth by Firm Age**  
(In percentage points)



Sources: Bloomberg; WIND; S&P Market Intelligence; and IMF staff calculations.  
Note: Young firms are < 14 years old; middle-aged are 14-20; and old firms are >21 years old.

## D. Empirical Results

**20. The local projections analysis suggests that interest rate-based shocks in China operate in line with theory and evidence from other countries.** Interest rate-based shocks have a disproportionately large impact on smaller firms. An unexpected 25 basis point decrease to the short-term interest rate swap—a close approximation to a one standard deviation shock—generates a 9.5 percentage point increase in the annual rate of growth in investment for the smallest third of firms (with assets below RMB 330 million) one and a half years later, controlling both for firm-level variables as well as the credit policy shock.<sup>14</sup> This result is statistically different from that of the largest third of firms by size (with assets above RMB 4.5 billion), who increase investment but by four times less, reaching about 2.6 percent one and a half years later. The reaction by midsize firms is smallest and statistically insignificant. As is predicted by the literature, transmission to investment is lagged manifesting most strongly three periods (one and a half years) after the initial shock, and fading thereafter.

**21. By contrast, credit policy shocks manifest somewhat earlier and with more muted differences between large and small firms.** Unexpected credit policy easing that generates a 12.5 percentage point increase in the level of credit relative to trend—roughly a one standard deviation shock—is estimated to make its peak impact on the growth rate of investment two periods later.<sup>15</sup>

<sup>13</sup> Given lags in reporting and pandemic-related delays, the magnitude of the surge in investment depicted during the COVID pandemic period in part reflects a sharp drop-off in the sample size of middle-aged and particularly young firms.

<sup>14</sup> The magnitude of this result is very close to that reported for young European firms in Durante et al (2020), but larger than the results for young US and UK firms reported in Cloyne et al (2018). The large investment impulse for small Chinese firms may reflect the sample's firm coverage skew towards more dynamic, well-funded SMEs, which in part explains the elevated mean and standard deviation of investment growth shown in the descriptive statistics.

<sup>15</sup> Standardizing the interest rate and credit policy shocks for comparison purposes is complicated due to the different units of the series (basis points of the one year-ahead swap rate and percentage points of credit above trend growth). In this case, 25 bps and 12.5 percentage points are chosen because they closely approximate one standard deviation of their respective time series (23.3 and 12.7, respectively).

Small firms' investment growth increases by 3.6 percentage points one year ahead, which is only about 1.5 times greater than the result for large firms. This differential is both smaller than the comparable difference generated by interest rate shocks and less precisely estimated, as the small firm results are not statistically different from zero or the credit policy effect on the larger firms.



**22. Results are broadly similar when grouping firms by age.** The relative benefits for small firms are still largest for interest rate shocks when policy shocks are estimated across age-based groupings, another common proxy for financial constraints, although the differences are not

statistically significant.<sup>16</sup> Interest rate-based shocks generate the largest investment response for young firms (below 14 years old), with incrementally smaller responses for middle-aged (below 20 years old) and older firms. The results are smaller in magnitude than for the size-based groupings and are generally statistically significant at one and one and a half years after the shock, except for older firms. In contrast to size-based groupings, credit policy shocks create the quantitatively largest impact for older and middle-aged firms, although the results are not statistically significant across any segment (see Appendix, Figure 1).

**23. In ownership-based groupings, credit policy shocks are also statistically significant only for larger state-backed firms.** Central SOEs' investment growth response has the correct sign and is statistically significant at three periods ahead, while entities classified by the bond market regulator as local government financing vehicles (LGFVs) have large and significant responses to credit policy shocks two periods ahead. This is line with previous IMF staff findings that SOEs and private firms do not face competitive neutrality in credit markets.<sup>17</sup>

**24. Robustness checks support the validity of the findings.** In an extension of the baseline equation controlling for the sign of the policy shock, the results for small and young firms one and a half years ahead show the correct sign during periods of both interest rate tightening as well as loosening, although only the results for small firms are statistically significant. This suggests that the results are not capturing noise from the dispersion and skew of the observed investment growth rates for these firms. Similarly, for the credit policy shock results, only the results for large, old, and middle-aged firms are correctly signed in both directions (see Appendix, Tables 1-4). The findings also hold when controlling for different asset thresholds for the size-based groupings and variance in firm count across periods. Similar results obtain when the firm sample is restricted to firms captured in 12 or more periods, and when the COVID-period results are excluded.<sup>18</sup>

**25. Additional groupings provide evidence of the importance of credit constraints in driving the results.** The baseline equation is re-run for subgroupings of firms that have higher financial constraints than the median small or young firm. The first grouping are small (assets below RMB 330 million), private firms with average cash flows that are negative over three periods, a group with negative median investment growth throughout the sample period. While the statistical power of this grouping is weaker with a sample size of only 8,950 observations, these firms exhibit large and statistically significant responses to interest rate policy shocks at three periods ahead. The response to credit policy shocks are smaller and statistically insignificant. A second grouping captures firms that are in the top third of observations for the ratio of revenue-to-fixed assets for their sector and year—a reasonable proxy for firm-level productivity—but with relatively modest average investment growth over the sample period (<10%), suggesting some difficulty accessing

---

<sup>16</sup> See Cloyne (2018) for a discussion of age as a proxy for financial constraints.

<sup>17</sup> See Guo, Jurzyk, Ruane, et al (2021) and Jahan, Catalan et al (2019).

<sup>18</sup> Restricting results to firms with results in all periods excludes over 90 percent of firms with less than RMB 330 mn in assets. The threshold of 12 periods is used as it approximates the median reporting frequency for the smallest and youngest terciles of firms.

external finance. Like the loss-making firm group, the impulse response from this group is larger and more statistically significant for the interest rate shock, although the credit policy response is notably larger and closer to being significant. In general, firms with productivity proxy measures in the top third of observations exhibit large and statistically significant responses to interest rate shocks, while those in the bottom tercile see a statistically significant reaction but with the opposite sign. Credit policy shocks are statistically insignificant across all productivity-based firm groupings (see Appendix, Figure 2).

**26. Extensions of this analysis suggest that uncoordinated use of interest rate- and credit-policy shocks undermines their impact.** The results are re-run using an extension of the baseline equation where the firm grouping dummy variable  $D_{g,i}$  is replaced with a time-based categorical variable  $D_{\text{coord}, t}$ . This variable takes the value of 1 during the half-year periods when policy rate and credit policy shocks have the same sign—that is, both loosening or both tightening—and zero for periods when they appear to counteract, with the result measuring the investment response across the entire firm sample. For uncoordinated shocks ( $n=88,619$ ), both have the correct sign and a similar magnitude, suggesting these shocks on balance largely offset each other. For coordinated shocks ( $n=40,042$ ), the net investment response across the two shocks (i.e., the sum of the coefficients) is large and with the correct sign, reflecting a large contribution from the interest rate shock (see Appendix, Figure 3). The statistical strength of the coordinated result is marginally weakened, however, by the fact that policy is coordinated in only five periods. The credit policy shock impact is wrongly signed towards the end of the projection period due to the relatively larger magnitude of credit policy easing in one of the coordinated easing periods where investment later weakened.

## E. Policy Implications

**27. Credit policies do not appear to generate robust “credit channel” effects.** Policies that induce additional supply of credit from banks in theory should create broad-based reductions in the price of credit that help stimulate activity among financially constrained borrowers. The evidence presented above suggests that these effects are not taking place, in line with initial results from similar studies drawn from the euro area. This could be attributed to a variety of non-mutually exclusive potential explanations.

- *Bank risk aversion.* In the absence of borrower-based balance sheet effects, prudential requirements, capital constraints, or risk aversion may lead banks to allocate policy-induced lending to lower risk firms or assets, like mortgages or government bonds.
- *Limited spillovers to riskier credit markets.* Additional credit supply for low-risk borrowers may not spill over to credit markets for high-risk borrowers if these markets are highly segmented or risk-adjusted returns for higher-risk borrowers are insufficient, as appears the case for much of Chinese bank lending.<sup>19</sup> Lower-risk firms with weak governance (like an LGFV) may choose to

---

<sup>19</sup> See Hoyle and Jeasakul (2021).

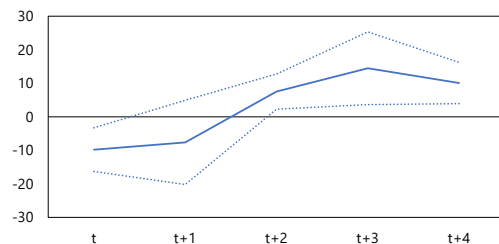
absorb the bulk of the policy-induced credit supply despite limited productive uses for the funding, potentially resulting in leakages into asset market investments.

- *The impact of a credit policy shock may be limited if it is not implemented in tandem with interest rate-based monetary policies.* In theory, inducing an increase in money supply should stimulate demand in part by reducing interest rates and raising prices. If a mixed price- and quantity-based monetary policy framework increases the money supply while constraining the complementary adjustment of interest rates, the broader impact on demand may be limited

### Firm-Level Investment Impulse Response to Monetary Policy Shocks, by Selected Groupings

#### Interest Rate Shock: Small, Private, Loss-Making Firms

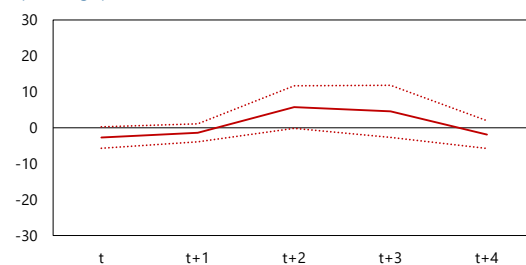
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations. Notes: Each time period  $t$  is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

#### Credit Policy Shock: Small, Private, Loss-Making Firms

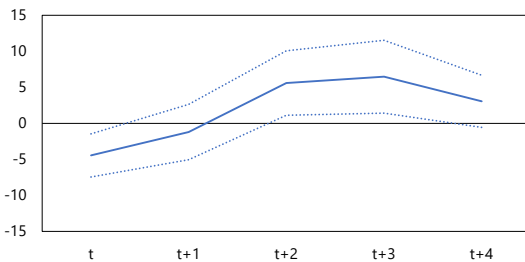
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations. Notes: Each time period  $t$  is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

#### Interest Rate Shock: High-Productivity, Low-Growth Firms

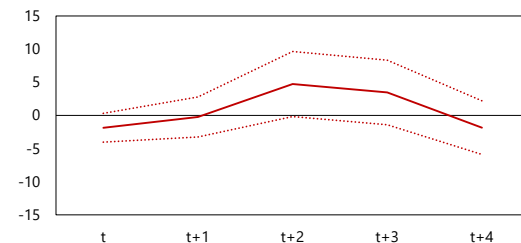
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations. Notes: Each time period  $t$  is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

#### Credit Policy Shock: High-Productivity, Low-Growth Firms

(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations. Notes: Each time period  $t$  is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**28. Credit policies may therefore be relatively less effective in managing cyclical fluctuations compared to interest rate policies.** A macroeconomic policy framework that operates via credit supply shocks with weak benefits for more financially constrained firms presents several challenges for countercyclical demand management.

- *Indirect and uncertain transmission mechanisms to the most cyclical sectors.* Larger, low-risk firms are unlikely to use additional credit supply to fund productive investments given that they were not credit-constrained prior to the change in credit policies. The ultimate demand spillovers to the cyclically weakest sectors is more indirect and uncertain compared to interest rate tools which have clear and broad-based demand effects. In part, spillovers will depend on cyclically



weak sectors' proximity to these large firms' supply chains as well as large firms' willingness to invest in less useful projects at sufficient scale (creating tradeoffs with productivity).

- *The “credit channel” impacts may become weaker as cyclical stress worsens.* Banks with sound risk management and credit underwriting frameworks would normally increase risk aversion as economic uncertainty increases, reinforcing credit allocation towards the least risky borrowers. Similarly, demand for new credit from market-oriented borrowers would likely decline.

**29. The use of credit policies as a primary monetary policy tool may also drive adaptive impacts on creditor lending behavior and financial conditions.** Firms that tend to directly benefit from credit policies, or those proximate to such firms, may benefit from structurally easier external financing availability as investors anticipate policy support during downturns. Conversely, creditors would rationally charge higher risk premiums to higher-risk borrowers or others with weaker prospects of benefiting from credit supply interventions. Chinese investors' sensitivity to patterns of government support is documented in recent Global Financial Stability Reports as well as Zhe and Jun (2019), which shows how investors charged higher risk premiums for non-SOE borrowers and SOEs with weak government support following changes in default outcomes.<sup>20</sup>

**30. Use of credit policies in place of interest rate policies may also negatively impact capital allocation and productivity growth.** The older and predominantly state-owned firms that react most to credit supply interventions tend to have relatively weak productivity compared to private sector peers.<sup>21</sup> Interest rate-based easing by contrast is particularly effective in boosting investment among financially constrained smaller firms with higher productivity and leads to weakening investment among low productivity firms. Compared with interest-rate based policies, credit policy-based easing is therefore likely to generate a larger share of incremental new investment from relatively low productivity firms. This implies weaker aggregate productivity growth in the short-term and potentially over the longer term.<sup>22</sup>

**31. While this analysis has been focused on “aggregate” credit policies, the findings are relevant for “financial inclusion”-targeted credit policies as well.** Recent credit supply interventions aimed at MSEs and other financial inclusion borrowers may be sufficiently narrowly targeted to ensure that increased credit supply create positive spillovers for marginal and constrained firms. Bank risk aversion is however likely to be an even more important factor within the MSE segment, given higher credit risks, forcing banks to make larger tradeoffs with underwriting quality. Lenders may choose to manage their MSE lending risk in the form of a strong preference for firms with collateral, for instance, residential real estate, rather than entrepreneurs. Banks may also

<sup>20</sup> See in particular the October 2021 IMF *Global Financial Stability Report*, pp. 16-19

<sup>21</sup> See Guo, Jurzyk, Ruane, et al (2021).

<sup>22</sup> The cumulative impact on productivity growth would depend on the intensity and frequency of future tightening cycles, as well as the symmetry of the cross-firm effect during tightening episodes. The heterogenous cross-firm impact of monetary policy is in line with an emerging literature on the supply-side effects of monetary policy, which finds that traditional monetary easing tends to improve capital allocation and productivity. See Baqaee, Farhi, and Sangini (2021) and David and Zeke (2022) for representative examples.

have difficulty in monitoring the activities and track records of MSEs, creating an elevated risk of regulatory arbitrage.

**32. MSE credit policies appear to have had weak broad-based impacts for credit availability for more financially constrained firms.** In the period since MSE credit targets were introduced in 2018, privately owned and lower-rated firms have seen a steady net contraction in their corporate bond issuance outstanding, underscoring how tight financing conditions have persisted for firms not directly benefiting from credit policies.

**33. MSE credit policies also appear to fall short of one of the rationales of credit policy, which is to avoid the risks of excessive credit growth.** An elevated incidence of regulatory arbitrage may also explain the lack of spillovers along the risk spectrum, in part reflecting the difficulty that banks have in monitoring the track records and activities of MSEs. A *National Audit Office* report from June 2022 found that 364 of 517 audited financial inclusion loans borrowers were not actually operational business entities, suggesting a high rate of arbitrage. The report found that some of these entities were shell companies used to route such funding to housing market investments or to ineligible large firms. One recent analysis identifies a link between MSE company formation and house price appreciation at the city-level, underscoring the potential arbitrage-driven asset market spillovers (Sun, Wang et al, 2022).

## F. Conclusion

**34. Interest rate policies' strong effects suggest they should continue to play a primary role in managing cyclical fluctuations.** Interest rates have a clear impact on activity among cyclically more vulnerable business segments, likely reflecting borrower balance sheet effects, underscoring their capacity to support demand. Unlike credit policies, policy transmission does not rely on the risk preferences or balance sheet capacity of financial institutions. While the investment impact of interest rate policy shocks manifest with a slight lag compared to credit policies, the easing of financial conditions may operate rapidly, which can help limit scarring by reducing firm closures and employment losses. Increased financial risk-taking that accompany reductions in interest rates should be addressed via prudential policy tools such as regulation, supervision, and macroprudential policy.

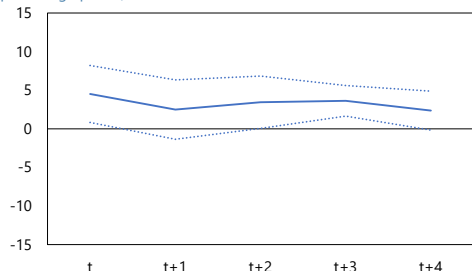
**35. Well-designed and market-based quantity-based instruments have a role in China's monetary policy toolkit, but should not replace interest rates as the primary instrument of policy.** Credit policies and other policy interventions in banks' credit supply function have an important function when there are clear market failures in credit supply, or in amplifying traditional interest rate-based policy shocks. Firm-level evidence suggests that credit policies do not have strong impacts independent of interest rate-based shocks for most firms, particularly among more financially constrained firms. Credit policies should be based on market-based incentives, for instance the PBC's re-lending facility that provides interest cost subsidies for qualifying loans to MSEs. Administrative requirements for loan growth, loan pricing requirements, or other non-market-based features may create inconsistencies with prudential loan underwriting and risk management, raising the risk of arbitrage and financial risks.

## Appendix I. Additional Empirical Results

**Figure 1. China: Firm-Level Investment Impulse Response to Monetary Policy Shocks, by Firm Age**

### Interest Rate Shock: Young Firms

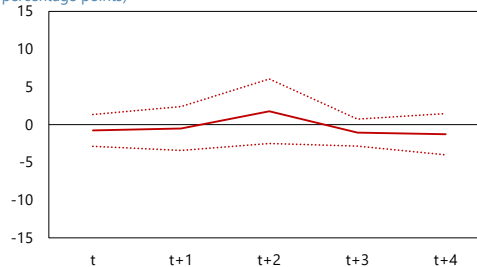
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

### Credit Policy Shock: Young Firms

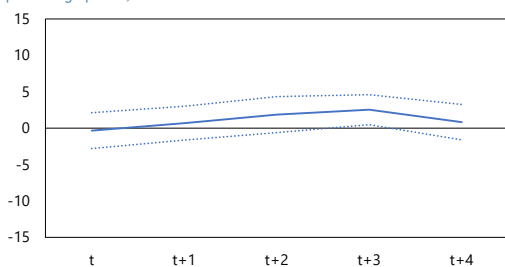
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

### Interest Rate Shock: Middle-aged Firms

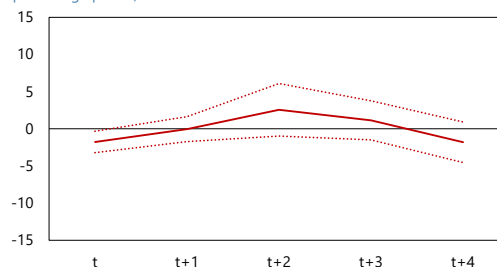
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

### Credit Policy Shock: Middle-aged Firms

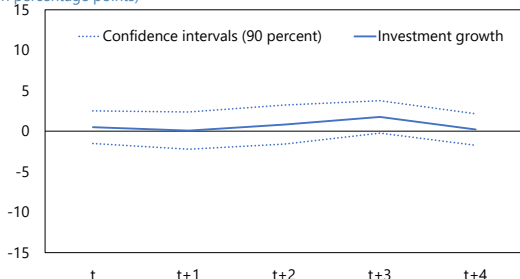
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

### Interest Rate Shock: Older Firms

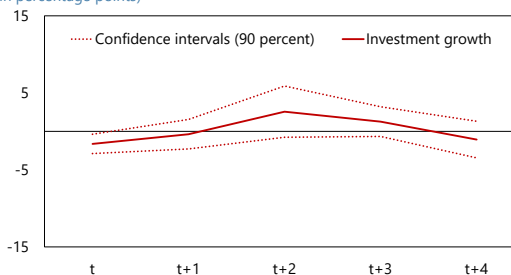
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

### Credit Policy Shock: Older Firms

(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Table 1. China: Robustness: Average Effect of Interest Rate Shock: By Firm Size & Shock Direction**

	$\Delta Y_{i,t}$	$\Delta Y_{i,t+1}$	$\Delta Y_{i,t+2}$	$\Delta Y_{i,t+3}$	$\Delta Y_{i,t+4}$
Small: Easing	-0.09 (0.17)	-0.07 (0.27)	-0.41*** (0.14)	-0.35** (0.14)	0.01 (0.11)
Small: Tightening	0.65** (0.3)	0.6 (0.39)	0.16 (0.28)	-0.52* (0.29)	-0.24 (0.23)
Mid-size: Easing	-0.08 (0.09)	-0.15** (0.06)	-0.1* (0.05)	0 (0.06)	-0.02 (0.08)
Mid-size: Tightening	0.16 (0.26)	0.58** (0.24)	0.27 (0.17)	-0.27 (0.34)	-0.24 (0.32)
Large: Easing	-0.2** (0.09)	-0.11* (0.06)	-0.05 (0.05)	-0.04 (0.05)	0.06 (0.06)
Large: Tightening	0.49** (0.19)	0.17 (0.28)	-0.1 (0.09)	-0.41* (0.2)	-0.42* (0.22)
Controls	Y	Y	Y	Y	Y
Observations	95213	83461	73791	63740	55183

Standard errors in parentheses.  
\* p < .10, \*\* p < .05, \*\*\* p < .01  
Note: Equation above shows results for baseline equation with the firm-level grouping dummy that interacts with the interest rate shock subdivided to reflect periods when the shock variable is negative and positive. Controls include one and two period lagged year-on-year growth of firm-level revenue, investment, liquidity, and leverage, plus one and two period lags on the policy shocks.

