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INTERNATIONAL FINANCE FORUM

INTERNATIONAL FINANCE FORUM (IFF)

GLOBAL FINANCE AND DEVELOPMENT REPORT 2023

October 2023

INTERNATIONAL FINANCE FORUM

About IFF

The International Finance Forum (IFF) is an independent, non-profit, non-governmental international organisation founded in Beijing in October 2003, established by financial leaders from more than 20 countries and regions, including China, the United States, the European Union, emerging countries and leaders of international organisations such as the United Nations, the World Bank and the International Monetary Fund (IMF). The IFF is a long-standing, high-level platform for dialogue and communication and multilateral cooperation and has been upgraded to F20 (Finance 20) status.

The International Finance Forum (IFF) advocates an international and market-oriented operation mechanism to advance the supportive role of finance in sustainable development through its platforms of strategic dialogue, co-operation, communication, practice and innovation, research and training programme.

Our Mission

Upholding the spirit of "Comprehensive and Sustainable Development – New Capital, New Value, New World", since the founding in 2003, the International Finance Forum (IFF) has been committed to building itself into a world-class academic think-tank and multilateral dialogue platform with strategic insight.

Our Goals

The International Finance Forum (IFF) operates based on an open, transparent and fair mechanism to ensure its independence, objectivity, foresight and inclusiveness and to facilitate global financial co-operation and exchanges. Through in-depth research on global finance, IFF is committed to promoting sustainable development of China and the world economy. Our targets include:

1. International Financial Strategic Dialogue Platform
2. International Financial Cooperation & Exchange Platform
3. International Financial Innovation & Practice Platform
4. International Financial Strategic Think-Tank Platform
5. International Financial Talents Platform

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Preface

The International Finance Forum (IFF) has been publishing the Global Finance Development Report (Report) during the IFF Annual Meeting since 2021. Based on a wide range of international data, the Report tracks and researches on major global issues to promote the role of finance services in supporting economic recovery and sustainable development. It analyzes and forecasts global economic trends and outlook, offers in-depth analysis on financial development and innovation, and discusses global challenges and policies.

The Report consists of four chapters. Chapter one, Global Economic Outlook, Risks and Policy Priorities, is written by ZHUANG Juzhong, IFF Academic Committee member and former deputy chief economist of Asian Development Bank(ADB) and WANG Xuesong. Chapter two, Global Financial Market Review and Outlook, is written by XIA Le, IFF Academic Committee member and chief economist for Asia at BBVA Research, and CAI Jinghan. Chapter three, with a focus on the Review and Outlook on Global Green Finance Innovation and Policy Development, is co-authored by LU Xuedu, IFF Academic Committee member and former lead climate change specialist at East Asia Department of Asian Development Bank(ADB), and LIANG Xi, REN Jiying, ZHAO Yang and WANG Xiaoqing. Chapter four, Big Data, Artificial Intelligence and Blockchain Finance, is co-authored by SONG Min, IFF Academic Committee member and former dean of economics and management school of Wuhan University, and SI Haitao and LIU Kehua.

Initiated by major global economic entities and international organizations including the UN, the IFF is a platform for international financial dialogues and a leading academic think tank. Since its founding 20 years ago, the IFF has built close relations with more than 200 global political and financial leaders from more than 50 countries and regions as well as more than 50 international and regional organisations. The IFF will continue to use its platform to promote strategic financial dialogues, international communications and cooperation, innovation, research and talent cultivation. The IFF dedicates its platform for world rld leading academic research and multilateral dialogues.

Zhang Jizhong
CEO / Founding Secretary General
Director of Executive Committee
International Finance Forum (IFF)

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Attachment one: Glossary

英文缩写	英文全称	中文
ACMF	ASEAN Capital Markets Forum	东盟资本市场论坛
ASEAN SLBS	ASEAN Sustainability-linked Bond Standards	东盟可持续发展相关债券标准
ASEAN SRFS	ASEAN Sustainable and Responsible Fund Standards	东盟可持续和负责任基金标准
CAR	Climate Action Reserve	气候行动储备
CBAM	Carbon Border Adjustment Mechanism	碳边境调整机制
CBI	Climate Bonds Initiative	气候债券倡议组织
CBS	Climate Bond Standard	气候债券标准
CCER	China Certified Emission Reductions	中国核证减排量
CDM	Clean Development Mechanism	清洁发展机制
CGT	Common Ground Taxonomy	共同分类目录
CIS	ASEAN Collective Investment Scheme	集体投资计划
COP15	Conference of Parties 15	第 15 次缔约方大会
COP26	Conference of Parties 26	第 26 次缔约方大会
COP27	Conference of Parties 27	第 27 次缔约方大会
COP28	Conference of Parties 28	第 28 次缔约方大会
COP30	Conference of Parties 30	第 30 次缔约方大会
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation	国际航空碳抵消和减排计划
Eps	Equator Principles	赤道原则
EU ETS	EU Emissions Trading System	欧盟排放权交易系统
G7	Group of Seven	七国集团

英文缩写	英文全称	中文
GFANZ	Glasgow Financial Alliance for Net Zero	格拉斯哥净零金融联盟
GLP	Green Loan Principles	绿色贷款原则
GS	Golden Standard	黄金标准
ICAP	International Carbon Action Partnership	国际碳行动伙伴
ICMA	International Capital Market Association	国际资本市场协会
IFF	International Finance Forum	国际金融论坛
IFRS	International Financial Reporting Standards	国际财务报告准则
IMF	International Monetary Fund	国际货币基金组织
IPSF	International Platform on Sustainable Finance	可持续金融国际平台
IRA	Inflation Reduction Act	通胀削减法案
ISSB	International Sustainability Standards Board	国际可持续发展标准委员会
ITC	Investment Tax Credit	美国太阳能投资税减免
JEPT	Just Energy Transition Partnership	公正能源转型伙伴关系计划
LMA	Loan Market Association	贷款市场协会
LTS	Long-term strategies	远景发展战略
MRV	Monitoring, Reporting, and Verification	监测、报告和核查
NDC	Nationally Determined Contributions	国家自主贡献
OECD	Organisation for Economic Co-operation and Development	经济合作与发展组织
PCAF	Partnership for Carbon Accounting Financials	碳核算金融联盟
RSF	Reform-Supporting Financing	改革配套融资
RST	Resilience and Sustainability Trust	韧性和可持续性信托
SDGs	Sustainable Development Goals	联合国可持续发展目标
SDRs	Special Drawing Rights	特别提款权

英文缩写	英文全称	中文
SLLP	Sustainability Linked Loan Principles	可持续相关贷款原则
SRI	Socially Responsible Investment	社会责任投资
TCFD	Task force on Climate related Financial Disclosure	气候变化相关财务信息披露指南
TTF	Title Transfer Facility	所有权转让设施
UCT	Upper-Credit-Tranche	特指 IMF 的较高信用级别的信贷额度（一个国家在 IMF 信贷额度的前 25%）
UNEP	United Nations Environment Programme	联合国环境规划署
UNFCCC	United Nations Framework Convention on Climate Change	联合国气候变化公约
VCS	Verified Carbon Standard	核证自愿减排标准
WTO	World Trade Organization	世界贸易组织

Chapter 1:
Global economic outlook, risks and policy priorities°

Global economic growth slowed further in 2023 due to the sharp tightening of monetary policy to contain inflation across the world. Growth has also been negatively affected by the continuation of the Russia-Ukraine war and lingering effects of negative shocks of the COVID-19 pandemic. The global economy is now projected to grow 3.1% this year, down from 3.4% in 2022, with the advanced countries combined growing 1.5% and developing economies as a group expanding 4.1%. In 2024, with tight monetary policy and financial conditions set to continue, global growth is expected to remain weak at 3.1%, with the advanced countries growing 1.3% and developing economies expanding 4.3%.