**Table 2. China: Robustness: Average Effect of Credit Policy Shock: By Firm Size & Shock Direction**

	$\Delta Y_{i,t}$	$\Delta Y_{i,t+1}$	$\Delta Y_{i,t+2}$	$\Delta Y_{i,t+3}$	$\Delta Y_{i,t+4}$
Small: Easing	-0.15 (0.09)	-0.05 (0.14)	-0.25 (0.16)	-0.18* (0.1)	0.41** (0.16)
Small: Tightening	0.51*** (0.15)	0.08 (0.22)	0.08 (0.21)	0.24 (0.18)	-0.42 (0.29)
Mid-size: Easing	0.07 (0.06)	0.08 (0.1)	-0.15 (0.13)	-0.14 (0.14)	0.15 (0.15)
Mid-size: Tightening	0.02 (0.13)	-0.06 (0.08)	0.06 (0.16)	0.11 (0.12)	-0.07 (0.1)
Large: Easing	-0.09** (0.04)	0.06 (0.06)	-0.02 (0.1)	0.01 (0.11)	0.37*** (0.05)
Large: Tightening	0.28** (0.11)	-0.07 (0.06)	-0.21** (0.09)	-0.1 (0.16)	-0.34*** (0.1)
Controls	Y	Y	Y	Y	Y
Observations	101297	89010	78898	68385	59424

Standard errors in parentheses.

\*  $p < .10$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Note: Equation above shows results for baseline equation with the firm-level grouping dummy that interacts with the credit policy shock subdivided to reflect periods when the shock variable is negative and positive. Controls include one and two period lagged year-on-year growth of firm-level revenue, investment, liquidity, and leverage, plus one and two period lags on the policy shocks.

**Table 3. China: Robustness: Average Effect of Interest Rate Shock: By Firm Age & Shock Direction**

	$\Delta Y_{i,t}$	$\Delta Y_{i,t+1}$	$\Delta Y_{i,t+2}$	$\Delta Y_{i,t+3}$	$\Delta Y_{i,t+4}$
Young: Easing	-0.32** (0.11)	-0.23** (0.09)	-0.2*** (0.07)	-0.07 (0.07)	-0.04 (0.1)
Young: Tightening	0.54 (0.31)	0.54 (0.33)	0.25 (0.25)	-0.52 (0.35)	-0.33 (0.29)
Middle-Aged: Easing	-0.08 (0.08)	-0.14* (0.07)	-0.11** (0.05)	-0.04 (0.06)	0.02 (0.08)
Middle-Aged: Tightening	0.49* (0.26)	0.45 (0.28)	-0.02 (0.16)	-0.4 (0.31)	-0.37 (0.27)
Old: Easing	-0.09 (0.08)	-0.1* (0.06)	-0.09 (0.05)	-0.02 (0.06)	0.03 (0.07)
Old: Tightening	0.21 (0.15)	0.43 (0.31)	0.24 (0.14)	-0.25 (0.23)	-0.2 (0.21)
Controls	Y	Y	Y	Y	Y
Observations	95213	83461	73791	63740	55183

Standard errors in parentheses.

\*  $p < .10$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Note: Equation above shows results for baseline equation with the firm-level grouping dummy that interacts with the interest rate shock subdivided to reflect periods when the shock variable is negative and positive. Controls include one and two period lagged year-on-year growth of firm-level revenue, investment, liquidity, and leverage, plus one and two period lags on the policy shocks.

**Table 4. China: Robustness: Average Effect of Credit Policy Shock: By Firm Age & Shock Direction**

	$\Delta Y_{i,t}$	$\Delta Y_{i,t+1}$	$\Delta Y_{i,t+2}$	$\Delta Y_{i,t+3}$	$\Delta Y_{i,t+4}$
Young: Easing	-0.15** (0.06)	-0.02 (0.14)	-0.15 (0.14)	-0.01 (0.08)	0.33* (0.16)
Young: Tightening	0.36*** (0.11)	0.1 (0.18)	0.06 (0.19)	0.13 (0.13)	-0.32 (0.22)
Middle-Aged: Easing	-0.01 (0.05)	0.04 (0.09)	-0.14 (0.12)	-0.09 (0.13)	0.32*** (0.11)
Middle-Aged: Tightening	0.2 (0.12)	-0.06 (0.1)	-0.05 (0.14)	0.02 (0.14)	-0.23 (0.15)
Old: Easing	0.03 (0.05)	0.09 (0.07)	-0.14 (0.1)	-0.13 (0.12)	0.24*** (0.07)
Old: Tightening	0.12 (0.12)	-0.11 (0.08)	-0.05 (0.1)	0.06 (0.14)	-0.18** (0.06)
Controls	Y	Y	Y	Y	Y
Observations	95213	83461	73791	63740	55183

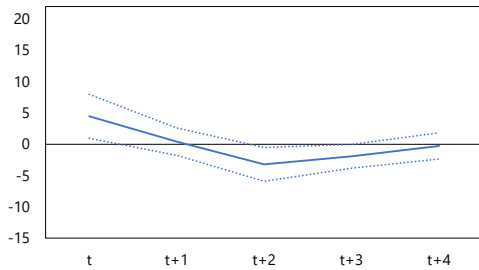
Standard errors in parentheses.

\* p < .10, \*\* p < .05, \*\*\* p < .01

Note: Equation above shows results for baseline equation with the firm-level grouping dummy that interacts with the credit policy shock subdivided to reflect periods when the shock variable is negative and positive. Controls include one and two period lagged year-on-year growth of firm-level revenue, investment, liquidity, and leverage, plus one and two period lags on the policy shocks.

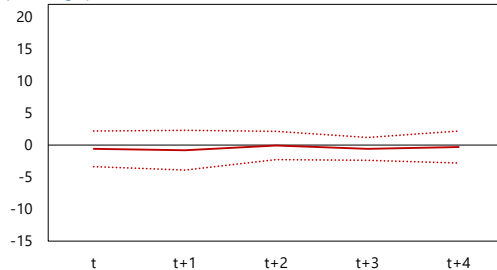
**Figure 2. China: Firm-Level Investment Impulse Response to Monetary Policy Shocks, by Firm Productivity Groupings**

**Interest Rate Shock: Lowest Productivity**  
(In percentage points)



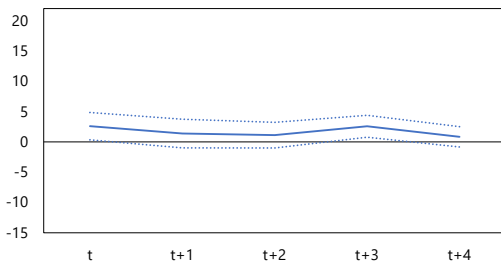
Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Credit Policy Shock: Lowest Productivity**  
(In percentage points)



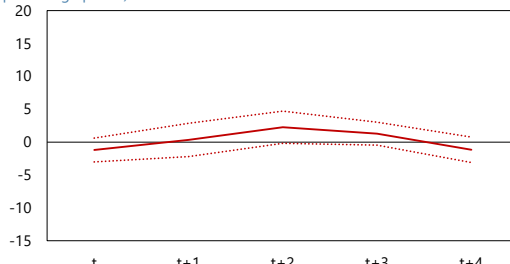
Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Interest Rate Shock: Mid-Range Productivity**  
(In percentage points)



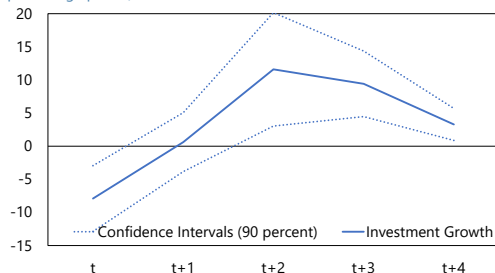
Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Credit Policy Shock: Mid-Range Productivity**  
(In percentage points)



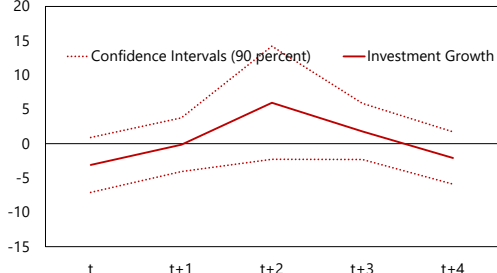
Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Interest Rate Shock: Highest Productivity**  
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Credit Policy Shock: Highest Productivity**  
(In percentage points)



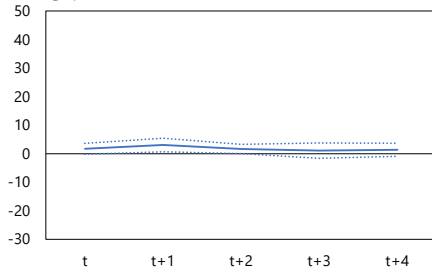
Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.



**Figure 3. China: Firm-Level Investment Impulse Response to Monetary Policy Shocks During Periods of Coordinated Credit and Interest Rate Shocks**

**Interest Rate Shock: Uncoordinated**

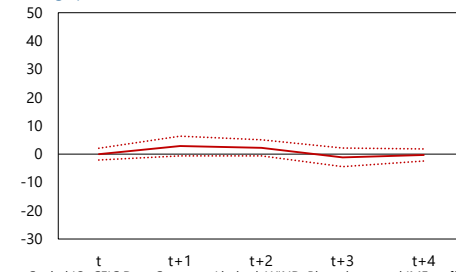
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Credit Policy Shock: Uncoordinated**

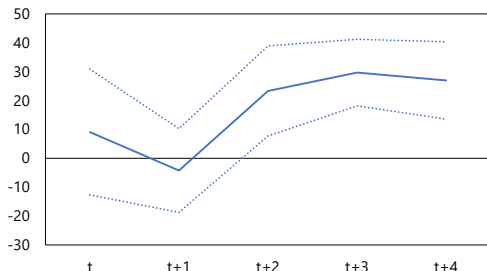
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Interest Rate Shock: Coordinated**

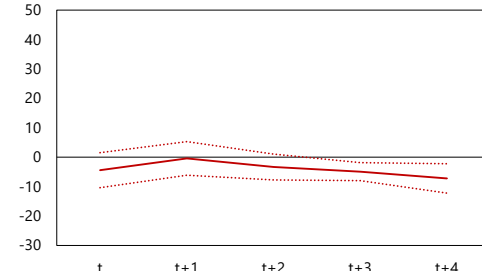
(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

**Credit Policy Shock: Coordinated**

(In percentage points)



Sources: Capital IQ; CEIC Data Company Limited; WIND; Bloomberg; and IMF staff calculations.  
Notes: Each time period t is one half-year. Interest rate shocks are unexpected 25 basis point decreases to the 1-year interest rate swap rate on days of monetary policy announcements. Credit policy shocks are unexpected 12.5 percentage point increases in credit above trend levels. Confidence intervals shown are 90 percent.

## References

- Adrian, Tobias, and Hyun Song Shin. "Liquidity and Leverage." *Journal of Financial Intermediation* vol. 19, issue 3, 2010.
- Bernanke, Ben S. and Mark Gertler, "Inside the Black Box: The Credit Channel of Monetary Policy Transmission." *Journal of Economic Perspectives*, Fall 1995, 9 (4), 27{48.
- Cecchetti, Stephen. "Distinguishing Theories of the Monetary Transmission Mechanism." *Federal Reserve Bank of St. Louis Review*, May/June 1995. Retrieved: [https://files.stlouisfed.org/files/htdocs/publications/review/95/05/Distinguishing\\_May\\_June1995.pdf](https://files.stlouisfed.org/files/htdocs/publications/review/95/05/Distinguishing_May_June1995.pdf)
- Cloyne, James, Clodomiro Ferreira, Maren Froemel, and Paolo Surico. "Monetary Policy, Corporate Finance and Investment," NBER Working Papers 25366, National Bureau of Economic Research, Inc December 2018.
- Durante, Elena, Annalisa Ferrando, and Philip Vermeulen. "Monetary policy, investment and firm heterogeneity," ECB Working Paper No. 2390. European Central Bank, April 2020.
- Das, Sonali, and Wenting Song. "Monetary Policy Transmission and Policy Coordination in China." IMF Working Paper No. 2022/074. May 2022.
- Ehrmann, Michael. "Firm Size and Monetary Policy Transmission – Evidence from German Business Survey Data". Ifo Survey Data in Business Cycle and Monetary Policy Analysis.
- Gertler, Mark and Peter Karadi. "Monetary Policy Surprises, Credit Costs, and Economic Activity." *American Economic Journal: Macroeconomics*, 7 (1): 44-76. 2015.
- Wei Guo, Fei Han, Sarwat Jahan, Emilia Jurzyk, and Cian Ruane. "Chinese State-Owned Enterprises, Resource (Mis)allocation, and Productivity." People's Republic of China, Selected Issues, Country Report No. 21/12. Jan. 2021.
- Hoyle, Henry and Phakawa Jeasakul. "Further Steps to Improve Monetary Policy Effectiveness and Credit Allocation." People's Republic of China, Selected Issues, Country Report No. 21/12. Jan. 2021.
- Harjes, Thomas. "A Market-Based Monetary Policy Approach for China" People's Republic of China, Selected Issues, Country Report No. 17/248, July 14, 2017, pp. 34-40.
- Harjes, Thomas. "Shifting to a Modern, Market-Based Monetary Policy Framework." The People's Republic of China: Selected Issues; IMF Country Report 16/271; July 7, 2016 pp.12-16
- Jahan, Sarwat, Mario Catalan, Emilia Jurzyk, Simon Paroutzoglou, and Longmei Zhang. "Improving the Allocation of Corporate Credit in China." The People's Republic of China: Selected Issues; IMF Country Report 19/274; Aug. 2019.

Michael McMahon, Alfred Schipke, and Xiang Li "China's Monetary Policy Communication: Frameworks, Impact, and Recommendations" IMF Working Paper 18/244, Nov 2018\

Sun, Wenkai, Wenjing Wang, and Xianghong Wang. "Can Money Flows Be Separated between Business and Housing? Evidence from China". 2022. Retrieved at [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=4002229](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4002229)

# MARKET REFORMS IN CHINA'S POWER SECTOR<sup>1</sup>

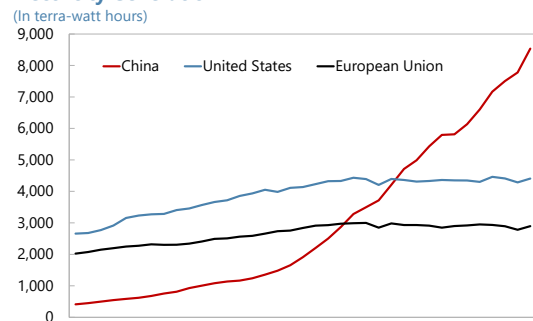
China's power industry was built to support rapidly growing demand. As China's economy matures and climate goals become priorities, the power sector has to adjust. Among the challenges are a lack of price responsiveness to demand and supply shocks, difficulty in integrating non-fossil fuels, and underdeveloped ancillary services markets that are needed to ensure flexible power production and storage capacity. Successful market reforms will require letting power prices fluctuate more freely based on market conditions, strengthening inter-provincial power trading and coordination of local power markets, and scaling up of ancillary services. If done successfully, market reforms will not only improve the efficiency in power generation but also ease the tradeoffs between climate goals and energy security.

## A. Introduction

**1. China's power system has been the engine behind the country's impressive growth over the past two decades.** Electricity demand has grown more than 6-fold between 2000 and 2021, making China's power generation capacity the largest in the world, producing about a third of the world's electricity. The fuel of choice has been predominantly coal, a domestic resource. In 2021, China began construction on 33 gigawatts of coal-based power generation, the most it has undertaken since 2016<sup>2</sup>, and in the first quarter of 2022, it approved 8.63 gigawatts of additional coal plants.<sup>3</sup> There has been some diversification into other fuels including hydro, nuclear, and more recently, wind and solar power.

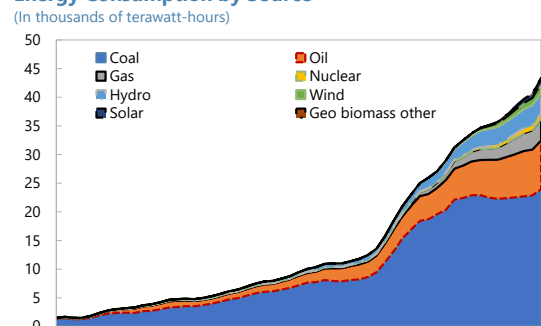
**2. To meet the extraordinary electricity demand, the regulation framework was designed to ensure sufficient investment.** As a result, electricity dispatch and pricing were predominantly administrated with the primary goal to stimulate generation and transmission investments rather than economic efficiency (Guo

**Electricity Generation**



Sources: Our World in Data; BP Statistical Review of World Energy; Ember Global Electricity Review (2022); and Ember European Electricity Review (2022).

**Energy Consumption by Source**



Sources: Our World in Data; and BP Statistical Review of World Energy.

<sup>1</sup> Prepared by Wenjie Chen. The author would like to thank for the very helpful discussions with Ximing Peng and Govinda Timilsina from the World Bank as well as Xiushan Chen and David Fischer at the International Energy Agency.

<sup>2</sup> See [Chinese Coal-based Power Plants | Wilson Center](#).

<sup>3</sup> See [China coal plant approvals surge as energy security trumps climate - Greenpeace | Reuters](#).

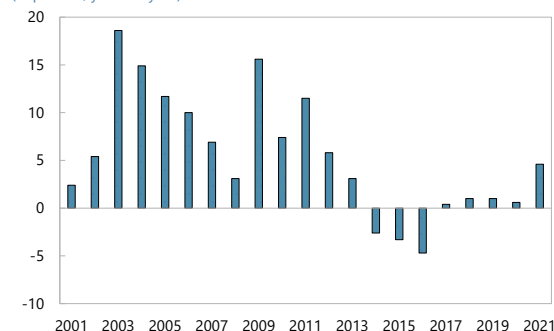
and others, 2021). The annual administrative procedure for power generation planning converted forecast electricity demand into generation quotas, and then evenly allocated the quotas to the generators. Under this setup, coal power plants, regardless of their age, size, efficiency, or emissions levels, would all be allocated the same numbers of generation hours. This “fair dispatch” rule effectively isolated generators from explicit market competition and led to suboptimal expansion and utilization of generation fleet.

### 3. As growth moderated and objectives shifted towards emissions reduction, China's traditional power system has become less compatible with the changing needs.

The challenges included low generation asset utilization, low energy efficiency, high pollutant emissions, and wastage (curtailment) in renewable energy generation. Moreover, the increasing importance of environmental welfare was at odds with the power system and its command-and-control pricing framework. While the latter ensured cost recovery for coal plant investments, the inflexibility of the planned operation hours contracts and lack of wholesale power market made renewable energy artificially less economical. The power system's regulatory framework also lacked incentives to decrease total energy consumption, the development of renewable energy, and the provisions of related products other than energy, such as ancillary services that are required to maintain grid stability and security (Supponen and others, 2021). Furthermore, inadequate inter-provincial power trading platforms and incentives have prevented provinces from purchasing and dispatching power efficiently. Despite some efforts to construct ultra-high-voltage lines between select provinces, the current power market has not created adequate incentives for China's grid companies to construct new grid networks to connect large renewable energy-producing regions to the populous coastal regions, resulting in curtailment.

#### Coal Consumption Increased in 2021

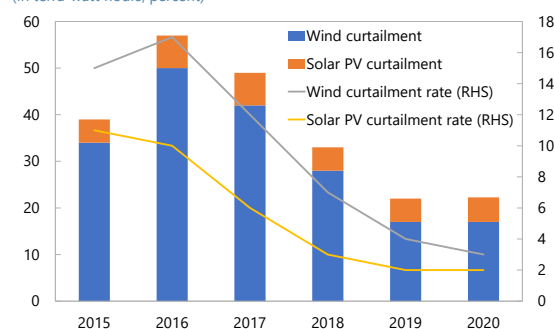
(In percent, year-on-year)



Source: National Bureau of Statistics China.

#### Wind and Solar PV Curtailment

(In terra-watt hours, percent)



Sources: China National Energy Administration; and staff estimates.

Note: PV= photovoltaic.

### 4. As laid out in greater detail below, more market-based reforms to the power sector can enhance the effectiveness of power generation and reduce the tradeoffs between climate ambitions and energy security.

- *Market reforms to the power sector can increase the efficiency and reliability of power generation.* A transition from planned fair dispatch rule where generators produce an allocated energy volume to economic dispatch which enables resources to compete based on their short-run marginal costs and thus, reflects economic optimization will result in lower power system

operational costs, increase efficiency, reduce capacity underutilization and renewable energy curtailment. The adoption of a national electricity market convergent across all provinces that offers flexible transactions along with upgraded transmission connectivity will help ensure that power plants operate efficiently by setting their own generation hours to optimize their profitability. By increasing the efficiency of existing power generators, China can also reduce the need to add new coal power capacity.

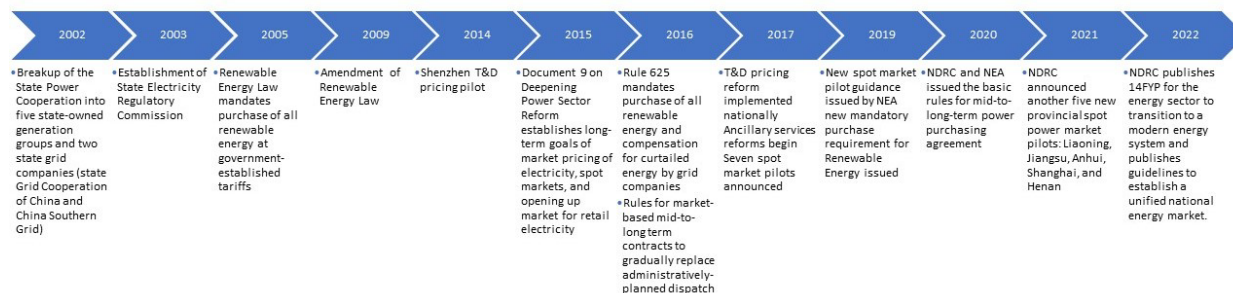
- *Market-based electricity pricing can help reduce the tradeoffs between China's climate ambitions and growth as well as energy security.* Market reforms to the power sector can enhance the efficiency of the national Emissions Trading Scheme (ETS). A market-based regulatory framework to effectively mobilize power system flexibility would ensure that carbon pricing would be passed through onto final consumers, thus, reducing the demand for energy as well as incentivizing a shift away from fossil fuel investment towards renewable energy sources. Guiding power generators to participate in the market while phasing out price controls and generation quotas will help them recover costs and alleviate the burden from fulfilling energy and carbon intensity targets. The reforms will optimize system cost, enhance system flexibility, and level the playing field for renewable energy.
- *Market reforms in the power sector will also require coordination and harmonization of markets.* The coordination and harmonization of regional markets will create an enabling environment for private sector investment in energy storage as well as for coal power plants to reduce operation and stand by for backup generation when necessary. Increasing power trading will also stimulate the development of ancillary services markets. They can fairly compensate reserve capacity that support system reliability and generate incremental revenue streams to energy storage and coal fleets not in use.

These power market reforms will result in transition costs that will require interventions to ensure they are shared in an equitable way. The introduction of economic dispatch is bound to trigger the exit of inefficient coal generators from the market, and this process will likely require active management to compensate the most vulnerable households including workers in coal- and high-energy intensive industries.

## B. Brief History and the Challenges of China's Power Market Reforms

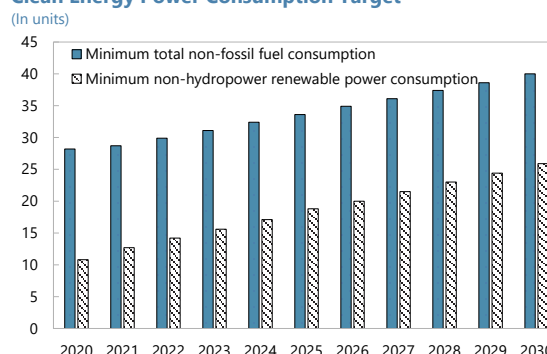
**5. China has launched several rounds of power sector reforms with the aim to improve efficiency, reduce electricity prices, and rationalize coal power investment.** The 2015 reforms—the most extensive in the series—saw the establishment of market-based mid- to long-term electricity forward markets. These markets allowed for wholesale energy prices to be decided via negotiation or auction between generators or suppliers and large consumers. It also enabled the broadening of ancillary services markets, and the piloting of spots markets which enable day-ahead, real-time energy exchanges, with eight spot market pilots currently operating in China. Since June 2020, more private players have been allowed to participate in the forward market, including distribution, wholesale and energy storage companies, with an estimated 45 percent of total energy consumption being traded on the mid- to long-term market as of end-2021 (Qin, 2021). In another

major step towards market pricing of electricity, further reforms took place in late 2021, allowing coal-fired power prices to rise or fall by up to 20 percent from benchmark price levels. The latest set of reforms—announced in 2022—envisions the establishment of a national electricity market by 2025 to further optimize resource allocation, including through increased interprovincial power trading and to better support renewables integration.<sup>4</sup>



**6. Despite the steady progress in power market reforms, however, the role of market-based mechanisms is still limited.** Dispatch and pricing continue to be largely determined administratively through a planned fair dispatch mechanism as of 2022. One of the biggest obstacles to implement the reforms is the dichotomy in political and economic interests between central and local governments (Hove and others, 2021). The latter has significant autonomy in formulating power sector reform programs, and it optimizes power generation and consumption based on its own needs rather than that of the central government. The provincial structure of markets, so far, has tended to enhance provincial protectionism and self-sufficiency (Guo and others, 2020). Competitive power markets entail market-based pricing that is subject to changes based on supply and demand. While these price fluctuations are intended consequences of market-based pricing, market players could be potentially facing more risks. Ideally, long- and short-term power markets should complement each other and provide hedging instruments that will minimize these risks. In the European Union, for instance, hedging through long term trading is an important and efficient tool for both sellers and buyers. A sufficiently liquid spot exchange acts as a reference market that gives a solid price signal on which the long-term markets can rely, and it allows the procurement of the required amounts of physical electricity at all times (Supponen and others, 2020). China’s heavy reliance on coal—with mines and plants largely operated and owned by local governments—also makes it difficult to switch to more flexible options that are inherent to market-based mechanisms. Moreover, as the share of renewables in the power market increases, prices may experience volatility and even decrease over time, creating a situation of stranded assets where

Clean Energy Power Consumption Target



Source: China Energy Administration.

<sup>4</sup> China State Council [announcement](#) on April 10, 2022.

long-standing investments, including those made by local governments, cease to be competitive and become liabilities.

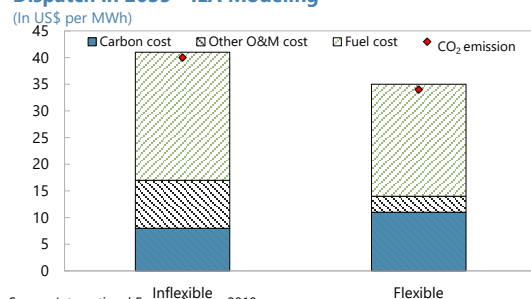
**7. The lack of a fully liberalized power market stands in the way of efficiently integrating renewable power.** China's richness in a diversity of energy reserves poses a challenge for distributing the installed renewable capacity evenly. The existing administrative mechanism of power pricing and dispatch does not provide incentives for the development of flexible production and storage technology that are necessary to allow renewable energy generation to become a source of stable power supply. For many imported-end local governments, the resulting on-grid price of wind and solar energy plus a transmission tariff could be potentially larger than the coal power generated in their own province which also helps with the local economy.

**8. Other barriers to implement market-based power market reforms include legal and regulatory hurdles, limited transparency, and the lack of inter-provincial coordination.** Many provincial markets begin trial operation prior to making the designs accessible to a wide range of actors. China's grid, dispatch, and power pricing usually operate without public information platforms that could enable market players or the public to analyze their operations or potentially participate via new business models (Hove and others, 2021). The lack of transparency not only hinders the effective operation of power markets but is also inhibiting market monitoring and energy demand-side management. Given the local government's autonomy over its own design and construction of power markets, including the existing eight spot markets, potential incompatibility issues among the different rules will pose difficulty in the future for the integration of these markets and achieving a higher level of optimization (Guo and others, 2020).

### C. Power Market Reforms to Increase Efficiency

**9. The switch to economic dispatch and higher levels of regional trading would help reduce operational costs.** It would effectively end the guaranteed offtake for coal-fired power under fair dispatch—which has enabled and incentivized the approval of coal-fired capacity. Market-based pricing allows for greater passthrough of costs to end users, industrial and commercial, resulting in greater volatility in prices that in turn should introduce and incentivize greater efficiencies in power use. Over time, this new pricing mechanism should enable power consumers to influence the supply and pricing of power products by making economic choices, and power generators will subsequently invest in new capacity based on the demands of power consumers. The decrease in system cost and emissions is driven by an increase in the utilization of both zero-marginal-cost renewables and more efficient thermal generators. Economic dispatch enables the integration of additional renewables, drops curtailment and drives better scheduling of generators so that those that are already running operate at higher run rates and therefore increase their overall efficiency. Recent work by the

**Operational Costs Under Inflexible and Flexible Power Dispatch in 2035 - IEA Modeling**



Source: International Energy Agency 2019.

Note: The introduction of economic dispatch, higher levels of regional trading and additional grid infrastructure can help to reduce operational costs and CO<sub>2</sub> emissions and brings savings of USD 63 billion annually.

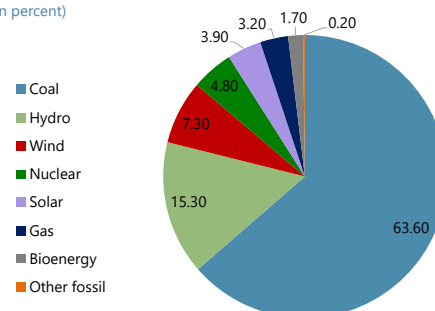


International Energy Agency (IEA) has shown that maintaining the current fair dispatch system would lead to major inefficiencies in the capacity mix, including high levels of renewable energy curtailment (IEA, 2019). The switch to economic dispatch would bring operational cost savings of about 11 percent per year in 2035. Moreover, power sector carbon emissions would also fall by 15 percent. In their simulations using latest existing data, Timilsina, Pang and Yang (2021) found that optimal electricity prices under economic dispatch could be lower by about 5 percent compared to electricity prices under the existing dispatch. In the long run, customer tariff rate reductions could be much larger as generators would be able to refine their cost structure and offer lower bids into the market—a trend observed in regions around the world that have previously implemented energy markets (Keay, 2016).

**10. The combination of economic dispatch and rapid trading will allow for more renewable energy integration and reduces the need to add new coal power capacity.** The share of renewable energy has grown in the Chinese power system, but there are still integration challenges and significant curtailment of renewable energy. International experiences have demonstrated that a well-functioning short-term market that allows rapid trading (e.g., spot market) for electricity is a very powerful measure to drive power system transformation (IEA, 2019; Qin, 2022). In such an arrangement, the power plant with the lowest generation costs has priority for meeting electricity demand. In most designs, the cost of the last (most costly) plant that is needed to meet demand sets the price paid to all generators. Combining effective spot markets with better utilization of interconnections and increased grid investment brings a more efficient power system that can absorb an increased share of variable renewable energy. The modelling analysis by the IEA (IEA, 2019) shows that the power system can integrate renewable energy at over 20 percent of total generation without any curtailment by improved operations and increased levels of physical interconnections. The capacity value of renewable energy, including solar photovoltaic, wind and hydro power, being used for planning in China is rather low and increasing it from the current level would result in less need for new peaking capacity such as coal that can be provided equally by renewables (WB, 2022).

**Electricity Production Mix 2021**

(In percent)



Sources: China Electricity Council; Statista; and Ember.

## D. The Importance of Power Market Reform for China's Climate Ambitions

**11. Because the largest share of China's emissions is energy-related, any successful climate agenda will require a significant transformation of the power sector.**

- **Intensity Targets:** As China has set out to achieve carbon emissions peak before 2030 and net carbon neutrality before 2060, it has relied heavily on mandatory energy consumption standards and energy intensity targets to drive carbon emissions reductions. These intensity targets, however, have often clashed with growth ambitions and energy security as showcased by the

2021 power crunch (Boxes 1 and 2). The inability of power generators to adjust electricity prices to end users as coal prices were rising significantly, resulted in reduced operations from low coal inventories and rationed energy supply to industrial users. The barriers to inter-provincial trading and the lack of coordination between local governments makes China also vulnerable to localized power shortages, exacerbated by weather-induced climate shocks, especially droughts and its heavy dependence on hydro power as seen in the recent power crunch in Sichuan province in August 2022. Yet, current investment incentives are not aligned with providing more support for bringing on more renewables onto the grid through expanding storage facilities and other ancillary services.

- **ETS:** The national ETS could potentially facilitate these incentives, but lacks teeth in its current form and without significant power market reforms. The predominantly administratively set pricing in the power sector limits the extent to which the ETS-implied carbon price will be passed on to downstream sectors and consumers and the incentives for power producers to adjust. Accelerating the dispatch reform would better enable the ETS and amplify its value, as a merit order dispatch system would take into account the carbon cost imposed by the ETS on less-efficient units and authorize lower-emitting technologies to operate more often. Slower reform progress would hold back electricity generators in adjusting their operations based on ETS price signals, and the ETS's effectiveness in carbon emissions could remain considerably constrained (see below).

### Box 1. China: The Impacts of Intensity Targets on Climate and Energy<sup>1</sup>

Relying on medium-term policy frameworks is an established way for China to implement its policy objectives. Like in the 12<sup>th</sup> and 13<sup>th</sup> Five-Year Plans (2011–2015, 2016–2020, respectively), China also set binding reduction targets for energy intensity and carbon intensity in its 14<sup>th</sup> FYP (2021–2025). These key interim climate targets include a 13.5 percent reduction for energy intensity and an 18 percent reduction of carbon intensity of GDP. A cap on energy consumption growth was set at 2 percent per year as well. These guidelines provide a basis for calculating the implied future emissions and energy needs under various assumptions of growth. All values (e.g., GDP, energy efficiency, energy use, emissions) in the baseline year are set at 100. Values for 2021 are based on outturns where available. The scenarios are extended to 2030 based on the targets of the 13<sup>th</sup> and 14<sup>th</sup> FYP. The following analysis illustrates the issue at stake using two different GDP scenarios, one based on a “baseline” growth path (based on the October 2022 *World Economic Outlook* (WEO)) and the other based on 5.5 percent annual “high growth” scenario after 2025.

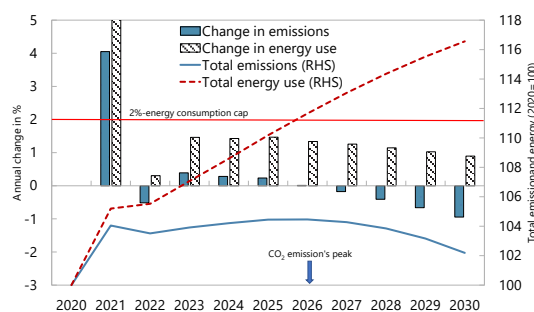
In the “baseline” scenario, Chinese carbon emissions would peak around the year 2026, four years ahead of the current ambitions. This scenario would lead to around 5 percent more carbon emissions compared to 2020 levels. As for energy consumption, the annual two-percent growth cap was violated in 2021 due to the strong recovery from the pandemic recession in 2020, but in all subsequent years, energy consumption growth would be below the cap.

In the “high growth” scenario after 2025, Chinese carbon emissions would peak in 2029, just one year before the target year of 2030, but with carbon emissions having grown by over 7 percent compared to levels in 2020. However, the energy consumption cap would be violated again in years 2026 and 2027.

These scenarios illustrate two important points. The first one is that the intensity targets are highly dependent on the growth trajectory. Given the strong rebound in growth in 2021, it was not surprising that local governments found it challenging to meet these targets (Box 2). The second insight is that even if carbon intensity falls by the targeted amount, there is a risk that carbon emission levels could still increase and force a much more intensive decarbonization effort after 2030 (IMF, 2021). For example, allowing coal capacity to increase in the near term could require sharp capacity reduction down the road. The absence of absolute caps on coal use—new coal plants might be forced to retire early given their average lifespan of around 50 years—and carbon emissions leaves room for emissions to increase over the next several years, implying sharper policy shifts later on—and if the availability and costs of clean technology alternatives do not evolve as expected, or future growth paths change unexpectedly on the downside, China will have made it even tougher for future generations to curb emissions.