Global inflation moderated in 2023 on the back of monetary policy tightening, weaker global growth, softening of world commodity prices especially energy prices, and continued improvement of global supply conditions. Global consumer price inflation rate is projected to decline to 7% in 2023, down from 9.2% in 2022, with prices rising by 4.6% in advanced countries and 8.6% in developing economies. In 2024, as tight monetary and financial conditions continue to dampen demand growth and pandemic-induced supply-side bottlenecks ease further, global inflation is projected to moderate to 5.8%, with prices rising by 2.8% in advanced countries and 7.8% in developing economies.

This outlook is subject to several downside risks. Compared with current expectations, inflation pressures could turn out to be more persistent; monetary and financial condition tightening could lead to more episodes of bank failure and financial instability in the advanced countries and more widespread debt distress in the developing world; geo-political tensions could intensify and lead to greater geo-economic and -financial fragmentations; and growth of the Chinese economy, which contributes about one third of global growth, could be lower than anticipated. If these risks materialize, global growth would be lower, and global inflation may also turn out to be higher.

To reduce the risks and support global economic recovery and growth, the global community should work together to address both short- and longer-term challenges. Monetary policy should continue the fight against inflation, while maintaining financial stability and ensuring a soft landing for the global economy. Fiscal policy should be geared toward consolidating fiscal positions while protecting vulnerable groups. Structural reform should address binding constraints to long-term growth. Countries should pursue international cooperation and multilateralism in dealing with common challenges, including reducing poverty, protecting environment and mitigating climate change, resolving cross-country conflicts and reducing geo-political tensions.

❶ The cutoff date for data used in this report is the mid-September 2023.

1.1 Economic outlook

Global growth slowed further this year due to the sharp tightening of monetary policy, and is likely to remain weak in 2024.

After a significant weakening in 2022, global economic growth has slowed further this year due to the sharp tightening of monetary policy to contain inflation across the world. Growth has also been negatively affected by the continuation of the Russia-Ukraine war and lingering effects of negative shocks of the COVID-19 pandemic. The Group of 20 (G20) countries, which represents about 80% of the global economy, grew 2.8% in the first quarter of 2023 and 3.5% in the second quarter, compared with the same quarter last year. The same growth rates were 1.8% and 2.5% for the United States (US); 4.5% and 6.3% for China; 1.1% and 0.4% for the European Union (EU); and 1.8% and 1.7% for Japan, respectively ((Fig. 1.1 (a) and Fig.1.1 (b)).

The consensus view of markets now is that the global economy will grow about 3.1% this year, down from 3.4% in 2022 (using country

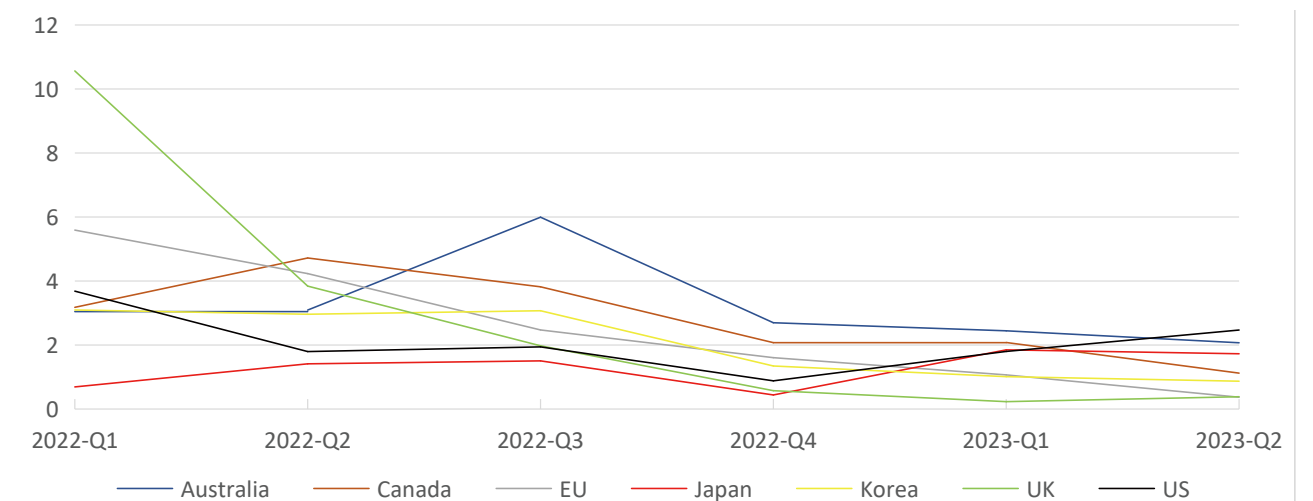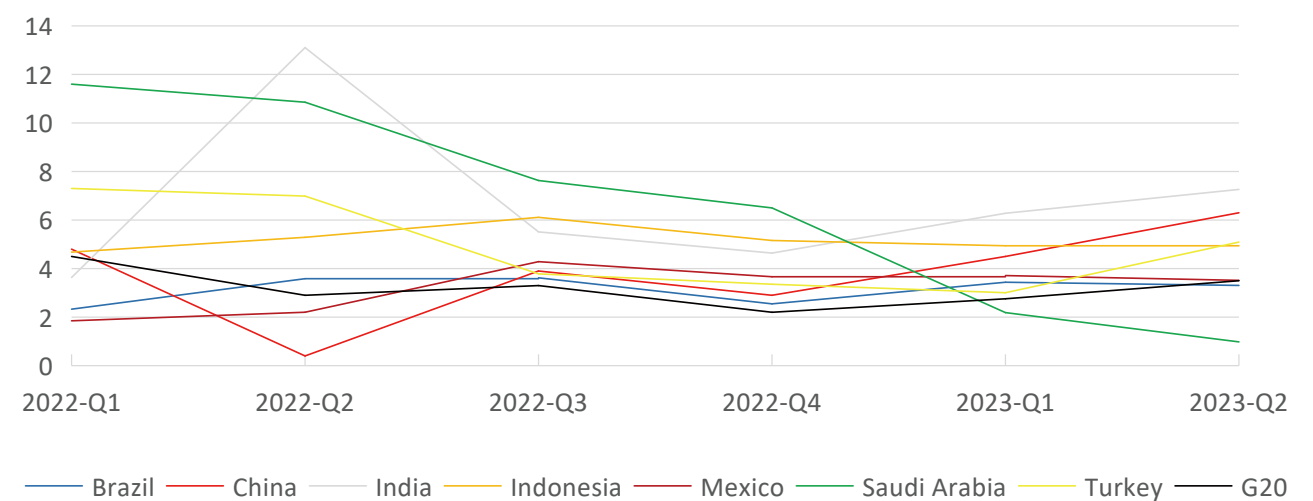Fig. 1.1 (a): Quarterly GDP growth (y-o-y, %), developed G20 economies