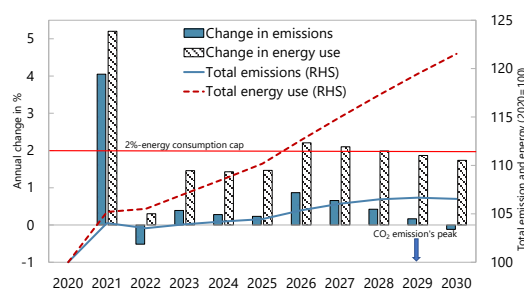
<sup>1</sup> Prepared by Wenjie Chen

CO<sub>2</sub> Emissions and Energy Trajectories Under Oct22 WEO Growth



Sources: IMF World Economic Outlook database; and IMF staff calculations.

CO<sub>2</sub> Emissions and Energy Trajectories Under 5.5% Growth



Sources: IMF World Economic Outlook database; and IMF staff calculations.

### Box 2. China: China's "Power Crunch" of 2021<sup>1</sup>

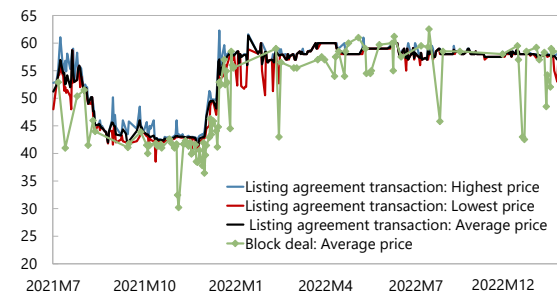
The power supply shortage in the second half of 2021 provided a stark reminder of the difficult tradeoffs between energy security and climate ambitions. In early 2021, the government set a target for energy intensity to decline by around 3 percent during the year, broken down further into provincial targets. The unbalanced nature of China's recovery from the pandemic recession, however, has led to a significant jump in energy consumption in 2021. Heavy industries like steel, non-ferrous metals, chemicals, and building materials like cement and glass have led the charge to satisfy increased manufactured export demand and the boom in domestic construction and infrastructure investment. This posed difficulty in fulfilling annual climate targets at the provincial level. In fact, in the first half of 2021, there were more than 12 provinces lacking on both counts of the targets, and several local governments proceeded to ration power supplies in order to meet the intensity goals (Meidan and Andrews-Speed, 2021).

On the supply side, the immediate cause of the crisis was that the electricity prices paid to generators were regulated, while coal prices were and still are set on the market. When coal prices rose, it became unprofitable for coal power plants to supply electricity. As a result, coal power plants cut back on coal purchases, running down coal inventories instead, and coal mines did not ramp up output in time, as the price and demand signals were dampened. The gap was exacerbated by supply-side disruptions: an anti-corruption campaign in Inner Mongolia, mining safety campaigns, heavy rains, and an intensive restructuring of the coal mining industry. Surging coal mine output eventually closed this gap.

The power crunch in 2021 led to several important changes in the power price controls. China had a narrow price band in which generation prices could fluctuate. In October 2021, reforms were passed, allowing the band to modestly expand up to 20 percent, and the prices for high energy-consuming enterprises and spot market trading no longer being subjected to the price control band range. All coal power plants were guided to participate in the market, which accelerated phase-out of generation quota. All industrial and commercial consumers were required to purchase electricity from the market. These changes helped coal generators recover increasing cost to some extent, however, it is not clear whether this has helped increase renewable energy utilization. Moreover, in early 2022, China published its 14th Five-Year Plan for energy as well as issued other important power market regulations including guidelines calling for a unified national energy market.

#### Unit Price of Listing Agreement Transactions and Block Deals

(In RMB per ton)



Source: CEIC Data Company Limited.

<sup>1</sup> Prepared by Wenjie Chen

**12. Progress in power market reform can significantly enhance the effectiveness of China's national ETS.** The ETS is a central component of China's efforts to implement its mitigation objectives, but in its current setting, emissions reductions are unlikely to be cost effective (IMF, 2021; Chateau and others, 2022). A transition from administratively determined dispatch to economic dispatch could strengthen the effectiveness of the ETS by allowing markets to reflect carbon prices in electricity generation costs and thus, to directly impact dispatch decisions. Without this reform, the ETS risks playing a limited role in reducing power sector emissions while coal power plants would not need to adjust their operation in response to the price signal stemming from the ETS allowance allocation. The transition to an economic dispatch mechanism would also allow cost passthrough from generators to energy consumers, and hence strengthen incentives for demand-side response. Together, power market reforms and effective carbon pricing could help to significantly reduce power system operational costs, improve wind and solar power integration, and achieve a considerable drop in power sector emissions. In turn, the ETS can support power market reforms by integrating carbon costs into dispatch decisions and providing incentives for plants to operate more flexibly depending on their carbon emissions levels. If externality costs are not taken into consideration and high-emitting sources remain cost-competitive, the power market reform might optimize the cost of electricity production in a manner not necessarily aligned with the transition to a low-carbon electricity mix (IEA, 2021a).

**13. By allowing more market forces to guide resource allocation and emissions abatement, an ETS can achieve significant carbon emissions reductions more effectively than mandatory intensity targets.** Model simulations show that compared to carbon emission reductions under a command-and control approach of imposing energy intensity and total energy consumption targets, the ETS in combination with power sector reforms would achieve the same emissions reductions at less additional cost to the system (IEA, 2019, 2021a, 2021b). The reason that the ETS with power market reforms could achieve more cost-effective emissions reduction than mandatory consumption standard is because allowance trading with flexible electricity prices leads to the most affordable emissions abatement measures in the system to be deployed first. In contrast, under mandatory energy consumption targets, technologies need to reduce their respective energy consumption by a similar scale regardless of the relative cost. Moreover, with more stringent allowances in combination with economic dispatch, the ETS would encourage high-efficiency units to run significantly more than they currently do, thus, improving utilization rates. Less-efficient—usually older units—would either serve as back-up capacity with low annual hours or be retired. In addition to changing operating patterns and optimizing the energy mix, the ETS—unlike the intensity target approach—provides incentives to accelerate and enlarge the deployment of carbon capture, utilization and storage (CCUS) in the power sector as well as ancillary service markets that would provide further support to renewable energy.

**14. Enhancing and developing China's ancillary service market will enable a more efficient integration of renewables.** Ancillary services markets are important to ensuring flexibility in systems with a high proportion of renewable energy. China's ancillary services are dominated by peak shaving, reserves, voltage regulation, and frequency regulation. Peak shaving allocates power according to predictable demand patterns, while reserves provide back-up for the entire system. So

far, most ancillary services markets are at the early stages of development and may only allow participation of some generators. They are also designed and operated by local governments and not necessarily compatible across provinces. The integration of renewables relies on having the technology and infrastructure to turn the inherent intermittency of renewable energy sources into stable power supply. Thus, making ancillary services markets operate more freely and market-based in tandem with power market reforms and the ETS would signal for more investments into the necessary technologies, including those in retrofitting coal plants for greater flexibility. The recent reforms announced by the NEA to expand ancillary services markets and to change the cost allocation mechanism to include power end-users for the first time are promising first steps.<sup>5</sup>

## E. Policy Implications

**15. Despite significant progress, many challenges remain in China's power sector, but market reforms can improve its compatibility with the changing needs.** This includes reducing the tradeoffs between climate objectives and energy security. In particular, these include the following:

- **Electricity pricing needs to be more cost-reflective**, convergent across the provinces and flexible to market conditions. China can expedite the elimination of the administrated price range set for market transactions with coal power plants, including by gradually abandoning the pricing band around electricity.
- **Expanding spot market trading has the potential to help reduce generation capacity reserve, increase flexibility and improve renewable energy integration.** Consistent with the vision outlined in the energy reform plans announced in 2022, regional pilot spot markets should be scaled up towards the adoption of a national spot market that offers flexible transactions for short time periods for the whole country. This will also require coordination between local governments to harmonize provincial power markets while increasing the transparency and independence of energy exchanges from grid, generation and retail companies.
- **Strengthening inter-provincial power trading platforms and incentives can ensure provinces purchase and dispatch power efficiently.** The current power market has, so far, not created adequate incentives for China's grid companies to construct new grid networks to connect large renewable energy-producing regions to the populous coastal regions although it is a central focus in the 2022 energy reform package. Inter-provincial power trading is still limited in scale and inflexible in terms of the amount of power provided from one province to another. Integrating provincial grids would allow one province to take advantage of reserve capacity in other provinces and reduce or eliminate the need of additional coal power capacity for system reliability subject to the extent of integration. It requires both physical investment for rapid expansion of inter-provincial transmission capacity and reform to optimize dispatch,

<sup>5</sup> See [China's ancillary services paradigm shift: Market rules adapt to a changing power system | IHS Markit](#)

moving dispatch operation and responsibility from provincial level to regional level and national level to enable dispatch optimization across provinces.

- **Incentivizing ancillary services markets and potentially a capacity market to support the integration of renewable energy.** These markets can fairly compensate reserve capacity or other ancillary services that support system reliability and generate incremental revenue streams to energy storage and coal fleets not in use. These markets will create an enabling environment for private sector investment in energy storage as well as for coal power plants to reduce operation and stand by for backup generation when necessary. Together with effective carbon pricing like the ETS, these key reform measures will optimize system cost, enhance system flexibility, level playing field for renewable energy, and recalibrate the role of coal fleets from a baseload supplier to a supportive facility for serving peak load and offering reserve capacity or other valuable ancillary services.
- **Building a conducive investment climate will encourage private sector participation.** To meet the scale of the investment needs for power sector decarbonization, attracting private sector investment is critical, especially for renewable energy and energy storage. Enhancing the predictability of the policy framework could help encourage stronger private investment. Expanding the green electricity certificate (GEC) market and allowing larger participation from renewable energy generators and voluntary purchasers may also enhance cash flow to private sector investors (see SIP on Climate Finance).
- **The capacity value of renewable energy in China may be further enhanced by revisiting approaches and regulations that align them with international standards.** There remains considerable potential to improve economic dispatch and utilization of hydro power and energy storage to meet peak demand following international best practices. In parallel, the potential of demand side management including demand response can be further harnessed to slow down peak load growth and support integration of variable renewable energy.

## References

- Chateau, J., Chen, W., Jaumotte, F., and K. Zhunussova. 2022. A Comprehensive Package of Macroeconomic Policy Measures for Implementing China's Climate Mitigation Strategy. IMF Working Paper 22/142.
- Guo, H., Davidson, M. R., Chen, Q., Qing, X., Kang, C., and X. Zhang. 2020. "Power market reforms in China: Motivations, progress, and recommendations." *Energy Policy* 145, 111717.
- Hove, A., Qian, W., Zhao, K., Geres, P., and Y. Liu. 2021. "China Energy Transition Status Report 2021." Sino-German Energy Transition Project commissioned by the German Federal Ministry for Economic Affairs and Energy (BMWi).
- International Energy Agency. 2019. *China Power System Transformation*. IEA, Paris.
- \_\_\_\_\_. 2021a. "The Role of China's ETS in Power Sector Decarbonisation." IEA, Paris.
- \_\_\_\_\_. 2021b. "An energy sector roadmap to carbon neutrality in China." IEA, Paris
- International Monetary Fund. 2021. *China Article IV Staff Report*.
- Keay, M. 2016. "Electricity markets are broken – can they be fixed?" OIES PAPER: EL 17, The Oxford Institute for Energy Studies.
- Meidan, M. and P. Andrews-Speed, P. 2021. *China's power crisis: Long-term goals meet short-term realities.* Mimeo, The Oxford Institute for Energy Studies.
- Oxford Energy Forum. 2022. "The 2021 energy crisis: Implications for China's energy market and policies." Issue 131, The Oxford Institute for Energy Studies.
- Qin, Y. 2021. "China power sector reform and power trading – an overview of recent policies and trends." [Wilson Center Presentation](#).
- Supponen, M., Xia, Q., Chen, Q, and N. Jiang. 2020. "Electricity markets and systems in the EU and China." 2020. Mimeo. EU-China Energy Cooperation Platform
- Timilsina, G. R., Pang, J. and X. Yang. 2021. "Macroeconomic impacts of power sector reforms in China." *Energy Policy* 157, 112509.
- World Bank Group. *Forthcoming*. "Country Climate and Development Report: China."



# FOSTERING THE DEVELOPMENT OF CLIMATE FINANCE<sup>1</sup>

*China is one of the largest green finance issuing jurisdictions in the world. However, more remains to be done to ensure that the capacity of China's climate finance ecosystem can satisfy the substantial financing needs for its transition toward a carbon-neutral economy. Key actions include strengthening the climate information architecture to create a solid foundation for market-oriented climate finance, improving banks' accountability of climate investing, enhancing market-based financing to complement banks' green lending, and developing the transition finance framework. Meanwhile, incorporating climate-related risks into the prudential policy and market conduct frameworks, as well as systemic risk oversight, could help safeguard financial stability that can be impacted by climate change.*

## A. Introduction

**1. A vibrant climate finance ecosystem is essential to support China's successful transition toward a carbon-neutral economy.**<sup>2</sup> China has made a commitment to reaching the carbon emissions peak before 2030 and achieving carbon neutrality before 2060. The transition toward a carbon-neutral economy requires a substantial amount of investment, with estimates for total financing needs in the range of RMB 150-300 trillion to achieve carbon peaking and carbon neutrality.<sup>3</sup> Although China is one of the largest green finance issuing jurisdictions in the world, additional efforts are critical to ensure China's ability to finance its climate mitigation, adaptation and transition needs.

**2. This analysis aims to assess China's existing climate finance ecosystem and discusses ways to improve it.** The paper is organized as follows. Section B reviews China's green finance landscape, and Section C covers China's existing policy initiatives on green finance. Section D discusses how to enhance market-oriented climate finance, while Section E discusses how to manage climate-related financial risks. Section F proposes actions to foster the development of climate finance in China going forward.

## B. China's Green Finance Landscape

<sup>1</sup> Prepared by Phakawa Jeasakul and Hong Xiao (IMF Resident Representative Office in Hong Kong SAR).

<sup>2</sup> Climate finance provides funds for addressing climate mitigation and adaptation, as well as facilitating climate transition. Green finance refers to financing for climate mitigation and climate adaptation efforts, as well as activities with broader environmental benefits (for example, biodiversity protection); typically, green finance is perceived to fund "green" investment as opposed to "brown" investment. Transition finance refers to financing for climate-related efforts during the transition more broadly. Sustainable finance refers to financing for activities with environmental and social benefits. Sustainable finance could also fund investment with appropriate environmental, social and governance factors.

<sup>3</sup> See [speech](#) by Deputy Governor Guiping Liu of the People's Bank of China at the 13<sup>th</sup> Lujiazui Forum.

**3. China already possesses a large domestic green finance ecosystem, which is dominated by banks' green lending (Figure 1).**

Chinese banks are the leading green finance provider, supplying RMB 20.9 trillion of green loans as of September 2022. Market-based financing is comparatively small, with total issuance of green bonds amounting to RMB 3.1 trillion. Nonfinancial firms and local governments have issued green bonds to fund green investment, while financial institutions, including policy banks, have also issued green bonds to fund their green lending. Onshore green financing activities are carried out in accordance with Chinese regulatory frameworks, which are not necessarily aligned with commonly accepted international standards. Meanwhile, the green asset management industry is still at a nascent stage, with total issuance of investment funds with environmental, social and governance (ESG) themes amounting to RMB 0.4 trillion.

**4. China is a leading green finance player globally.** China is the second largest green bond issuer, following the United States, when considering green bonds that are aligned with commonly accepted international standards. According to the BloombergNEF database,<sup>4</sup> China's total issuance of green bonds amounted to \$327 billion, accounting for 15 percent of global total issuance. While China's offshore green bonds are generally aligned with commonly accepted international standards, a notable portion of its onshore green bonds has been issued under Chinese standards with more lenient use-of-proceeds requirements (see further discussion in paragraph 9). Chinese entities have issued offshore green bonds to raise funds in international financial markets, with Hong Kong SAR serving as the primary location where bonds are arranged. In addition, China has issued \$75 billion of other sustainable finance, which include green loans, social bonds, sustainability bonds, and sustainability-linked bonds and loans.

---

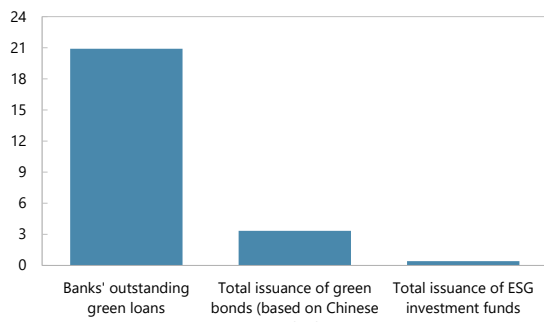
<sup>4</sup> The BloombergNEF database provides information on green bonds and other sustainable finance in line with standards set by the International Capital Market Association and the Loan Market Association. For green bonds, the Climate Bonds Initiative is another major standards-setter given its leading role in green bond certification globally.

**Figure 1. China: Green Finance Landscape**

China's onshore green finance ecosystem is dominated by banks' green lending, while the green asset management industry is still at a nascent stage

**Onshore Green Finance Ecosystem, September 2022**

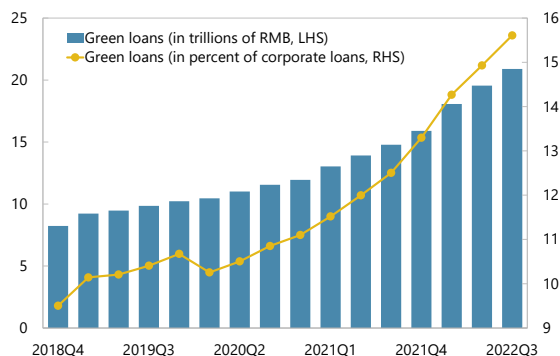
(In trillions of RMB)



Sources: CEIC Data Company Limited; WIND; and IMF staff calculations.

Banks' green lending has grown steadily, driven by policy guidance. Loans categorized as green now account for nearly 16 percent of banks' total corporate loans.

**Banks' Green Loans**

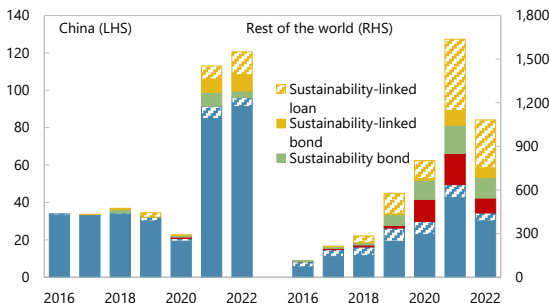


Sources: CEIC Data Company Limited; and IMF staff calculations.

China is one of the largest green finance issuing jurisdictions in the world, with its issuance of green bonds (aligned with international standards) accounting for 15 percent of the global total, ...

**Issuance of Sustainable Finance**

(In billions of US\$)

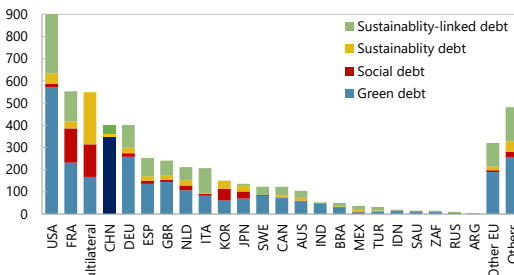


Sources: BloombergNEF; and IMF staff calculations. Note: For 2022, data are as of October.

... while its issuance of other sustainable financing instruments has been more limited. However, China has become more active in issuing other sustainability debt since 2021.

**Total Issuance of Sustainable Finance Since 1996**

(In billions of US\$)



Sources: BloombergNEF; and IMF staff calculations. Note: Data are as of October 2022.

A large portion of Chinese onshore green bonds are not aligned with international standards primarily due to lenient use-of-proceeds requirements for certain onshore bonds.

**Issuance of Green Bonds**

(In billions of US\$)

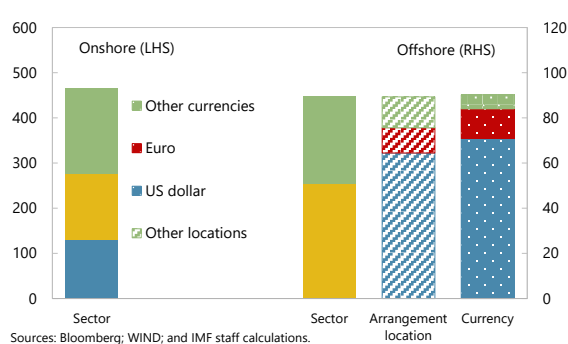


Sources: Bloomberg; BloombergNEF; Climate Bonds Initiative; WIND; and IMF staff calculations.

While nonfinancial firms issue green bonds to finance their green investment, financial institutions also issue green bonds to fund their green lending.

**Total Issuance of Onshore and Offshore Green Bonds**

(In billions of US\$, based on total issuance between January 2015 and June 2022)



Sources: Bloomberg; WIND; and IMF staff calculations. Note: Onshore green bonds are based on Chinese standards.

**5. Existing evidence points to lower financing costs of green bonds, better investment returns on green assets, and potential climate-related risk mispricing (Figure 2).** By comparing at-issuance bond yields for the same issuers between green bonds and other bonds of comparable maturity, at least 60 percent of issuers have obtained lower financing costs for their green bonds. Meanwhile, evidence so far suggests that investors in green bonds and equities tended to enjoy additional investment returns relative to investment in overall benchmarks, with positive excess returns over an extended timeframe (from 2018 onward) and on a more frequent basis (based on monthly returns). Such higher investment returns could be driven by the increase in demand for green assets, which could be induced by policy guidance and/or investors' perception for lower underlying risks of green assets. At the same time, the Global Financial Stability Report (April 2020) found a temperature pricing anomaly in China, Hong Kong SAR, and several other economies, implying that equity investors in these markets have not paid adequate attention to climate change. A mispricing of climate-related risks could undermine the efficiency of resources allocation and potentially heighten financial stability risks.

**6. Existing green loans and bonds help finance cleaner energy and energy saving, but carbon-intensive activities' access to bond finance has become more limited.** Banks' green lending is used to finance infrastructure (45 percent), clean energy (26 percent), energy saving and environmental protection (14 percent), and other green investment (16 percent), with the main green borrowers from the utilities and transportation sectors. The pattern of green bond issuances also suggests the availability of funding for cleaner energy generation (for the utilities sector) and energy saving (for the real estate sector); firms in the industrials sector (that is, manufacturers of capital goods) and the transportation sector are also able to tap green bond financing. In contrast, the access of carbon-intensive sectors to bond financing appears to have somewhat diminished over time.<sup>5</sup> Bond issuances of these sectors have been more limited compared with other sectors, and their net bond issuances even turned negative in 2017 and 2021.

---

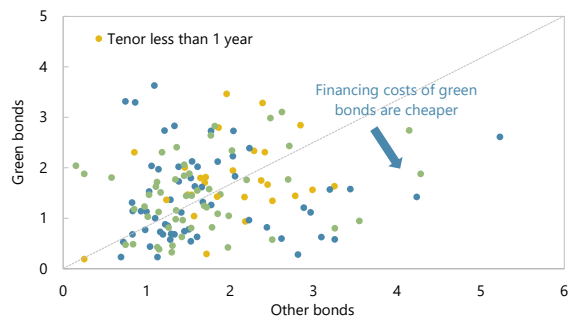
<sup>5</sup> In 2019, the electricity and heating sector was responsible for about half of total emissions, while other major sources of carbon emissions included manufacturing, construction and industrial processes (33 percent), and transportation (8 percent). Overall, total energy generation (including for manufacturing) accounted for about 80 percent of carbon emissions.

**Figure 2. China: Selected Characteristics of Green Finance**

For the same bond issuers, at least 60 percent of issuers enjoy cheaper financing costs for green bonds than non-green bonds.

**Financing Costs of Green Bonds**

Interest rate spreads of AAA-rated green and other bonds at issuance of the same issuers, relative to central government bond yields (in percentage points, at issuance)

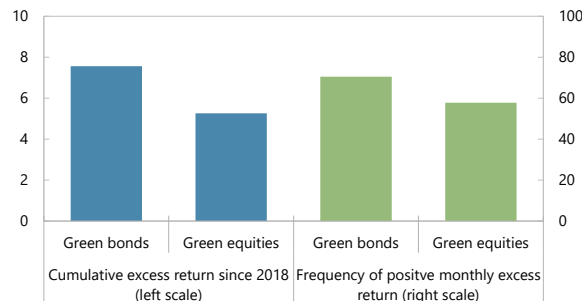


Sources: WIND; and IMF staff calculations.

Investing in green bonds and equities tends to obtain higher returns over a longer term as well as on a more frequent basis.

**Investment Return of Green Assets**

(In percent)

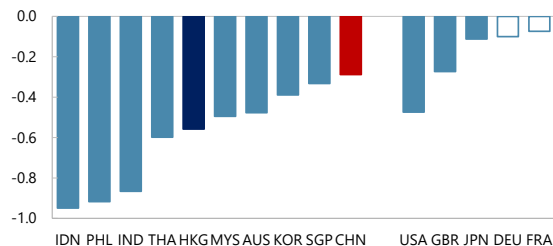


Sources: WIND; and IMF staff calculations. Note: The excess returns of green bonds and green equities (based on 300 Carbon Neutrality) are computed relative to enterprise bonds and overall equities (based on CSI 300).

There is some evidence of mispricing of climate-related risks in China, Hong Kong SAR, and several economies.

**Selected Economies: Abnormal Equity Returns of Firms with the Highest Sensitivity to Temperature**

(In percent, filled bars mean that estimates are statistically significant)

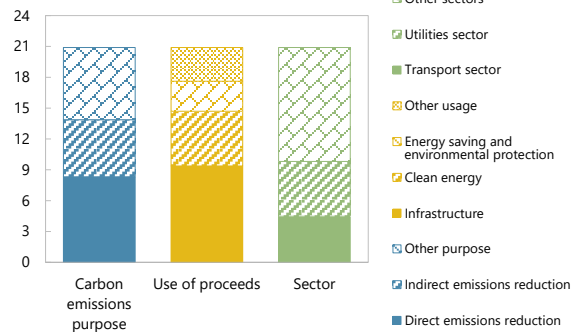


Sources: GFSR, April 2020, Chapter 3; and IMF staff calculations. Note: Abnormal equity returns reflect the difference in performance between firms with high temperature sensitivity (top quintile) and all other firms. Estimates are based on 1998-2017 data.

Banks' green lending has helped finance climate mitigation and adaptation- efforts.

**Banks' Green Loans by Characteristics, 2022Q3**

(In trillions of RMB)

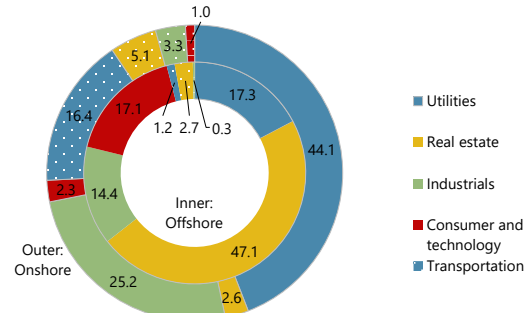


Sources: CEIC Data Company Limited; and IMF staff calculations.

Bond financing has been largely tapped by firms in the utilities, industrials and transportation sectors (onshore market) and in the real estate sector (offshore market).

**Total Issuance of Nonfinancial Corporate Green Bonds**

(In percent of total; based on total issuance between January 2015 and June 2022)

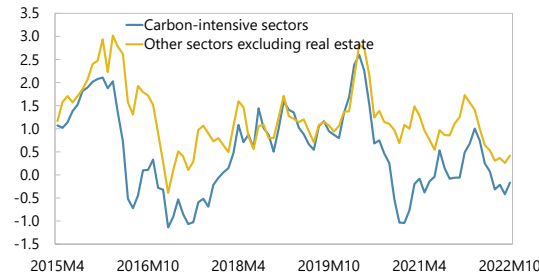


Sources: Bloomberg; and IMF staff calculations. Note: Onshore green bonds are based on Chinese standards.

Firms in carbon-intensive sectors have faced a diminishing access to bond financing.

**Net Issuances of Nonfinancial Corporate Bonds**

(In percent of outstanding bonds, based on 3-month moving average)



Sources: Bloomberg; and IMF staff calculations. Note: Carbon-intensive sectors include power generation, coal operations, oil and gas (excluding services and equipment), metals and mining, chemicals, forest and paper products, and construction materials.

## C. China's Policy Initiatives on Green Finance

**7. The rapid development of China's green finance has benefited from various policy initiatives.** In August 2016, Chinese authorities issued [joint guidelines](#), approved by the State Council, to develop China's green financial system to mobilize private capital to support green investment. Since 2017, pilot programs and local policy measures have also been rolled out to support the green transformation and enhance the provision of green finance. In recent years, the ["three functions" and "five pillars"](#) policy approach has been formulated as part of the strategy to achieve the carbon peaking and carbon neutrality goals. The "three functions" refer to the financial system's role in supporting the climate transition in three key areas—resource allocation, risk management and market pricing. The "five pillars" refer to the five components of policy actions to further strengthen the development of the green finance ecosystem, including (i) improving green finance standards, (ii) strengthening disclosure requirements, (iii) enhancing the incentive and restraint mechanisms, (iv) developing the product and market system of green finance, and (v) expanding international cooperation on green finance.

**8. Banks' sizeable green lending is driven by policy guidance.** Major Chinese banks are encouraged to extend loans that can be categorized as green to achieve satisfactory evaluation results.<sup>6</sup> In February 2012, the China Banking Regulatory Commission (CBRC) issued a guideline on the issuance of green credit, and the People's Bank of China (PBC) incorporated the green finance evaluation into its macroprudential policy assessment (MPA) in the third quarter of 2018.<sup>7</sup> While the policy guidance led to a significant increase in green loans within few years, such green lending is carried out under the Chinese regulatory framework, which differs from commonly accepted international standards in terms of eligibility of green projects, as well as use-of-proceeds and disclosure requirements. In general, banks are not intrinsically motivated to ensure that their funds are used to properly finance green investment. To promote greater transparency of banks' green lending, the PBC launched the Carbon Emission Reduction Facility (CERF) in November 2021 to provide low-cost funding to support financial institutions' lending to enterprises in the fields of clean energy, energy saving and environmental protection, and carbon emissions reduction technological development. To be eligible for the CERF, banks are required to disclose climate-related information on a loan basis.<sup>8</sup> As of end-June 2022, re-lending under the CERF amounted to RMB 182.7 billion.

**9. The updated Green Bond Endorsed Project Catalogue and China Green Bond Principles help bring the Chinese frameworks in line with commonly accepted international standards.** Previously, the non-alignment of onshore Chinese green bonds primarily resulted from the lenient

<sup>6</sup> Data suggests that even among banks with total assets more than RMB 1 trillion, the proportion of green loans in their total corporate lending is much larger for top-tier banks.

<sup>7</sup> In May 2021, the PBC enhanced its green finance evaluation scheme, which includes other green financial instruments (for example, green bonds) in addition to green loans.

<sup>8</sup> Another re-lending scheme was introduced in November 2021 to support the clean and efficient use of coal, with the current quota at RMB 300 billion. This re-lending scheme could be viewed as to support transition finance. As of June 2022, such re-lending amounted to RMB 35.7 billion.

use-of-proceeds requirements of certain onshore bonds (for example, exchange-traded bonds and enterprise bonds) and the inclusion of carbon-intensive projects in the taxonomy.<sup>9</sup> In April 2021, Chinese authorities issued the updated Green Bond Endorsed Project Catalogue, which adopted the principle of “do no significant harm” and removed carbon-intensive projects related to fossil fuels such as clean coal technology.<sup>10</sup> In July 2022, the Green Bond Standards Committee issued a new China Green Bond Principles, which stipulate that all of proceeds must be used to finance green projects.<sup>11</sup> These two updates, in principle, would help bring the Chinese green bond frameworks closer to commonly accepted international standards. The bond market regulators are working on regulations to implement the 2022 China Green Bond Principles.

**10. The guideline on environmental information disclosures for financial institutions was issued to enhance their transparency of climate-related risks and opportunities.** Stipulated by the PBC in July 2021, the guideline is applied to banks, insurers, asset managers, and other financial institutions. By setting disclosure requirements, the guideline implicitly requires financial institutions to (i) put in place their environment-related governance structure, (ii) articulate their environment-related strategies and internal policies, (iii) develop their business plans to provide environment-related financial products and services, and (iv) set up their environment-related risk management frameworks and their analytical capacity to analyze environment-related risks. The guideline appears consistent with the Task Force on Climate-related Financial Disclosures (TCFD)’s recommendations.<sup>12</sup> Financial institutions in the pilot exercise have prepared their reporting, but the timeframe for mandatory disclosures has not been set.

## D. Enhancing Market-oriented Climate Finance

**11. Despite the ongoing reform efforts, China has significant room to further strengthen its climate finance ecosystem to help meet the substantial financing needs for the transition toward a carbon-neutral economy.** Building on its already large, bank-dominant and policy-driven green finance, China should focus on the following actions to further develop its climate finance ecosystem: (i) strengthening the climate information architecture to enable market-oriented climate finance, (ii) improving banks’ accountability for climate investing, (iii) enhancing market-based climate financing, and (iv) developing transition finance. The development of climate finance should also be supported by effective carbon pricing to ensure that funding is directed to appropriate

<sup>9</sup> Enterprise bonds allowed up to 50 percent of proceeds to be used for debt repayment and working capital, while exchange-traded bonds required at least 70 percent of proceeds to be used for investment in green projects.

<sup>10</sup> The updated catalogue also serves as a single reference document that issuers and intermediaries can use for issuance, evaluation, and certification of green bonds.

<sup>11</sup> The Green Bond Standards Committee is overseen by the National Association of Financial Market Institutional Investors (NAFMII).

<sup>12</sup> The TCFD’s recommendations emphasize the disclosure of relevant information in four areas that include (i) the organization’s governance around climate-related risks and opportunities, (ii) its strategy, (iii) its risk management practices, and (iv) the key metrics and targets used to assess and manage the organization’s climate-related risks and opportunities.

climate-related investment (see April 2022 Global Financial Stability Report for more complete discussion).

### ***Strengthening the Climate Information Architecture***

#### **12. A robust climate information architecture that features high-quality data, proper definition, and appropriate disclosures, is the foundation for market-oriented climate finance.**

Market participants seek reliable and comparable climate-related data to conduct climate-related financial risk assessment and management. A well-developed taxonomy would help limit greenwashing and provide an anchor for relevant parties to move on the path consistent with the carbon neutrality objective. Meanwhile, appropriate disclosure requirements would improve the transparency on relevant parties' climate-related strategy, accountability, and risk management.

**13. A more robust national climate-related data framework could support China's transition toward a carbon-neutral economy and development of climate finance.** Similar to other economies, China is working to overcome data challenges.<sup>13</sup> Reportedly, data issues have hampered the operation of the national carbon trading system, while the onshore intermediation of green finance does not generally rely on external review of climate-related information. A more comprehensive mandatory disclosure regime can facilitate the preparation and compilation of key information such as carbon emissions as well as exposures to climate change in terms of both physical and transition risks.<sup>14</sup> Such data could be used to support carbon trading, financial institutions' management of climate-related financial risks, and climate adaptation efforts. Relevant parties, such as firms in carbon-intensive sectors, financial institutions, and listed firms should be subjected to mandatory disclosure requirements, while borrowers seeking banks' green loans should be required to provide relevant climate-related information. The quality of data should also be ensured by a robust internal control process and an independent review by external parties.

**14. China could further improve the green and climate taxonomy, which in turn could provide an anchor for the transition toward a carbon-neutral economy.** Building on its updated Green Bond Endorsed Project Catalogue, which is only relevant for the issuance of onshore green bonds, China could consider introducing a unified, economy-wide taxonomy that applies across financial products and economic activities, similar to the European Union. Furthermore, a transition taxonomy could be developed to complement the existing green taxonomy; this could help provide a clearer path for how carbon-intensive activities should be adjusted and/or phased out over time, consistent with the carbon neutrality objective (see further discussion in paragraph 22). In principle,

---

<sup>13</sup> Under the oversight of the Ministry of Ecology and Environment, only nonfinancial firms in certain heavy-pollution industries, as well as bond issuers that violate environmental laws, are subject to some mandatory disclosures of environmental information. Central state-owned enterprises are tasked to taking the lead in improving the disclosures, with their regular reporting (only for listed firms) being expected by 2023.

<sup>14</sup> The European Union's experience could provide an example for a comprehensive approach to sustainability-related reporting. The Corporate Sustainability Reporting Directive was adopted in April 2021, amending the existing reporting framework based on the Non-financial Reporting Directive. Key changes include: (i) extending the scope of reporting to all large firms and listed firms except micro enterprises, (ii) requiring the audit of reported information, and (iii) mandating the reporting requirement in accordance with the sustainability reporting standards.



the taxonomy should adhere to the “do no significant harm” principle, make material contributions to environmental goals and broader sustainability issues, be guided based on scientific evidence, and remain dynamic to reflect changes in technology and state of the transition.<sup>15</sup>

**15. Strengthening disclosure requirements could promote the transparency and accountability of climate finance and broader efforts to tackle climate change.** While the International Sustainability Standards Board (ISSB) is in the process of developing sustainability-related disclosure standards,<sup>16</sup> preparation for the adoption of these international disclosure standards could commence. In the interim, China can enhance its existing disclosure requirements by making them more aligned with the TCFD’s recommendations. The improvement of climate-related information would support risk management, facilitate capital allocation, strengthen investor protection, and promote market discipline. Mandatory disclosure requirements should apply to all financial institutions and financial market participants (including listed firms and green bond issuers).<sup>17</sup>

### ***Improving Banks’ Accountability for Climate Investing***

**16. Greater bank accountability of climate investing is essential, building on enhanced green lending practices and market-oriented mechanisms.** As the leading green finance investor, banks should be motivated to intermediate green and climate finance based on market-oriented incentives along with greater transparency. Simply forcing banks to expand their green lending to meet certain quantitative targets could exacerbate the credit misallocation. A more conducive approach would be to put in place a well-developed regulatory framework that ensures the availability and accuracy of relevant climate-related information and define a taxonomy consistent with the climate neutrality objective. The regulatory framework should also enhance the governance and accountability of banks’ climate financing to strengthen their climate investing responsibility, limit greenwashing and ensure appropriate climate-related risk management. The introduction of the Green Finance Guideline for Banking and Insurance Sectors by the China Banking and Insurance Regulatory Commission (CBIRC) was a step in the right direction (see further discussion in paragraph 24). Some policy support, such as subsidized funding and credit guarantees, could be employed, and the use of such policy support could be made conditional on meeting certain climate-related disclosures, similar to the PBC’s existing re-lending schemes. Furthermore, the benefit of subsidized funding could be made contingent on meeting the carbon emissions reduction target, broadly similar to the design of sustainability-linked debt.

<sup>15</sup> See the “[G20 Sustainable Finance Roadmap](#)” for more detailed discussion on how to foster the development of sustainable finance. The roadmap suggested six voluntary principles to develop the sustainable finance taxonomy, including accounting for transition finance considerations.