Fig. 1.1 (b): Quarterly GDP growth (y-o-y, %), selected G20 developing economies

Source: The OECD Statistics web site, accessed 15 September 2023.

weights at the PPP exchange rates) (Table 1.1). The advanced economies combined will grow 1.5% and developing economies as a group will expand 4.1%. But there are large variations in the pace of growth across countries, reflecting differential levels of inflation and pace of monetary policy tightening, the strength of growth in 2022, and some region- and country-specific developments. At these rates, the advanced economies will contribute 20% of the global growth in 2023, and developing economies will contribute 80%. Across regions, developing Asia will contribute 60%, North America 11%, Middle East & North Africa 8%, Latin America & Caribbean 6%, high-income Asia 5%, the EU and Sub-Saharan Africa each 4%, and developing Europe 3%. Across countries, China will remain the largest source of global growth, contributing about 32%, followed by India at 15%, and the US at 10%.

Global recovery is set to continue in 2024, but remains weak. With the COVID-19 pandemic finally over, it no longer constitutes a significant drag on global growth. The cycle of monetary tightening is likely to end in most countries next year. However, the monetary and financial conditions will remain tight and their lagging effects will continue to dampen demand growth and limit the pace of global recovery. Against this background, the global economy is projected to grow 3.1% in 2024, the same rate as this year, with the advance economies combined growing 1.3% and developing countries as a group expanding 4.3%.

Among major groups of economies, developing Asia is to grow 5.2% in both 2023 and 2024; high income Asia 2% in 2023 and 1.7% in 2024; developing Europe 1.7% and 2%; the EU 0.8% and 1.5%; Latin America and Caribbean 2.4% and 2.4%; Middle East and North Africa 2.9% and 3.2%; North America 1.9% and 1.2%; Sub-Saharan Africa 3.6% and 4.1%; ASEAN 4.6% and 4.9%; BRICS countries 4.9% and 4.6%; the G20 group 3% and 2.9%; and one-belt-one-road economies 3.7% and 3.9%, respectively.

Among major economies, the US is projected to grow 2% in 2023, slightly down from 2.1% in 2022. The US economy has so far proved resilient to the sharp tightening of monetary policy, with household spending buoyed by steady job growth and pay rises and factory investment spurred by the government's fiscal incentives. In July 2023, the Federal Reserve (Fed) raised interest rates for the 11th time since March 2022, bringing the Fed funds rate to a target range of 5.25-5.5%, the highest level in more than 20 years, but in its September policy meeting, it left the rate unchanged, amid significant reduction in inflation, while not ruling out more rate hiking in coming months. The Fed will continue its fight against inflation by keeping the rates at high levels not seen for many years for a considerable period of time. On the other hand, the Inflation Reduction Act of 2022 that provides incentives for investment in a number of sectors will help offset somewhat negative impacts of the tight monetary and financial conditions. Against these considerations, growth is projected to slow down to 1.2% in 2024. A key risk to growth outlook is that monetary tightening ends too soon leading to a resurge of inflation or too late pushing the economy into recession and leading to more episodes of bank failure and financial instability.

Th EU is projected to grow 0.8% in 2023 and 1.5% in 2024, down from 3.7% in 2022. The slowdown was mainly due to high inflation and monetary tightening curtailing domestic demand. The continued Russia-Ukraine war also affects consumer and business confidence. The European Central Bank (ECB) in September 2023 pushed through a 10th increase in a row in interest rates since July 2022, leaving its main lending rate at 4.5%. It has also started to trim its balance sheet. Among the three largest EU member economies, France is projected to grow 0.9% and 1% in 2023 and 2024, respectively, Italy to grow 0.7% in both years, and Germany is projected to contract by 0.4% this year but grow 0.9% next year. With underlying price pressures remaining high, the ECB

is expected to continue its tight monetary policy and maintain the interest rates at the current level for an extended period in order to achieve the 2% inflation target. But the disbursement of EU funds should support growth. A key risk to growth outlook is the escalation of the Russia-Ukraine war leading to soaring energy prices and a significant dampening of consumer and business confidence.

China is projected to grow 5.2% in 2023 and 5% in 2024, up from 3% in 2022. The pickup in growth is mainly due to the phasing out of its dynamic zero-COVID policy at the end of last year returning the economy back to normal. Economic data in recent months show some weakening in growth momentum due to a number of factors, including soft household consumption, declining housing investment, and sluggish exports (declining by 5.6% in the first 8 months in US dollar terms), although the August and September data showed some improvements. To support growth, the government in late July rolled out 20 measures to help promote consumer spending. Measures among others include liberalizing car-buying restrictions, encouraging the purchase of new energy vehicles, supporting housing demand by first-time buyers and for upgrading, increasing consumption of home improvement and household electronics, and promoting sports, recreation, eating-out, tourism and consumption of health services. To boost business confidence of the private sector, the government also unveiled a series of measures to encourage private investment, including improved access to some key sectors and financing support. The government will continue to take actions to ensure the orderly resolution of debt problems of some large property developers and sustainability of local government finance, and monetary and fiscal policies will continue to support recovery. Key risks to growth outlook include a deeper than expected downturn in the housing sector, a deepening of local government debt stress, and weaker than expected external demand.

ASEAN as a group is projected to grow 4.6% in 2023 and 4.9% in 2024, down from 5.7% last year. The slowdown reflected a number of factors, including rising inflation, monetary tightening by central banks across the region, and weaker demand for manufactured exports from key trading partners. However, domestic demand remains strong, and private consumption has continued to be the primary driver of economic growth, backed by improved labour market conditions and increases in income. Continued recovery of the services sector, particularly tourism, also supported growth. Among major economies of ASEAN, Indonesia is projected to grow 4.9% and 5%, the Philippines 5.8% and 6%, Malaysia 4.5% and 4.9%, Singapore 1.2% and 2.5%, Thailand 3.6% and 3.8%, and Viet Nam 5.6% and 6.3%, in 2023 and 2024, respectively. A key risk to growth outlook is weaker than expected global growth leading to further deterioration of external demand.