<sup>16</sup> The ISSB have published two proposed standards for public consultation. One is general requirements for disclosure of sustainability-related financial information; another is climate-related disclosures.

<sup>17</sup> The PBC issued a guideline on environmental information disclosures for financial institutions, but such disclosures remain voluntary. For listed firms, guidelines on ESG reporting remain absent, and existing reporting typically lacks relevant quantitative information such as carbon emissions.

### **Enhancing Market-Based Climate Financing**

**17. More vibrant market-based financing, along with a more diversified investor base, could significantly strengthen China's climate finance ecosystem.** As banks also face their own climate transition challenges, the availability of bank financing for certain entities and/or activities that do not have credible pathways to carbon neutrality could become constrained. Market-based financing could help fill such financing gaps by mobilizing private capital from a more diversified investor base. However, this requires improving green and climate financing instruments and fostering the development of green and sustainable investing in addition to the strong climate information architecture.

**18. China has taken steps to improve its green bond standards, but the rigorous implementation of the 2022 China Green Bond Principles would be key to limit greenwashing.**

While the updated Chinese standards appear broadly aligned with international best practices, a further improvement could be made in certain areas. An external review for pre-issuance assessment and post-issuance verification of proceeds management could be made mandatory, similar to the CBI's Climate Bonds Standard and the European Union's proposed Green Bond Standard.<sup>18</sup> In fact, a notable portion of Chinese green bonds do not feature any external review (Figure 3). Furthermore, a proper oversight of third-party evaluation and certification agencies is critical to ensure the credibility of disclosures by green bond issuers.<sup>19</sup> In addition to the external review, the Chinese standards could be further enhanced by (i) introducing a harmonized framework for impact reporting to improve information comparability and (ii) requiring bond issuers to consider social and environmental risks associated with the green projects to ensure appropriate risk management. The Chinese standards could also require bond issuers to be more transparent about the use of proceeds for refinancing existing green projects.

**19. Efforts to address existing credit mispricing issues in the onshore bond markets would also be helpful to the development of green and sustainable bond markets.**

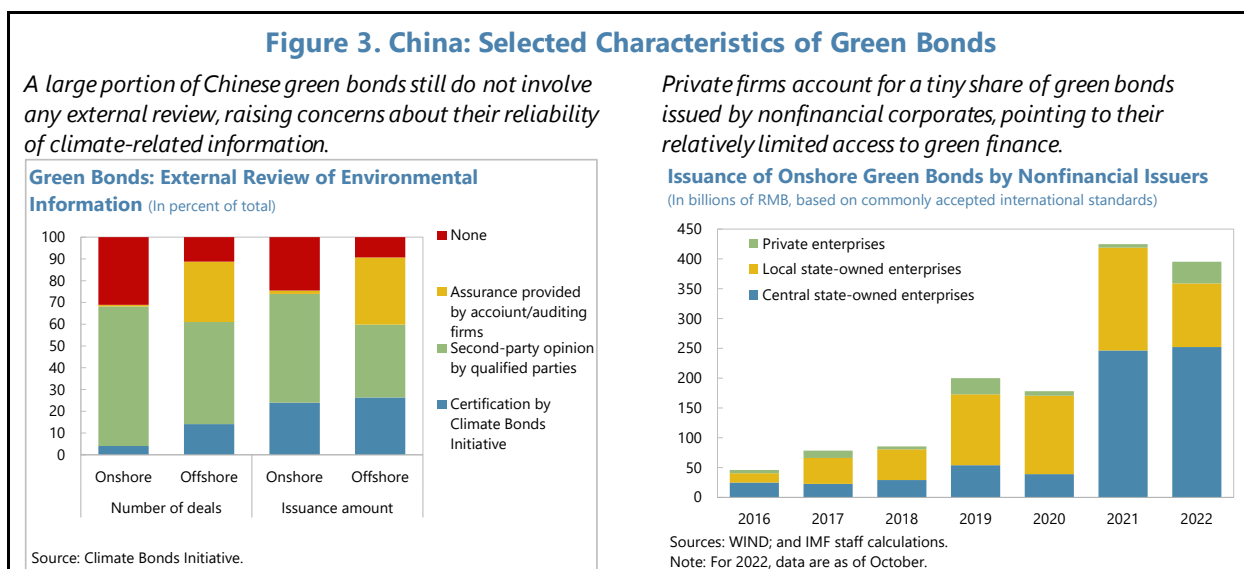
So far, private nonfinancial firms' access to green bond financing appears relatively limited especially in the onshore market, with their bond issuances accounting for 5 percent of total green bond issuances by nonfinancial firms. Market perception of implicit state support to state-owned enterprises and local government financing vehicles, which leads investors to be more willing to hold bonds issued by government-linked entities, should be phased out in an orderly manner. In addition, the credit ratings of onshore bonds could be improved with a greater transparency on issuers' financial strength on a standalone basis and related to potential government support.

**20. A well-developed policy framework can give an impetus to boost green and sustainable asset management activity.** At the moment, the lack of clear expectations and/or

<sup>18</sup> The International Capital Market Association's standards only recommend, but not require, the use of external review.

<sup>19</sup> In September 2021, the China Green Bond Standards Committee introduced operational rules for third-party evaluation and certification agencies. In September 2022, the first batch of 18 institutions were authorized to provide green bond assessment and certification services.

guidelines around investment strategies, disclosure requirements, as well as investment oversight and risk management, for green and ESG investment funds make it difficult for investors to properly make investment decisions to hold green assets. The regulatory framework should set clear investment and disclosure requirements for green and ESG investment products (including investment funds and wealth management products). Such investment products must adopt common green and/or ESG investment strategies (for example, screening, thematic, ESG integration and impact investment) as their primary investing strategy, with green and/or ESG assets accounting for the majority of their net asset value. Disclosure requirements at the offering stage should be adequate to enable investors to make appropriate investment decisions, particularly including information on investment strategy, asset allocation, reference benchmark, and investment risks.



## Developing Transition Finance

**21. There would be huge demand for transition finance as China embarks on the transition journey toward a carbon-neutral economy.** Carbon-intensive sectors' ability to obtain financing has diminished amid growing concerns about climate-related risks. However, these sectors still need funding to undergo the transition—for instance, some activities can adopt existing technology to reduce carbon emissions even if a pathway to zero emissions still does not exist (for example, retrofits of airline fleets), or to support the phasing-out of stranded assets (for example, capture and utilization of gas). In recent years, China has been developing financing instruments to support the climate transition (for example, sustainability-linked bonds and hybrid green bonds),<sup>20</sup> and some Chinese entities have issued transition bonds overseas in accordance with international standards.

**22. The development of transition finance should, in principle, aim to support the transition toward a carbon-neutral economy and not to maintain stranded assets.** A number of

<sup>20</sup> The 2022 China Green Bond Principles also introduced a new type of green bonds, which features both use-of-proceeds requirements and performance-based financing costs.

jurisdictions and international bodies have been developing transition finance standards. Based on emerging concepts of transition finance, the following guidance could help develop the transition finance policy framework in China.

- The transition taxonomy aligned with China's climate objectives would better serve the country's climate vision.** For international bodies, the transition taxonomy is set to be aligned with the Paris Agreement. For China, the transition taxonomy could be defined to be consistent with its carbon peaking and carbon neutrality objectives. The concept of transition does not mean that activities are green right now; however, credible transition pathways should exist, consistent with science-based evidence and ambitious timeframes. Qualifying transition activities should not involve activities that would lock in the use of high carbon-emissions technology over an extended period. The G20 Sustainable Finance Working Group also suggested that the transition taxonomy should be dynamic, reflecting technological advancement, developmental priorities, and the overall climate policy setting. Transition should also be orderly, just, and affordable (see the [2022 G20 Sustainable Finance Report](#) for more complete discussion).
- The transition concept can cover carbon-intensive sectors and interim activities.** As an example, the CBI's framework considers five categories for transition finance—(i) near-zero activities (also green); (ii) activities with existing pathways to zero (potentially both green and transition); (iii) investment that supports significant carbon emissions reduction for activities with no pathways to zero (for example, international aviation); (iv) interim activities that are currently needed but should be phased out (for example, energy from municipal waste); and (v) investment that helps phase out stranded activities, which cannot be adjusted to align with carbon neutrality but have alternative low-carbon substitutes (for example, electricity generation using coal). Enabling activities—that is, activities that provide essential goods and services to qualifying green and transition activities—would also be eligible for transition finance.
- A transition finance framework, including taxonomy and underwriting standards, is essential to support the development of transition finance.** The transition taxonomy can complement the existing green taxonomy. Some jurisdictions, such as the European Union, have developed the taxonomy that encompasses both green and transition components. In general, guiding principles for green finance standards—that is, use of proceeds, process for project evaluation and selection, management of proceeds, and reporting—should remain applicable for transition financing instruments. In terms of financial products, some market participants are advocating for debt financing instruments with use-of-proceeds requirements for eligible transition projects and determination of financing costs contingent on environmental performance.

## E. Managing Climate-Related Financial Risks

**23. Carefully monitoring and proactively managing climate-related risks can help safeguard financial stability.** Chinese banks' lending to carbon-intensive sectors is non-negligible. Major Chinese banks extended nearly 30 percent of their total loans to firms in utilities and energy,

transportation and logistics, and manufacturing sectors, which tend to feature carbon-intensive activities. Climate-related transition risks could materialize during the transition toward a low-carbon economy prompted by changes in climate policy, technological advancement, and market sentiment, resulting in some stranded assets and inducing losses to financial institutions.

**24. China should incorporate climate-related risks into the prudential policy and market conduct frameworks, especially through better sustainability disclosures.** To safeguard financial stability amid climate-related risks, financial supervisors should enhance their capacity to handle climate-related risks, including supervisory processes, data collection and analytical capability. In June 2022, the CBIRC issued the Green Finance Guideline for Banking and Insurance Sectors to outline supervisory expectations on how banks and insurers should manage climate-related risks,<sup>21</sup> complementing the PBC's existing guideline on environmental information disclosures. The CBIRC expects banks and insurers to put in place an appropriate arrangement for governance, strategy, and risk management to manage climate-related risks within one year.<sup>22</sup> Building on these existing guidelines, additional efforts could be made to ensure that financial institutions properly account for climate-related risks.

- **Setting supervisory expectations.** Supervisory expectations should be set for all financial institutions, and their progress of managing climate-related risks should be monitored as part of regular supervisory processes.<sup>23</sup> Financial institutions should put in place an appropriate arrangement for governance, strategy (including investment management for asset managers), risk management, and disclosures to manage climate-related risks. The board of a financial institutions should be accountable for its climate resilience and responsible for overseeing its climate strategy. Climate considerations should be embedded in the financial institution's overall strategy from formulation to implementation, while climate-related risks should be identified, measured, monitored, and managed. Relevant climate-related information should also be disclosed; for investment funds, disclosures should also be at the investment product level.
- **Promoting climate-focused stress testing and scenario analysis.** Given that the nature of climate-related risks requires a forward-looking approach, stress testing and scenario analysis can help financial institutions to assess the impact of climate change on their businesses.<sup>24</sup> With

<sup>21</sup> The guideline is only applied to large commercial banks, policy banks, and insurers (including reinsurance companies and insurance asset management firms).

<sup>22</sup> The guideline also requires an appointment of a senior personnel to oversee green finance work and the incorporation of ESG consideration into decision-making on extending financing. The pricing of financing and other services should also be differentiated based on clients' ESG performance.

<sup>23</sup> The Hong Kong SAR's experience could also provide an example on how to integrate climate-related risks into the prudential policy framework. The Hong Kong Monetary Authority adopted a [three-phased approach](#) to promote green and sustainable banking—first, assessing the “greenness baseline” of individual banks; second, developing supervisory expectations and requirements on green and sustainable banking; and third, monitoring banks' progress of managing climate-related risks.

<sup>24</sup> The PBC conducted a pilot climate stress testing exercise for 23 major banks in 2021. The exercise focused on assessing the impact in the case that firms in the thermal power, steel and cement sectors do not carry out necessary actions to secure a successful transition toward a low-carbon economy.

a better understanding of risks, financial institutions can embed climate considerations into their business processes and take appropriate actions to mitigate identified risks. Due to uncertainties around how climate change would evolve over the longer term, financial institutions should thus assess the impact of climate change under different pathways.

- **Ensuring adequate capital buffers.** To some extent, the prudential policy framework already captures climate-related risks as traditional financial risks like credit, market and operational risks could be amplified by climate change. However, regulatory capital requirements under Pillar 1 framework could be inadequate. Pillar 2 capital requirements could be employed to ensure that financial institutions maintain sufficient capital buffers to absorb potential losses based on the identified climate-related exposures.
- **Avoiding using preferential risk weights.** The international community of financial supervisors started examining the linkages between climate-related risks and regulatory capital, but empirical evidence on risk differential between green and non-green exposures is still limited. In the absence of clear evidence on the relationship between financial risks and greenness of exposures, using preferential risk weights to incentivize green finance (or punitive risk weights to discourage “brown” finance) would be incompatible with the risk-based regulatory approach.

**25. The PBC could take into account of climate change when carrying out its policy functions and other duties.** The Network for Greening the Financial System (NGFS) recommended central banks to make climate-related disclosures with a focus on governance, strategy, and risk management. Central banks should disclose (i) the high-level approach to climate-related risks and opportunities, (ii) the climate-related governance structure around monetary policy, asset management, financial stability, and internal operations, (iii) the strategy for identifying and assessing climate-related risks, as well as measures regarding climate-related risks and opportunities, and (iv) the risk management of climate-related exposures, which could be associated with investment portfolios and credit facilities. The risk management aspect is particularly relevant for the PBC given its sizeable foreign reserves and growing climate-related re-lending schemes. In addition, the PBC could consider publishing a sustainability report to set an exemplar on how financial institutions should approach their climate-related disclosures.<sup>25</sup>

**26. Financial stability issues related to climate change could also be embedded into the authorities’ systemic risk oversight.** In addition to the efforts to incorporate climate-related risks into microprudential and market conduct oversight, it is important that similar efforts are undertaken by relevant authorities for systemic risk analysis and mitigation. Climate change could amplify existing macro-financial vulnerabilities such as elevated indebtedness, credit mispricing, and weaknesses of some small banks, and a macroprudential approach is warranted to properly manage climate-related risks over a long-term horizon.

---

<sup>25</sup>Authorities in some jurisdictions have published sustainability reports. See the Monetary Authority of Singapore’s [Sustainability Report](#) as an example.

## F. Conclusion

**27. China is leading the world in developing green finance, but more remain to be done to strengthen its financial system's capacity to finance the climate transition successfully.** China already possesses a large climate finance ecosystem whose rapid growth has been mainly driven by policy guidance. Going forward, its further development would need to be underpinned by market-oriented mechanisms, enabling financial institutions and financial market participants to dynamically respond to the demand for climate finance. To secure a vibrant climate finance ecosystem, China could consider taking further actions in the following aspects:

- Strengthening the foundation for well-functioning, market-oriented climate finance by improving the quality and comparability of data, setting proper green and transition definitions, and ensuring appropriate climate-related disclosures,
- Improving banks' accountability for climate investing, supported by enhanced climate-related lending practices and market-oriented mechanisms,
- Deepening market-based climate financing and developing a more diversified investor base, to complement the existing bank-dominant green finance intermediation,
- Enhancing the standards of green and climate financing instruments, with a particular focus on improving the reliability of information via credible external reviews, to ensure the transparency critical to enable proper investment decisions, limit greenwashing, and avoid getting locked in stranded assets, and
- Developing the transition finance framework that is aligned with the overall climate objective, with an aim to finance a credible climate transition.

**28. At the same time, China should take further actions to enhance its financial system's resilience against climate change.** While providing funding to support their clients' green investment and broader climate transition efforts, financial institutions also need to proactively adjust their business models and manage climate-related physical and transition risks. As climate change could amplify existing macro-financial vulnerabilities and heighten financial stability concerns, China should adopt a proactive approach to safeguard financial stability, with key actions including:

- Incorporating climate-related risks into the prudential policy and market conduct frameworks by setting supervisory expectations and requirements on developing a sustainable business in response to climate change and monitoring financial institutions' progress,
- Mandating appropriate disclosure requirements to ensure the transparency of financial institutions' actions and improve their accountability, and

- Strengthening systemic risk oversight by accounting for climate change considerations, enhancing the analytical capacity and closing data gaps to assess climate-related exposures, and ensuring sufficient capital buffers to absorb potential losses induced by climate change.



## References

Chen, Yulu. 2021. "Green Finance's 'Three Functions' and 'Five Pillars' for Realizing "30-60 Goals." Available at the People's Bank of China's [website](#).

China Banking and Insurance Regulatory Commission. 2022. "Green Finance Guidelines for Banking and Insurance Sectors." Chinese version available at the State Council's [website](#).

Chinese authorities. 2016. "Guidelines for Establishing the Green Financial System." Available at the People's Bank of China's [website](#).

\_\_\_\_\_. 2021. "Green Bond Endorsed Projects Catalogue", Available at the People's Bank of China's [website](#).

Climate Bonds Initiative. 2020. "Financing Credible Transitions: How to Ensure Transition Label Has Impact." Climate Bonds White Paper. Available at Climate Bonds Initiative's [website](#).

\_\_\_\_\_. 2022. "Green Bond China Investor Survey 2022." Available at Climate Bonds Initiative's [website](#).

Climate Bonds Initiative, and CECEP Hundred Technical Service (Beijing) Co., Ltd. 2022. "Transition Finance in China: Latest Development and Future Outlook." Available at Climate Bonds Initiative's [website](#).

Climate Bonds Initiative, and China Central Depository & Clearing Research Centre. 2022. "China Green Bond Market Report 2021". Available at Climate Bonds Initiative's [website](#).

Climate Bonds Initiative, and SynTao Green Finance. 2022. "China Green Finance Policy: Analysis Report 2021." Available at Climate Bonds Initiative's [website](#).

European Commission. 2021. "FAQ: What Is the EU Taxonomy and How Will It Work in Practice?"

Green Bond Standards Committee. 2022. "China Green Bond Principles." Available at National Association of Financial Market Institutional Investors' [website](#).

G20 Sustainable Finance Working Group. 2021. "G20 Sustainable Finance Roadmap". Available at G20 Sustainable Finance Working Group's [website](#).

\_\_\_\_\_. 2022. "G20 Sustainable Finance Report". Available at G20 Sustainable Finance Working Group's [website](#).

International Capital Market Association. 2020. "Climate Transition Finance Handbook: Guidance for Issuers." Available on International Capital Market Association's [website](#).

International Monetary Fund. 2022. "Scaling up Private Financing in Emerging Market and Developing Economies: Challenges and Opportunities", *Global Financial Stability Report*. Washington.

Liu, Guiping. 2021. "On Leveraging the Financial Market to Achieve the Goal of Carbon Peaking and Carbon Neutrality." Speech at the 13th Lujiazui Forum. Available at the People's Bank of China's [website](#).

Ministry of Ecology and Environment. 2021. "The Plan for the Reform of the Legal Disclosure System of Environmental Information." Chinese version available at Ministry of Ecology and Environment's [website](#).

Monetary Authority of Singapore. 2022. *Sustainability Report 2021/2022*. Singapore.

Network for Greening the Financial System. 2021. "Progress Report on the Guide for Supervisors." Technical Document, October.

\_\_\_\_\_. 2021. "Guide on Climate-related Disclosures for Central Banks." Technical Document, December.

\_\_\_\_\_. 2022. "Enhancing Market Transparency in Green and Transition Finance." Technical Document, April.