Inflationary pressures remain elevated globally, but moderated amid tight monetary and financial conditions, and is likely to moderate further in 2024.

The global inflation, while it remained elevated, has moderated since the second half of 2022, as central banks around the world tightened monetary policy. The average monthly year-on-year inflation rate for the G20 economies declined from its recent peak of 9.5% in 2022 to 6.3% in August 2023. The declines were driven mainly by developed countries as they drove the recent inflation surge. Among these countries, the monthly year-on-year CPI inflation declined from the 2022 peak of 9.1% in the US, 11.5% in the EU, 11.1% in the UK, 8.1% in Canada, and 6.3% in Korea to 3.7%, 5.9%, 6.7%, 4%, and 3.4%, respectively, in August 2023 (Fig.1.2 (a)). The decline in inflation has been more limited for developing G20 economies as a whole, although Brazil, Mexico, South Africa, and Turkey also saw large declines, with the monthly rate declining from the 2022 peak of 12.1%, 8.7%, 8.1% and 85.4% to 4.6%, 4.6%,

Fig. 1.2 (a): CPI inflation (y-o-y, %), selected G20 developed economies
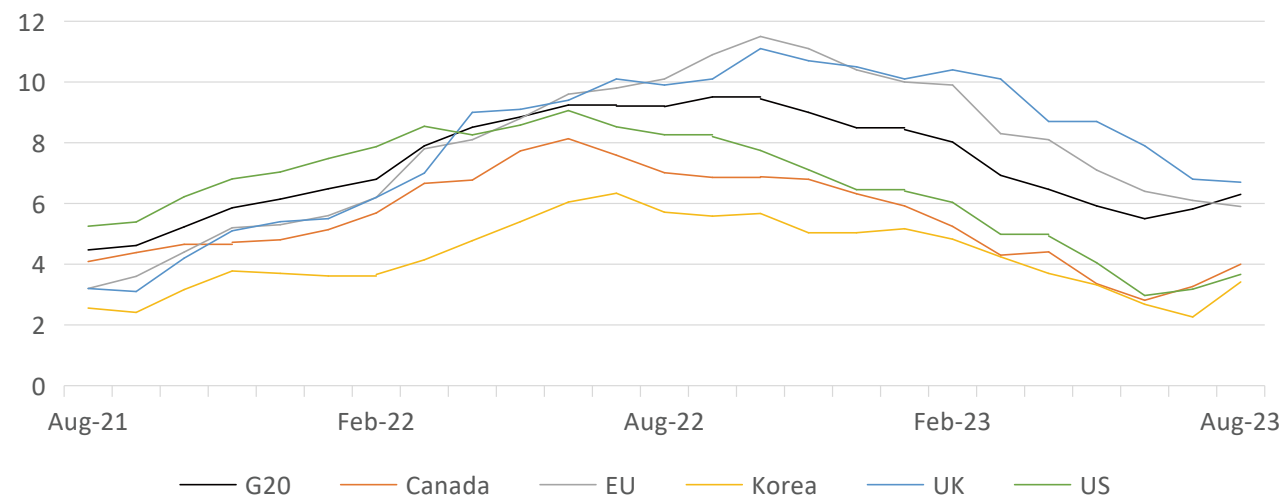
Fig. 1.2 (b): CPI inflation (y-o-y, %), selected G20 developing economies
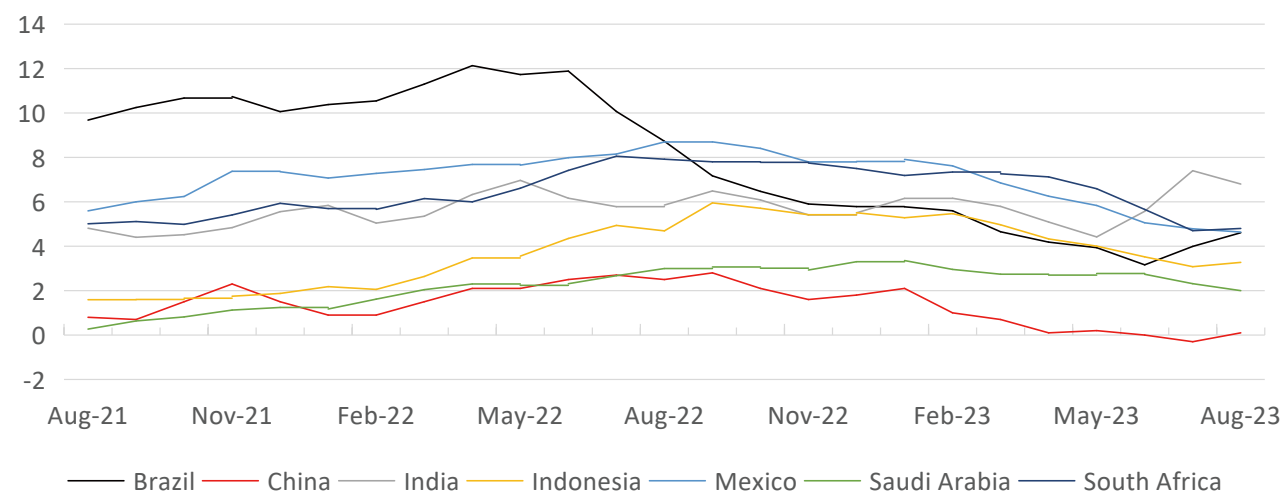
Fig. 1.2 (c): CPI inflation (y-o-y, %), selected G20 developing economies
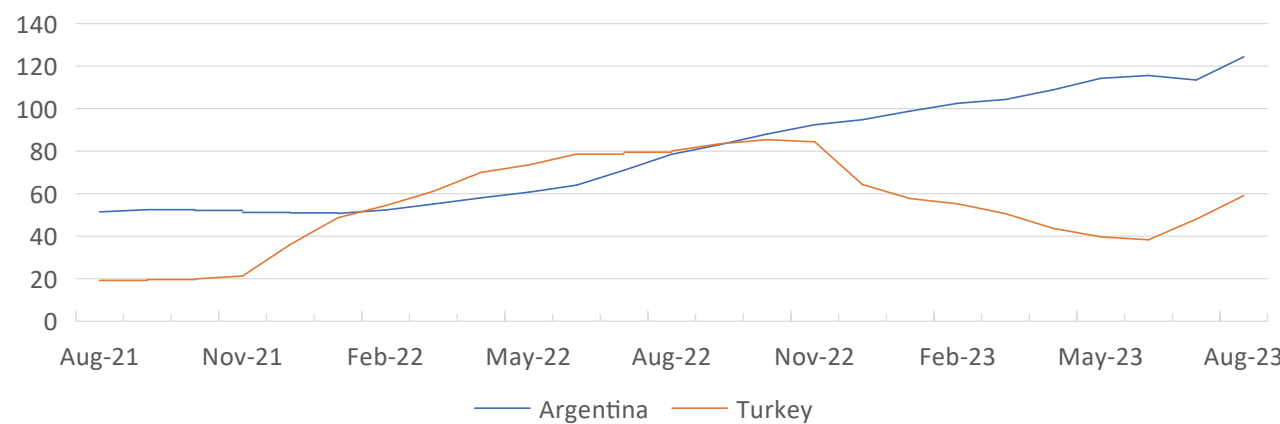
Source: The OECD Statistics web site. Accessed 23 September 2023.

4.8% and 59.1%, respectively, in August 2023 (Fig. 1.2 (b) and Fig 1.2 (c)).

The moderations in inflation were mainly due to the sharp tightening of monetary policy constraining demand growth, especially in advanced countries, and further relaxation of supply-side bottlenecks as the COVID-19 pandemic ended and production returned to normal. Softening global demand also led to declines in world commodity prices, especially prices of energy. Switching to renewable energy, especially in many European countries, and efficiency improvement by industries and households, in response to the energy crisis caused by the Russia-Ukraine war, were also major contributors to declines in energy prices. The consensus view now is that global consumer price inflation rate will decline to 7% in 2023, down from 9.2% in 2022, with that of advanced economies falling to 4.6%, down from 7.3% in 2022, and of developing countries moderating to 8.6%, down from 10.6% last year (Table 1.2).

Among the developed G20 economies, inflation in 2023 will be the highest in the UK at 7.6%, followed by Germany and Italy at 6.2%, France at 5.7%, Australia at 5.5%, US at 4%, Canada at 3.7%, Korea at 3.4%, and Japan at 3%. Among G20 developing economies, Argentina and Turkey will continue to experience a double-digit inflation in 2023, at 99% and 50%, respectively. Inflation will decline to the range of 5-5.9% in India, Mexico, Russia, and South Africa, 4.8% in Brazil, 3.7% in Indonesia, and 0.7% in China. Inflation will slightly edge up, to 2.6%, in Saudi Arabia.

In 2024, inflation will moderate further for a number of reasons. First, the tight monetary and financial conditions and their lagging effects will continue to constrain demand growth. Second, while energy prices may increase somewhat from its 2023 level due to slower supply growth if the Organization of Petroleum Exporting Countries and 10 affiliated member countries (OPEC+) continue production cuts to support oil prices, the

increase is expected to be modest. Third, the pandemic-induced supply-side bottlenecks will be further relaxed if not entirely eliminated. Against these considerations, the global consumer price inflation is projected to taper off to 5.8% in 2024 (Table 1.2). Inflation will moderate from 4.6% to 2.8% for developed economies and from 8.6% to 7.8% for developing economies.

Among the developed economies, inflation is projected to soften from 4% in 2023 to 2.7% in 2024 in the US, from 6.5% to 3.7% in the EU, from 7.6% to 3.5% in the UK, from 3% to 2.5% in Japan, and from 3.4% to 2.5% in Korea. Among developing economies, inflation is expected to remain at a two-digit level in Argentina and Turkey, as the two countries continue to face macroeconomic challenges. Inflation is expected to moderate to 3%, 3.9%, 4.6%, 4.8% and 4.8% in Indonesia, Mexico, Brazil, South Africa and India, respectively, but edge up to 6% in Russia. Inflation in 2024 is expected to remain low in China and Suadi Arabia, at 2% and 2.2%, respectively.
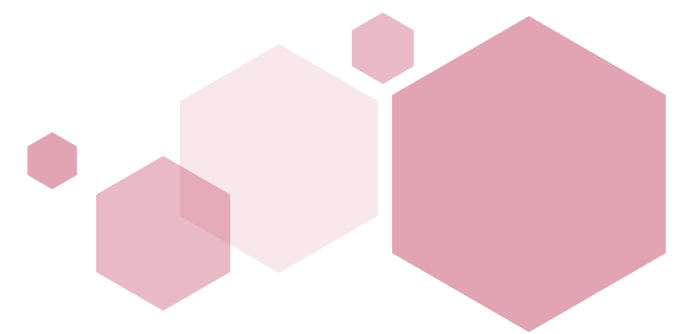
Table 1.1: Annual GDP growth (%)

	2020	2021	2022	2023	2024
				Projection	
World (PPP)	-2.8	6.3	3.4	3.1	3.1
Major groups of economies					
Developed economies	-4.2	5.4	2.7	1.5	1.3
Developing economies	-1.8	6.9	4.0	4.1	4.3
Developing Asia	-0.5	7.4	4.4	5.2	5.2
High income Asia	-2.6	4.1	1.8	2.0	1.7
Developing Europe	-2.9	6.0	-0.9	1.7	2.0
Euro area	-6.2	5.4	3.6	0.8	1.3
Latin America and Caribbean	-6.9	7.1	4.0	2.4	2.4
Middle East and North Africa	-1.8	6.3	5.5	2.9	3.2
Sub-Saharan Africa	-1.6	4.8	3.9	3.6	4.1
ASEAN	-3.2	3.2	5.7	4.6	4.9
BRICS	-0.5	7.9	3.3	4.9	4.6
European Union	-5.6	5.6	3.7	0.8	1.5
G20	-2.8	6.5	3.3	3.0	2.9
One-belt-one-road economies	-1.1	6.6	3.5	3.7	3.9
North America	-3.0	5.9	2.2	1.9	1.2
Major economies					
Argentina	-9.9	10.4	5.2	-2.3	2.0
Australia	-1.8	5.2	3.7	1.8	1.3
Brazil	-3.3	5.0	2.9	3.0	1.6
Canada	-5.1	5.0	3.4	1.3	1.2
China	2.2	8.5	3.0	5.2	5.0
France	-7.9	6.8	2.6	0.9	1.0
Germany	-3.7	2.6	1.8	-0.4	0.9
India	-5.8	9.1	6.8	6.3	6.2
Indonesia	-2.1	3.7	5.3	4.9	5.0
Italy	-9.0	7.0	3.7	0.7	0.7
Japan	-4.3	2.1	1.1	1.9	1.0
Korea	-0.7	4.1	2.6	1.4	2.1
Mexico	-8.0	4.7	3.1	3.1	2.2
Russia	-2.7	5.6	-2.1	2.0	1.0
Saudi Arabia	-4.3	3.9	8.7	1.0	3.5
South Africa	-6.3	4.9	2.0	0.8	1.1
Turkiye	1.9	11.4	5.6	4.0	2.7
UK	-11.0	7.6	4.0	0.5	0.8
US	-2.8	5.9	2.1	2.0	1.2

Sources: Growth rates for 2020-2022 are from the IMF; growth projections for 2023 and 2024 are based on the latest available forecasts by international organizations (including the IMF, World Bank, ADB, OECD, EBRD, and AfDB) as of the mid-September 2023, the September 2023 issue of Focus-Economics country reports, and IFF analysis.