\_\_\_\_\_. 2022. "Capturing Risk Differentials from Climate-related Risks: A Progress Report." Technical Document, May.

People's Bank of China. 2021. "Guidelines for Financial Institutions on Environmental Information Disclosures." Chinese version available at the Financial Industry Standard of the People's Republic of China's [website](#).

State-owned Assets Supervision and Administration Commission. 2022. "Work Plan for Improving the Quality of Listed Companies Held by Central Enterprises." Chinese version available at the State Council's [website](#).

Task Force on Climate-related Financial Disclosures. 2017. "Recommendations of the Task Force on Climate-related Financial Disclosures".

# SUSTAINABLE AND BALANCED GROWTH IN THE LONGER TERM<sup>1</sup>

*China's potential growth has slowed, and the economy is facing several headwinds expected to further lower potential growth in the medium to long term. Comprehensive structural reforms to lift productivity growth and foster rebalancing towards more sustainable and less investment-driven growth can significantly improve the growth outlook.*

## A. Introduction

**1. After decades of high growth, the Chinese economy has started slowing and is facing headwinds that are projected to lower potential growth substantially in the longer term.** First, with its rapidly aging population, the Chinese economy is expected to have fewer people entering the labor force, which will diminish growth prospects (IMF, 2017). Second, productivity growth has slowed significantly, and as China edges closer to advanced economy status and the technology frontier, its aggregate productivity growth is expected to eventually decline further (Madsen and others, 2010). What is unique in the case of China is the additional pressure from diminishing returns of investment-led growth, as excessive investment—driven by record-high domestic savings—has been channeled towards relatively less productive SOEs, activities such as real estate, which are less growth-enhancing over the longer term, and to further increase China's already comparatively very large public capital stock. This pattern of investment in China has sped up the decline in aggregate productivity, and hence, potential growth.

**2. Structural reforms and rebalancing China's growth towards a more consumption-based growth path would help transition to "high-quality"—balanced, inclusive, and green—growth.** This paper provides updated estimates of China's potential growth over the medium- to long-term. We establish a baseline scenario of China's growth prospects and study an illustrative reform scenario and its impact on potential growth that tackles the slowdown in potential growth. Reforms that simultaneously enhance productivity growth, facilitate rebalancing towards consumption against the backdrop of an adjustment of the current zero-COVID strategy (ZCS), and steer against the demographic headwinds are the most promising.

## B. Background

**3. China's potential growth decelerated in the decade between the global financial crisis and the pandemic.** While China's high growth rates in the early 2000s were—from the supply-side—largely driven by increases in productivity following the WTO accession and rapid accumulation of capital, they were accompanied by increasing imbalances on the demand side. In the decade before the pandemic, productivity growth slowed, including because of increasingly less productive investment, and domestic demand-side imbalances further increased.

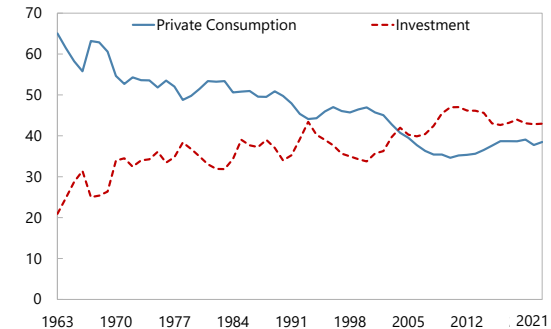
<sup>1</sup> Prepared by Anne Oeking, Natalija Novta, and Fan Zhang.

**4. Chinese households have an exceptionally high savings rate, also reflected in its low consumption share in GDP.**

High household savings have been driven by precautionary savings due to gaps in the social protection system and falling job security, in addition to China's aging population (IMF, 2022; and Zhang and others, 2018). During the pandemic, recurrent COVID outbreaks under the zero-COVID policies have further increased household savings amid high uncertainty, weaker labor markets, and subdued private consumption. This high savings rate is reflected in China's rising share of investment in GDP over time, coupled with a falling share of consumption.

**Investment and Private Consumption**

(In percent of GDP)



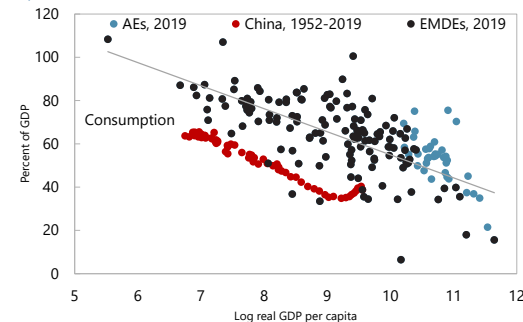
Sources: National authorities; and IMF staff calculations.

**5. High domestic savings have fueled increasingly unsustainable levels of investment.**

With increasing per capita income, countries tend to have a lower share of consumption and a higher share of investment in GDP. For China, however, the reduction in the share of consumption and the increase in the share of investment by far exceed the changes implied by the level of its GDP per capita observed elsewhere (Text Figures), leaving China with one of the highest investment-to-GDP ratios and a particularly low consumption-to-GDP share in international comparison. The extraordinarily high amount of savings has been channeled into investments that helped support high growth rates, especially in the 2000s. Later, however, a substantial amount of investment went to relatively less productive sectors which, beyond the short-term effect on GDP, provided diminishing support to China's growth potential over the long run.

**Consumption Across Countries vs. China Over Time**

(In percent)

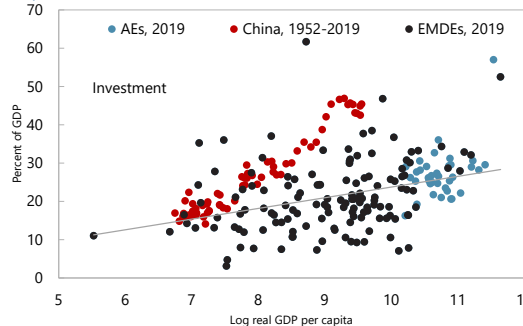


Sources: Penn World Table, 10.0 and IMF staff calculations.

Note: AEs = Advanced economies; EMDEs = emerging market and developing economies.

**Investment Across Countries vs. China Over Time**

(In percent)



Sources: Penn World Table, 10.0 and IMF staff calculations.

Note: AEs = Advanced economies; EMDEs = emerging market and developing economies.

**6. Following the Global Financial Crisis**

**(GFC), China's growth has become increasingly dependent on investment in infrastructure and housing.** To maintain high growth rates in the wake of the global recession, the authorities ramped up infrastructure investment. In addition, households channeled their high savings increasingly towards housing, including for speculative motives, and real estate investment became one of the main drivers of growth, with the real estate sector accounting for around 20 percent of China's GDP. This was made possible by high savings and excessive credit growth (Text Figure) accompanied by sharply rising debt levels across the economy, particularly in the real estate sector and the

government, with the augmented government debt-to-GDP ratio reaching more than 100 percent in recent years.<sup>2</sup>

### 7. China's investment-led growth strategy has been facing rapidly diminishing returns.

Vulnerabilities have risen—as shown by the ongoing crisis in the real estate sector—and strong investment in infrastructure and housing has been associated with falling returns to capital (Brandt and others, 2020). The marginal product of capital, in aggregate, has been falling (Text Figure). While China's capital stock is still considerably below that of advanced economies, this suggests resource misallocation and build-up of excess capacity in some parts of the economy.

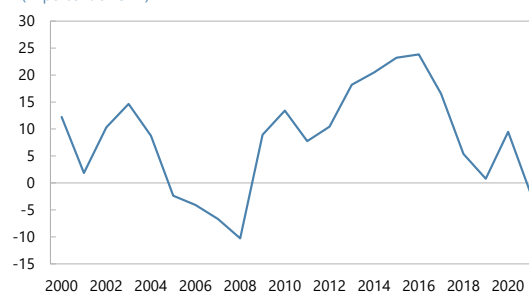
### 8. Productivity growth in China's manufacturing sector has been falling amid a large SOE presence.

Compared to infrastructure and real estate investment, manufacturing investment has grown more slowly in the previous decade with less evidence of excessiveness. Yet several studies show that China's manufacturing productivity growth slowed considerably following the global financial crisis (Brandt and others, 2020; and Cerdeiro and Ruane, 2022), linked to declining business dynamism and a significant presence of less-productive state-owned enterprises (SOEs). Detailed analysis using manufacturing firm-level data indicates that the responsiveness of capital growth to the marginal product of capital has declined in recent years, and that large productivity gaps between SOEs and private firms persist (Jurzyk and Ruane, 2021; and Cerdeiro and Ruane, 2022).

## C. Approach and Historical Decomposition

9. We rely on a standard supply-side production function approach to estimate potential growth. Standard growth accounting frameworks decompose output into contributions

**Credit to GDP Gap**  
(In percent of GDP)

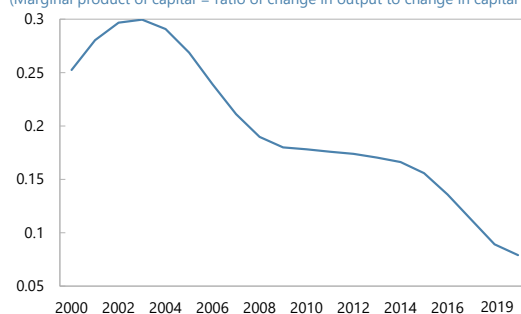


Source: BIS.

Note: The credit-to-GDP gap shows the deviation of credit from all sectors to the private non-financial sector from its HP-filtered trend.

**Marginal Product of Capital**

(Marginal product of capital = ratio of change in output to change in capital stock)

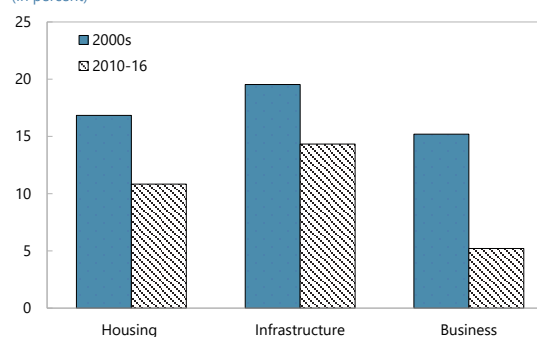


Sources: Penn World Table, 10.0 and IMF staff calculations.

Note: Ratio has been smoothed using HP filter.

**Average Growth Rate of Sectoral Investment**

(In percent)



Sources: Herd (2020); and IMF staff calculations.

<sup>2</sup> Augmented debt is comprised of official general government debt (central and explicit local government debt, including general and special local government bonds and other recognized off-budget liabilities incurred by end-2014) and off-budget liabilities estimated by staff (debt of local government financing vehicles, government-guided funds, and special construction funds).

from physical capital, labor, human capital (i.e., the skill-level of the labor force) and total factor productivity (TFP). TFP measures an economies' efficiency, i.e., the output produced for a given level of inputs. Our potential growth estimates are based on a standard Cobb-Douglas production function:

$$Y_t = A_t K_t^\alpha (L_t h_t)^{1-\alpha}$$

with  $Y$  = real GDP,  $A$  = TFP,  $K$  = capital stock (derived from investment  $I$  and depreciation rate  $\delta$  via the perpetual inventory method),  $L$  = labor,  $h$  = human capital,  $\alpha$  = elasticity of output to capital,  $1 - \alpha$  = elasticity of output to labor, and  $t$  = years. In the historical decomposition, TFP is derived as the residual of the production function (see Annex I). Historical data is described in Annex II.

**10. One adjustment to the standard approach is a sectoral decomposition to capture the impact of sectoral rebalancing.** We incorporate sectoral factor reallocation between the primary, secondary and tertiary sectors, and split total TFP into within-sector productivity and productivity gains from sectoral reallocation (see Annex I).<sup>3</sup> Data constraints do not allow us modelling the real estate sector separately. Instead, the sector is incorporated as part of the secondary sector.

**11. We make the simplifying assumption that parameter  $\alpha$  remains constant.** The elasticity of output to input factors is oftentimes approximated by their shares in incomes, as this is the case when firms are profit-maximizing under perfect competition and the production function has constant returns to scale. However, given labor and capital misallocations in China (see e.g., Hsieh and Klenow, 2009), factor prices might not adequately represent their marginal productivities. In line with the literature (see Albert and others, 2015), we thus use conventional coefficients  $\alpha = 0.4$  and  $1 - \alpha = 0.6$ .

**12. When decomposing historical output, we use Chen and Kang's (2018) estimates of sustainable GDP growth—i.e., growth without excessive credit expansion—rather than actual GDP growth.** Sustainable output is the level of GDP that an economy can sustainably produce over the medium term in the absence of imbalances. Post-GFC, Chinese GDP and investment growth were supported by excessive credit growth, with the nonfinancial private sector credit-to-GDP ratio increasing by 45 percentage points during 2012-2016. Without excessive credit growth and the private sector credit gap, Chen and Kang (2018) estimate that nonfinancial private sector credit-to-GDP would have increased by around 10 percentage points over the same period. They note that credit efficiency—the amount of credit needed for a unit increase in nominal GDP—deteriorated sharply during the post-GFC period, pointing to growing resource misallocation as capital increasingly grew in relatively less productive sectors, such as real estate. When deriving sustainable GDP, Chen and Kang (2018) use counterfactual credit efficiency, assuming it remains in line with the previous trend, thus deteriorating less than the actual. We extend their analysis until 2018, when China's credit gap was largely closed according to BIS estimates. Following these adjustments, we

<sup>3</sup> We will refer to the main sectors of China's economy as the primary, secondary, and tertiary sectors. The primary sector encompasses agriculture, forestry, animal husbandry and fishery industries, the secondary sector includes not only manufacturing, but also construction, mining and quarrying, and production and supply of utilities. The tertiary sector encompasses all other industries.

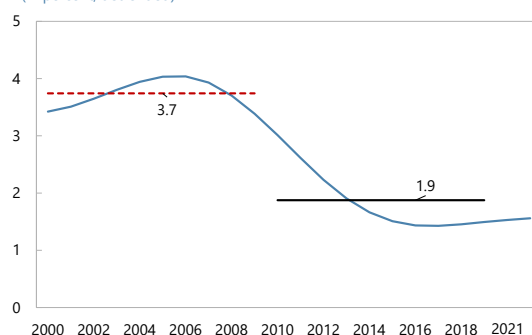
find that average sustainable real GDP growth for 2012-18 would have been 5.3 percent rather than actual GDP growth of 7.2 percent.

**13. TFP growth fell sharply over the last decade.** We derive historical TFP growth as the residual of the production function based on the estimated sustainable level of GDP growth. The decomposition shows that aggregate TFP growth sharply fell from 3.7 percent in the 2000s to 1.9 percent from 2010-19. While these numbers diverge from other estimates of TFP growth (see Text Figure), all point to a significant slowdown in the last decade.

**14. Within-sector TFP growth rates have also fallen across all sectors since the 2000s, similar to aggregate TFP growth rates.** Our sectoral decomposition shows that within-sector TFP growth fell from averages of around 3-4 percent in the 2000s to 1 percent or less in the 2010s (see Text Figure). TFP levels are highest in the secondary sector, though the level of TFP in the tertiary sector is starting to catch up to that in the secondary sector thanks to slightly higher TFP growth rates in the tertiary sector in recent years. Finally, as more resources have moved out of the primary sector and into the more productive secondary and tertiary sectors, factor reallocation across sectors is contributing toward aggregate TFP growth, so that aggregate TFP growth exceeds within-sector TFP growth rates.

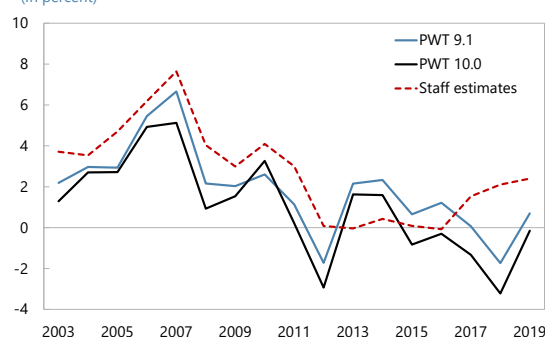
**15. Overall, we find that China's potential growth has fallen from a peak of around 10 percent to less than 5 percent.** The historical decomposition shows China's potential growth peaked in 2005-06 and has fallen since in line with weaker productivity growth, less productive capital, and a shrinking workforce. For 2021, we estimate potential growth of 4.7 percent, with weaker TFP growth explaining the largest part of the drop from its peak.

**Estimated Aggregate TFP Growth**  
(In percent, detrended)



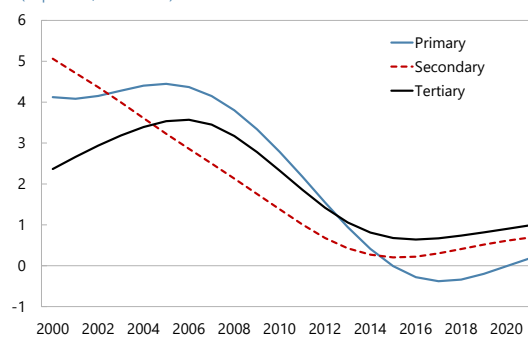
Source: IMF staff estimates.

**TFP Growth Estimates**  
(In percent)



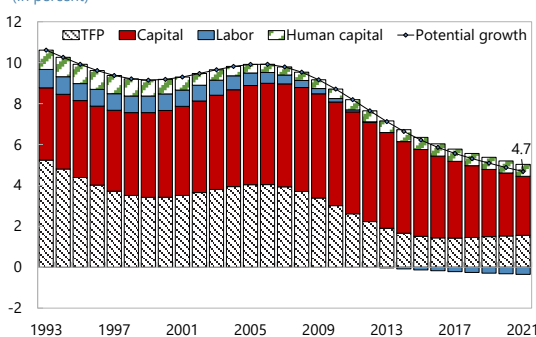
Sources: Penn World Tables; and IMF staff estimates.

**Sectoral TFP Growth Estimates**  
(In percent, detrended)



Source: IMF staff estimates.

**Potential Growth**  
(In percent)



Source: IMF staff estimates.

## D. Forecast Scenarios

**16. We provide estimates of China's potential growth over the medium- to long-term under a baseline and an upside scenario.** With our upside scenario, we aim to illustrate one possible path of China's potential growth under a set of simultaneous reforms—a best-case scenario. We use a bottom-up approach to forecast each of the factors in our production function. Forecast scenarios are derived by projecting and changing assumptions of the input factors to the production function.

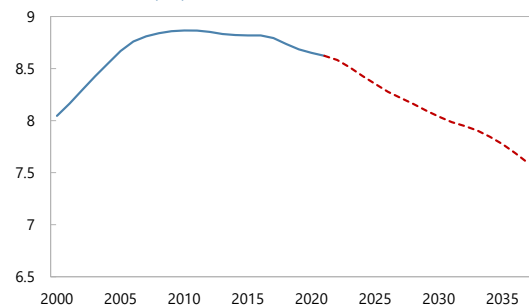
### **Baseline scenario**

**17. In our baseline scenario, we assume no significant structural reforms, but a return to pre-pandemic trends following the lifting of the zero-COVID strategy in 2023.** The baseline assumes the following developments (see Text Table):

- *Labor* evolves in line with the UN's medium fertility growth scenario. This implicitly assumes that the average retirement age of 54 will remain constant. In the absence of significant rebalancing, sectoral labor shares converge to advanced economy shares only by 2050.
- *Human capital* will continue growing at its current rate, i.e., assumes no lasting scarring from ZCS.
- *Investment*: In the absence of significant reforms towards rebalancing, investment is assumed to remain a large share of GDP, even as it grows less than before. In line with trends in the household savings rate and demographics, we assume the investment-to-GDP ratio will fall by about 1 percentage point in the long term from its current level. Slow factor reallocation implies capital stock shares converge to current advanced economy shares only by 2050.
- *TFP*: Within-sector TFP growth is assumed to remain constant at its current level, which—as discussed above—is at the higher end of different available estimates. Additionally, sectoral reallocation will continue in line with the assumptions on labor and capital shares, with the reallocation share in total TFP gradually falling over time.