Table 1.2: Annual CPI Inflation (%)

	2020	2021	2022	2023	2024
				Projection	
World (PPP)	3.5	5.0	9.2	7.0	5.8
Major groups of economies					
Developed economies	0.7	3.1	7.3	4.6	2.8
Developing economies	5.6	6.4	10.6	8.6	7.8
Developing Asia	3.5	2.6	4.3	3.5	3.6
High income Asia	0.2	1.2	3.8	3.4	2.6
Developing Europe	3.1	6.2	14.2	8.7	7.6
Euro area	0.3	2.6	8.5	5.6	3.1
Latin America and Caribbean	6.9	10.4	15.2	15.5	13.0
Middle East and North Africa	11.7	17.8	29.5	23.3	21.3
Sub-Saharan Africa	13.0	11.5	15.4	14.6	10.3
ASEAN	1.5	2.0	5.0	4.2	3.3
BRICS	3.4	3.0	4.6	2.5	3.2
European Union	0.7	2.9	9.3	6.5	3.7
G20	2.6	4.0	8.7	6.0	5.3
One-belt-one-road economies	4.6	5.5	10.3	7.8	6.9
North America	1.2	4.6	7.9	4.0	2.7
Major economies					
Argentina	42.0	48.4	72.4	99.0	90.0
Australia	0.9	2.8	6.6	5.5	3.7
Brazil	3.2	8.3	9.3	4.8	4.6
Canada	0.7	3.4	6.8	3.7	2.3
China	2.5	0.9	1.9	0.7	2.0
France	0.5	2.1	5.9	5.7	2.6
Germany	0.4	3.2	8.7	6.2	3.3
India	6.2	5.5	6.7	5.4	4.8
Indonesia	2.0	1.6	4.2	3.7	3.0
Italy	-0.1	1.9	8.7	6.2	2.6
Japan	0.0	-0.2	2.5	3.0	2.5
Korea	0.5	2.5	5.1	3.4	2.5
Mexico	3.4	5.7	7.9	5.7	3.9
Russia	3.4	6.7	13.8	5.3	6.0
Saudi Arabia	3.4	3.1	2.5	2.6	2.2
South Africa	3.3	4.6	6.9	5.9	4.8
Turkiye	12.3	19.6	72.3	50.0	55.0
United Kingdom	0.9	2.6	9.1	7.6	3.5
United States	1.3	4.7	8.0	4.0	2.7

Sources: Inflation rates for 2020-2022 are from the IMF; inflation projections for 2023 and 2024 are based on the latest available forecasts by international organizations (including the IMF, OECD, ADB, and AfDB) as of the mid-September 2023, the September 2023 issue of Focus-Economics country reports, and IFF analysis.

1.2 Risks to the outlook

There are a number of downside risks to this outlook. If these risks materialize, global growth would be lower and inflation higher, and the possibility of a global economy hard landing cannot be ruled out.

First, inflation pressures could be more persistent.

The consensus view is that global inflation will continue to decline and return to near target or pre-pandemic long term average levels by late 2025 or 2026. However, several factors could cause it to remain elevated in 2024 and beyond. While the headline inflation has declined significantly in many countries mainly due to falling energy prices, the core inflation that excludes energy and food generally continues to stay well above central bank targets. The core inflation could prove to be more stubborn than expected because of, for instance, tight labour markets putting upward pressures on wages or de-anchoring of long-term inflation expectations in response to the pro-longed above-target inflation.

An escalation of the Russia-Ukraine war or more than anticipated disruptions to oil and food supplies by the war, sanctions and counter measures could cause more shocks to global energy and food markets. The Brent crude oil price has been fluctuating in the range of $70-95 per barrel following a significant surge immediately after the outbreak of the war. The consensus view now is that the world oil price will be around 80-85$ per barrel in 2023 and 2024 on average. These projections assume that demand grows more slowly amid weak global GDP growth and that there is no significant worsening in supply conditions. However, if oil supply conditions worsen significantly due to an escalation of the war or more than anticipated disruptions by the war, sanctions and counter measures, oil prices could soar again. More than expected production cuts by OPEC+ countries could also push oil prices to levels higher than projected.

Other factors that could cause inflation to be more persistent include central banks ending monetary tightening too soon, thereby failing to sufficiently contain demand growth, and more occurrences of extreme weather events and natural disasters that are happening more frequently as a result of climate change, affecting agriculture production and raising food prices. Further, while global economic and financial integration has contributed to low inflation worldwide in the past two decades, the increasing geo-economic and -financial fragmentations as a result of intensifying geo-political tensions in recent years could work the other way round and have inflationary consequences (see more discussions below).

Second, financial distress could widen and deepen across the world.

To fight against inflation, central banks around the world have raised interest rates to levels not seen for many years (Fig. 1.3 (a) and Fig. 1.3 (b)). High interest rates and tight financial conditions dampened demand growth and helped to contain inflation, but they have also increased burdens of households, corporates and governments with high debt and financial institutions that offered large amounts of fixed-rate loans at time of low interest rates. In the US, monetary tightening has triggered the collapse of five banks so far in 2023 (Silvergate Bank, Signature Bank, Silicon Valley Bank, First Republic Bank, and Heartland Tri-State Bank). The collapse of three banks last March led to large selloffs of banking stocks and a more than 20% drop in NASDAQ banking index. More recently, Moody's cut ratings of 10 US banks and put some big names in the sector on downgrade watch. The banking sector problem in the US has also prompted concerns over its contagion to Europe and elsewhere. Although banks globally are now in a stronger position than one and half decade ago, the possibility of pro-longed monetary tightening resulting in more episodes of bank failure and wider distress in financial systems cannot be ruled out, including a repricing in financial markets (see more discussions in Part 2 of this report).

Pro-longed monetary tightening in advanced countries not only tests the financial system of their own, but also have significant implications for macroeconomic and financial stability in emerging markets and developing countries. Increases in foreign borrowing costs and capital outflows put pressure on their international reserves, cause currency deprecations, and make their foreign debt servicing more difficult. Governments around the world have spent aggressively to help households and firms to weather economic and social impacts of the pandemic in the past three years. The average ratio of gross public debt to GDP—a key measure of a country's fiscal health—is expected to rise to a record 67.5% by the end of 2023 for emerging markets and developing countries as a whole, which is 12.4 percentage points higher than it was in 2019 (Fig 1.4 (a) and Fig. 1.4 (b)). According to the IMF's estimates, 39 out of 69 low-income countries are now in or near debt distress, with countries that were showing signs of debt distress before the pandemic being hit particularly hard.[2] Deeper and more widespread debt distress

Fig. 1.3 (a): Central bank policy rate (%)
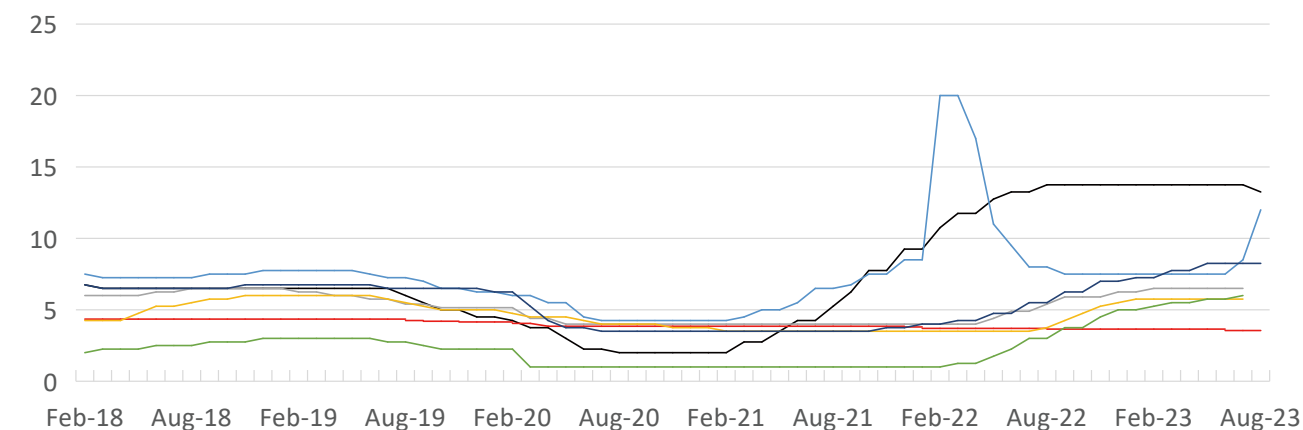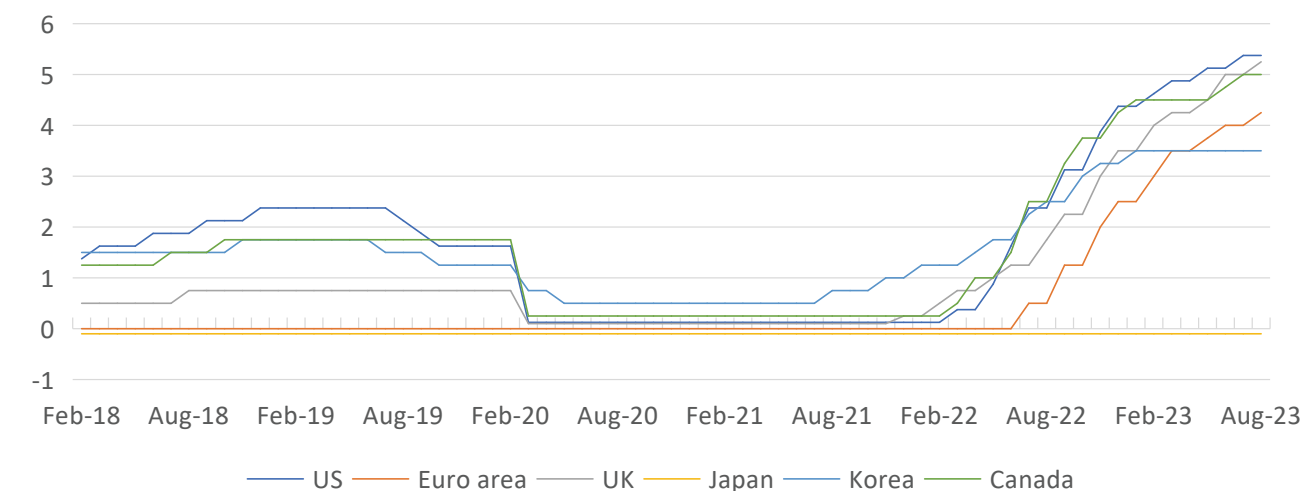

Fig. 1.3 (b): Central bank policy rate (%)

US — Euro area — UK — Japan — Korea — Canada

Source: The Bank for International Settlements web site (accessed 15 September 2023).

❷ IMF. Fiscal Monitor April 2023. Accessed 4 Aug 2023.

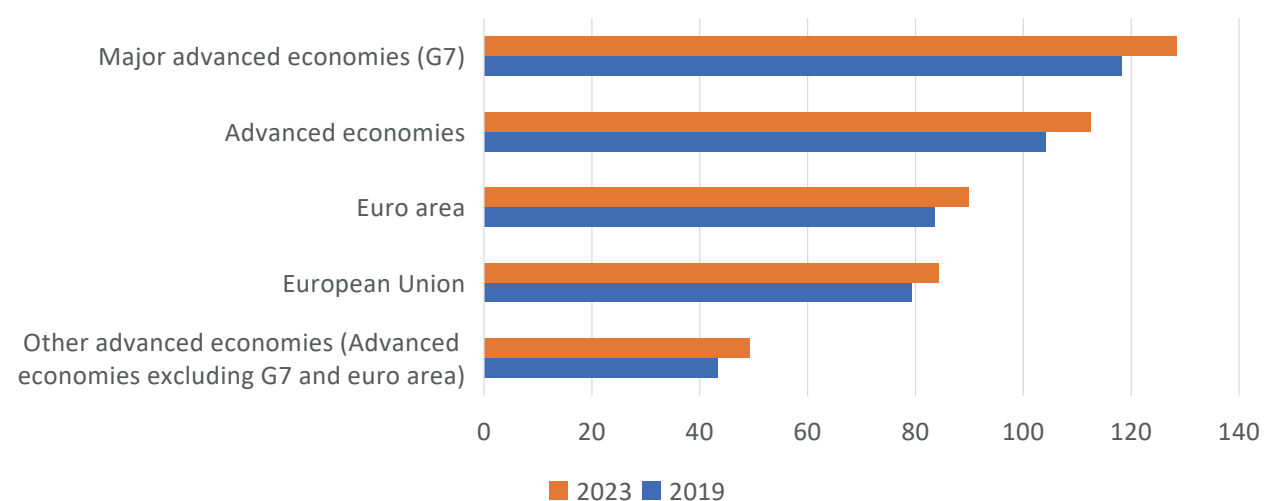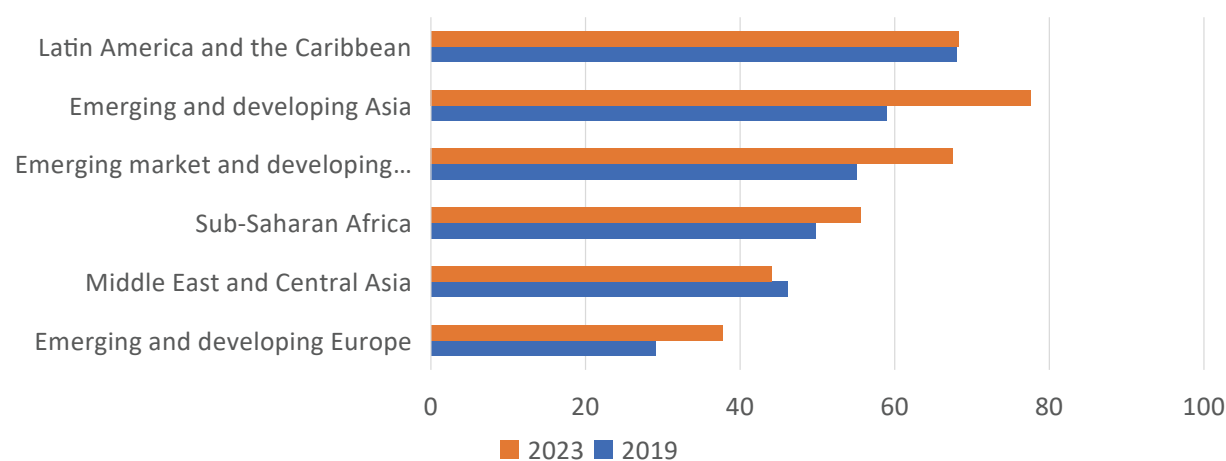Fig. 1.4 (a): Gross government debt, developed economies (% of GDP)