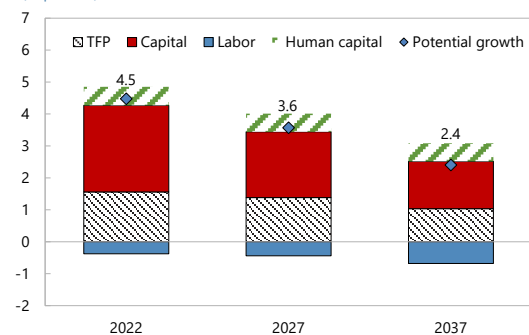
**18. Our baseline scenario suggests that potential growth is going to slow considerably over the medium- to long-term.** We find that potential GDP growth rates could drop to about 4

**Estimated Workforce**  
(In hundred thousand people)



Sources: United Nations, Department of Economic and Social Affairs, Population Division (2022). World Population Prospects 2022; and IMF staff calculations.

**Potential Growth Estimate, Baseline**  
(In percent)



Source: IMF staff estimates.



percent on average between 2023-27 and 3 percent on average over 2028-37, implying per capita growth rates of similar magnitude over the same horizon. This compares to averages of around 6 percent sustainable GDP growth, 7 percent actual GDP growth, and 6 percent real per capita GDP growth over the last 10 years.

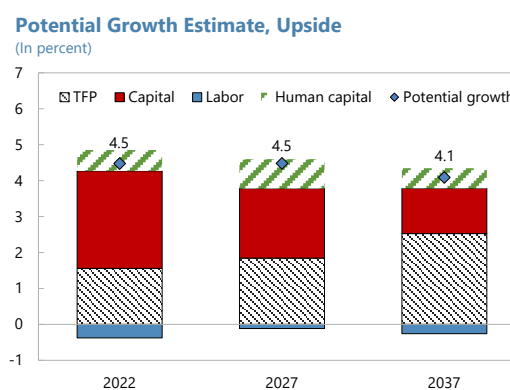
Scenario Assumptions in the Production Function		
	Baseline	Upside
$K$	Investment-to-GDP ratio falls in line with savings rate by about 1 percent until 2050 (based on demographics & income).	Investment-to-GDP ratio falls to advanced economy (AE) average of 22 percent over 15 years.
$K_i$	Convergence to shares in AEs by 2050.	Convergence to AE shares within 15 years.
$L$	Total workforce in line with UN population projections, medium fertility scenario.	Retirement age gradually moves by 10 years (from 55 to 65) for females and by 5 years (from 60 to 65) for males over long-run.
$L_i$	Return to pre-pandemic trends; by 2050 convergence towards AE sectoral employment shares.	Reallocation towards services and AE shares over reform horizon of 15 years.
$h$	Continues to grow at current rate.	Human capital converges to current AE level within 15 years.
$A_i$	Stays constant at pre-pandemic growth rate.	No change for primary sector; secondary sector TFP lifted by 6 percent over 15 years on top of baseline to close SOE productivity gap plus 1ppt higher growth over 15 years from higher market dynamism; tertiary sector TFP improves with labor reallocation by 0.05ppt per 1ppt higher labor share.

### Upside scenario

**19. To illustrate the scope for reform, the upside scenario assumes several growth-enhancing reforms compared to the baseline.** Reforms are phased in linearly over 15 years starting in 2023. The main assumptions are the following (see Text Table for the production function assumptions):

- *SOE reforms:* Implementation of SOE reforms help close the SOE-POE productivity gap in the manufacturing sector by improving resource allocation and deleveraging among SOEs. Jurzyk and Ruane (2021) estimate the counterfactual productivity gap to be around 6 percent. We assume this gap to extend to the entire secondary sector and to be closed by year 2038. We make the simplifying assumption that productivity reform alone will not have an impact on rebalancing.

- *Market dynamism:* Pro-market reforms improve business dynamism, with higher firm entry and exit boosting productivity. In line with findings in Brandt and others (2020), we assume these reforms would boost productivity in the secondary sector by 1 percentage point over the reform horizon.
- *Demand-side rebalancing:* A budget-neutral re-composition of fiscal expenditures toward households, including strengthening the social protection system (IMF, 2022), supports a reduction of the excessively high household savings rate and rebalancing toward consumption, triggering an expansion of services and consumer industries and associated investment. Consequently, the investment -to-GDP share is assumed to fall by around 18 percentage points over the reform horizon as it converges to current advanced economy ratios, implying an improvement in the ratio of private consumption of a similar magnitude. Sectoral reallocation of labor and capital will occur faster than under the baseline scenario as higher consumption implies more demand for services, increasing factor demand in the sector relative to the other sectors.<sup>4</sup> Reallocation of resources from less productive to more productive sectors is assumed to boost tertiary sector TFP by 0.05 percentage points per additional percentage point of higher labor share (see Nabar and N'Diaye, 2013) on the back of higher investments and within-sector reallocation over the reform horizon.
- *Retirement age reform:* To address changing demographics, labor market reforms gradually lift the retirement age from 60 (male) and 55 (female) to 65 over the long run, thus enlarging the potential workforce. This is in line with suggestions in IMF (2022).
- *Education reform:* Reforms that further improve access to and enhance the quality of education boost human capital, with human capital converging to current advanced economy levels over the reform horizon.
- We find that potential growth would be significantly higher under our upside scenario than the baseline over the reform period. The scenario implies average GDP growth rates of about 4.5 percent between 2023-37 and a similar per capita growth rate. The reforms are estimated to lift the level of real GDP by around 2.5 percent by 2027 compared to the baseline scenario, and by around 18 percent by 2037, with the bulk of the benefits stemming from productivity-enhancing reforms (Text Figure). Combined



<sup>4</sup> The rise of the tertiary sector and the decline or leveling-off of the secondary sector need not hinder economy-wide productivity growth even as aggregate productivity in the secondary sector is higher. Market-based service subsectors, such as finance and telecommunications, have labor productivity growth as high or higher than the manufacturing sector in a cross section of countries (IMF, 2018). In China's case, Zhu and others (2019) show how sectoral transitions within the manufacturing and services sector based on significant variation in productivity within those sectors could be an important buffer to moderate a productivity slowdown. In addition, resolving resource misallocation would help outweigh downward pressures.

with a re-orientation of fiscal resources toward household support, domestic consumption would increase significantly, with the higher consumption share of GDP by around 18 percentage points in 2037 translating to an improvement in consumption of 75 percent over the same time period.

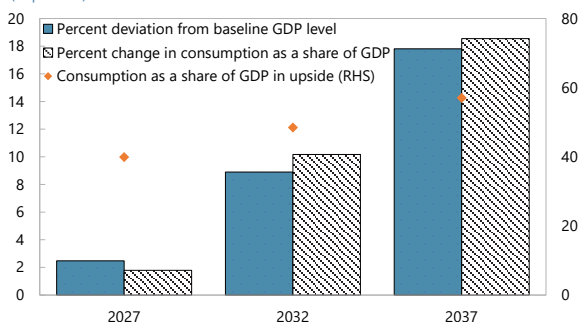
**20. These reform policies would also ensure growth benefits are shared more broadly and offer faster progress towards China's climate goals.** In particular, China would not only narrow the gap to advanced economies in terms of per capita GDP (Text Figure) but—thanks to the lower energy intensity of a more balanced GDP growth—make faster progress towards its climate goals, with the direct effect on CO<sub>2</sub> emissions a reduction of about 15 percent by 2037 (Chateau and others, 2022). Productivity enhancing SOE reforms could also support decarbonization goals, especially since estimates suggest that SOEs generate about half of the country's total GHG emission (Clark and Benoit, 2022), while typically having easier access to credit.

**21. Finally, growth would also be less risky.** Under the same path for fiscal policy, higher growth would reduce augmented public debt by 2037 from 173 percent of GDP under the baseline to 146 percent of GDP in the upside scenario. This would create additional fiscal space the authorities could build as a buffer. The corporate debt burden would also fall, mainly because of higher growth. The reduction in saving rates would also make the economy less prone to asset bubbles and provide a sustainable driver for non-real estate investment.

## E. Conclusion

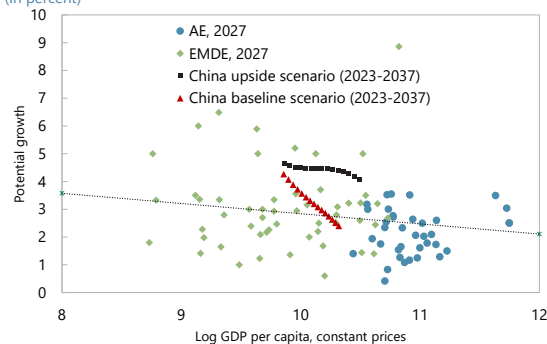
**22. China's potential growth has started falling and several headwinds suggest it will continue to slow, showing the need for comprehensive reforms of China's growth model.** With an ageing population, slowing aggregate productivity, as well as record-high investment rates that have pushed investment into less productive sectors, potential growth under a baseline medium- to long-term scenario is expected to fall. Without reform efforts, aging and declining productivity would likely continue to suppress growth over the long term, beyond our forecast horizon. These pressing factors suggest the need to rebalance away from the investment-led, carbon-intensive, growth model towards more sustainable growth drivers, in particular consumption. Such a demand-side transformation could be an important step on China's path to an advanced economy. Additional downside risks, such as a prolonged adherence to zero-COVID policies, geoeconomic

**Gains Over the Reform Period in Upside Scenario**  
(In percent)



Source: IMF staff estimates.

**Potential Growth in the Cross-Section**  
(In percent)



Sources: IMF World Economic Outlook; and IMF staff estimates.

fragmentation and reduced technology knowledge exchange amid technological decoupling, could further dampen short- to medium-term prospects.

**23. Under a comprehensive reform scenario, steps to lift productivity growth and foster rebalancing towards sustainable, less investment-driven growth can significantly raise China's growth potential.** A return to market-based structural reforms addressing productivity issues could lift aggregate TFP. In addition, reallocating capital between SOEs and POEs and from infrastructure and real estate into more productive manufacturing or services sectors would help lift overall productivity. SOE reforms to enhance productivity in the use of carbon-intensive inputs, while stimulating innovation in renewables, could also support growth. Furthermore, to shift reliance towards more sustainable demand drivers, moving to more consumption-based growth would expand the services sector and rebalance away from excessive, low-productivity investment. These policies would not only raise growth and output levels, but reduce risks, raise welfare, and make growth more sustainable, balanced, and green.

## Annex I. Methodology

We rely on a standard Cobb-Douglas production function describing the supply side of output:

$$Y_t = A_t K_t^\alpha (L_t h_t)^\beta \quad (1)$$

with  $Y$  = real GDP,  $A$  = total factor productivity (TFP),  $K$  = capital stock (derived from investment  $I$  and depreciation rate  $\delta$  via the perpetual inventory method),  $L$  = labor,  $h$  = human capital,  $\alpha$  = elasticity of output to capital,  $\beta$  = elasticity of output to labor, and  $t$  = years.

By log-linearizing and taking first differences, we can express equation (1) in growth rates, with  $\hat{X}$  denoting the growth rate of variable  $X$ :

$$\hat{Y}_t = \hat{A}_t + \alpha \hat{K}_t + (1 - \alpha) \hat{L}_t + (1 - \alpha) \hat{h}_t \quad (2)$$

Potential growth  $\widehat{Y}_t$  is thus defined by the following equation, taking into account the trend  $\bar{X}$  of each variable  $X$  (derived through a Hodrick-Prescott filter) to abstract from the business cycle:

$$\widehat{Y}_t = \widehat{A}_t + \alpha \widehat{K}_t + (1 - \alpha) \widehat{L}_t + (1 - \alpha) \widehat{h}_t \quad (3)$$

In the historical decomposition, TFP is derived as the residual of the production function:

$$\hat{A}_t = \hat{Y}_t - \alpha \hat{K}_t - (1 - \alpha) \hat{L}_t - (1 - \alpha) \hat{h}_t \quad (4)$$

We adjust equation (3) by also taking into account a sectoral decomposition, in which each sector  $i$  = primary, secondary, tertiary sector is described by a Cobb-Douglas production function analogous to the economy-wide function:

$$Y_{i,t} = A_{i,t} K_{i,t}^\alpha (L_{i,t} h_{i,t})^{(1-\alpha)} \quad (5)$$

With  $Y_t = \sum_{i=1}^3 Y_{i,t}$  and  $\hat{Y}_{i,t} = \hat{A}_{i,t} + \alpha \hat{K}_{i,t} + (1 - \alpha) \hat{L}_{i,t} + (1 - \alpha) \hat{h}_{i,t}$ , assuming  $\alpha$  the same across all sectors and human capital  $\widehat{h}_{i,t} = \widehat{h}_t$ , we can decompose overall TFP from equation (4) into a within-sector TFP growth component and a reallocation factor:

$$\hat{A}_t = \underbrace{\sum_{i=1}^3 \left(\frac{Y_i}{Y}\right) \hat{A}_i}_{\text{Within-sector TFP growth}} + \underbrace{\alpha \sum_{i=1}^3 \left(\frac{Y_i}{Y} - \frac{K_i}{K}\right) \hat{K}_i + (1 - \alpha) \sum_{i=1}^3 \left(\frac{Y_i}{Y} - \frac{L_i}{L}\right) \hat{L}_i}_{\text{Factor reallocation across sectors}} \quad (6)$$

Within-sector TFP growth      Factor reallocation across sectors

And can thus express potential growth as:

$$\widehat{Y}_t = \widehat{A}_t^{\text{within}} + A_t^{\text{reallocation}} + \alpha \widehat{K}_t + (1 - \alpha) \widehat{L}_t + (1 - \alpha) \widehat{h}_t. \quad (7)$$

## Annex II. Data

CI. Real GDP (from NBS); sectoral GDP shares based on nominal GDP shares.

CII. Capital stock sourced from Herd (2020), extended by the perpetual inventory method using real gross fixed capital formation (staff estimates based on NBS data) and depreciation rates from Herd (2020). Sectoral capital stock based on Wu (2016) for the initial period and subsequent investment shares based on sectoral shares in fixed asset investment. This data is based on urban investment and thus likely underestimates investment in the primary sector.

CIII. Labor is proxied by the working age population (15-59 for males, 15-54 for females); sectoral labor is based on employment shares by sector, sourced from NBS.

CIV. Human capital is based on an index from Penn World Tables 10.0, based on average years of schooling and returns to education.

## References

- Acemoglu, Daron, Philippe Aghion, and Fabrizio Zilibotti, 2006, "Distance to frontier, selection, and economic growth," *Journal of the European Economic Association* Vol. 4, no. 1, pp. 37-74.
- Albert, Marie, Cristina Jude, and Cyril Rebillard, 2015, "The Long Landing Scenario: Rebalancing from Overinvestment and Excessive Credit Growth. Implications for Potential Growth in China," Banque de France, Document de Travail no. 572.
- Bailliu, Jeannine, Mark Kruger, Argyn Toktamyssov, and Wheaton Welbourn, 2016, "How Fast Can China Grow? The Middle Kingdom's Prospects to 2030," Bank of Canada Working Paper no. 2016-15.
- Borio, Claudio, Piti Disyatat, and Mikael Juselius, 2013, "Rethinking potential output: Embedding information about the financial cycle," BIS Working Paper no. 404.
- Brandt, Loren, John Litwack, Elitza Mileva, Luhang Wang, Yifan Zhang, and Luan Zhao, 2020, "China's Productivity Slowdown and Future Growth Potential," World Bank Policy Research Working Paper no. 9298.
- Cerdeiro, Diego, and Cian Ruane, 2022, "China's Declining Business Dynamism," IMF Working Paper no. 22/32.
- Chateau, Jean, Wenjie Chen, Florence Jaumotte, and Karlygash Zhunussova, 2022, "A Comprehensive Package of Macroeconomic Policy Measures for Implementing China's Climate Mitigation Strategy," IMF Working Paper no. 22/142.
- Chen, Sally, and Joong Shik Kang, 2018, "Credit Booms—Is China Different?" IMF Working Paper no. 18/2.
- Clark, Alex, and Philippe Benoit, 2022, "Greenhouse Gas Emissions From State-Owned Enterprises: A Preliminary Inventory," New York: Columbia Center on Global Energy Policy.
- Dizioli, Allan, Benjamin Hunt, and Wojciech Maliszewski, 2016, "Spillovers from the Maturing of China's economy," IMF Working Paper no. 16/212.
- Gulen, Huseyin, and Mihai Ion, 2015, "Policy Uncertainty and Corporate Investment," *The Review of Financial Studies* Vol. 29 (3).
- Herd, Richard, 2020, "Estimating Capital Formation and Capital Stock by Economic Sector in China—The Implications for Productivity Growth," World Bank Policy Research Working Paper no. 9317.
- Hsieh, Chang-Tai, and Peter J. Klenow, 2009, "Misallocation and Manufacturing TFP in China and India," *The Quarterly Journal of Economics*, Vol. 124(4), pp. 1403–1448.
- International Monetary Fund (IMF), 2017, "Asia: At Risk of Growing Old before Becoming Rich?" Chapter 2 in Asia Pacific Region, Regional Economic Outlook, April 2017: Washington, DC.

\_\_\_\_\_, 2018, "Manufacturing Jobs: Implications for Productivity and Inequality," Chapter 3 in the World Economic Outlook, April 2018: Washington, DC.

\_\_\_\_\_, 2022, "People's Republic of China: Selected Issues," IMF Country Report No. 22/22 (Washington: International Monetary Fund).

Jurzyk, Emilia, and Cian Ruane, 2021, "Resource Misallocation Among Listed Firms in China: The Evolving Role of State-Owned Enterprises." IMF Working Paper no. 21/75.

Kim, Soyoun, Jong-Wha Lee, and Warwick J. McKibbin, 2018, "Asia's Rebalancing and Growth," *The World Economy* Vol. 41, pp. 2709–2731.

Liu, Guanchun, and Chengsi Zhang, 2020, "Economic policy uncertainty and firms' investment and financing decisions in China," *China Economic Review* Vol. 63 101279.

Madsen, Jakob B., Md Rabiul Islam, and James B. Ang, 2010, "Catching up to the technology frontier: the dichotomy between innovation and imitation," *Canadian Journal of Economics/Revue canadienne d'économique* Vol. 43.4, pp. 1389-1411.

Nabar, Malhar and Papa N'Diaye, 2013, "Enhancing China's Medium-Term Growth Prospects: The Path to a High-Income Economy," IMF Working Paper no. 13/204.

Wu, Yanrui, 2016, "China's Capital Stock Series by Region and Sector," *Front. Econ. China* Vol. 11(1), pp. 156–172.

Zhang, Longmei, R. Brooks, Ding Ding, Haiyan Ding, Hui He, Jing Lu, and Rui Mano, 2018, "China's High Savings: Drivers, Prospects, and Policies," IMF Working Paper no. 18/277.

Zhu, Min, Longmei Zhang and Daoju Peng, 2019, "China's Productivity Convergence and Growth Potential—A Stocktaking and Sectoral Approach," IMF Working Paper no. 2019/263.