Fig. 1.4 (b): Gross government debt, developing economies (% of GDP)

Source: The IMF web site. Accessed 15 September 2023.

in developing countries, by undermining investor and consumer confidence and constraining both demand and supply, could reduce global growth through their direct impacts on developing countries themselves and indirect impacts on developed countries, even if not triggering a financial crisis.

Third, geo-political tensions could lead to greater geo-economic and -financial fragmentations.

The Russia-Ukraine war and Western sanctions against Russia have caused major shocks to world commodity markets and were among key contributors to rising global inflation and economic slowdown. After one year and half, the war has continued and is now the largest spot of geo-political tensions of the world. In the meantime, tensions in the Middle East, Korean Peninsular, and more recently US-China relations show no signs of lessening. Geo-political tensions are leading to geo-economic and -financial fragmentations as some countries increasingly resort to unilateral economic sanctions and weaponization of economic policies in order to weaken the opposite countries. These have included imposing trade restrictions and embargoes, starting trade wars, seizing assets of target countries, limiting access to cutting-edge technologies and high-tech products, screening investment, banning foreign direct investment, removing banks from SWIFT

international payments, and re-shoring and friend-shoring production. These measures, often implemented together with the exercise of the so-called long-arm jurisdictions, are increasingly curtailing global trade and cross-border capital flows; restricting skill mobility and technology diffusion; increasing costs of production, doing business and finance; and constraining global growth.

A recent global risks perception survey by the World Economic Forum[3] ranked "geo-economic confrontation" including sanctions, trade wars and investment screening the third most severe risk with the greatest potential impact on a global scale over the next two years. A recent study by IMF staff shows that trade fragmentation alone could cost the world up to almost 7% of its combined GDP in the long term.[4] If technological decoupling is added, some countries could see long term losses of up to 12% of GDP. The full impact would likely be even greater if restrictions on cross-border migration, reduced capital flows, and a decline in international cooperation in tackling global challenges are taken into account, in addition to trade restrictions and barriers to the spread of technology. The study also shows that under these scenarios, lower-income consumers in advanced economies would lose access to cheaper imported goods, and small, open-market economies would be particularly hard-hit. As developing economies would no longer benefit from technology spillovers that have boosted productivity growth, they would fall further behind, instead of catching up to advanced economy income levels.

Fourth, China's economic growth could be lower than anticipated.

As mentioned earlier, China's economic data in recent months has been less than satisfactory, dragged down by weak

household consumption, falling housing investment and shrinking exports. Although the Chinese government has recently introduced a series of measures to stimulate domestic consumption and encourage private sector investment, it remains to be seen how long these measures will take effect and how effective they will be. Furthermore, China's economy faces risks such as a larger-than-expected downturn in the real estate sector due to excess housing stock in some cities and loss-making, liquidity shortages and debt defaults for some developers, slow progress in resolving local government debt restricting their ability to support economic growth through fiscal expansion, and further deterioration of the external economic environment affecting exports. China's economy accounts for more than 18% of the global economy (measured at PPPs) and contributes about a third of global growth, and China is the world's largest trading country and a major trading partner of more than 140 countries and regions around the world. If China's economic growth does not meet expectations, it will have a significant impact on global growth.

[3] https://www.weforum.org/reports/global-risks-report-2023/in-full/1-global-risks-2023-today-s-crisis. Accessed 15 September 2023.

[4] Shekhar Aiyar, et al. Geoeconomic Fragmentation and the Future of Multilateralism. IMF Staff Discussion Note (SDN/2023/001). January 2023. Cost of fragmentation_IMF 2023.pdf. Accessed 15 September 2023.

1.3 Policy priorities

To reduce the risks and support global economic recovery and growth, the global community should work together to address both short- and longer-term challenges. Policy priories going forward include (i) continuing the fight against inflation, while maintaining financial stability; (ii) consolidating the fiscal position, while protecting vulnerable groups; (iii) accelerating structural reform to address binding constraints to long-term growth; and (iv) pursuing international cooperation and multilateralism to deal with common challenges, including reducing poverty, protecting environment and responding to climate change and resolving cross-country conflicts and reducing geo-political tensions.

Continuing the fight against inflation, while maintaining financial stability.

Monetary tightening has been effective in containing inflationary pressures so far, but inflation remains elevated around the world. In the US and Euro area, inflation is well above central banks' 2% long-term target.

Image source: United Nations official website

Interest rates have been raised to the levels not seen for many years in a large part of the world. In the coming months, central banks must walk a fine line—they need to ensure that monetary tightening is not too much to lead to a hard landing for the economy and financial instability, or is ended too early to make inflation to resurge. They should closely monitor and assess economic data and make monetary policy decisions accordingly. To avoid large market reactions to policy changes, policy messages need to be carefully communicated. With highly integrated global financial markets, policy makers—especially in advanced economies—will have to consider not only impacts of policy changes on their domestic economies, but also spillovers to other markets, especially developing countries.

Monetary tightening should be implemented in tandem with close monitoring of financial sector risks and strengthened supervision of financial institutions. Countries should make more progress in implementing Basel III an international regulatory framework for banks, remove oversight gaps for nonbank financial institutions, and employ macro-prudential

policy measures to control financial risks and maintain financial stability. Isolated episodes of financial institution distress need to be managed carefully when occurring by deploying tools including liquidity support to prevent them from developing into a systemic crisis, while mitigating the risk of moral hazard. Developing countries should continue to strengthen their macroeconomic fundamentals and reduce vulnerability to external shocks, and use policy tools in disposal including temporal capital control when necessary. Advanced and developing countries should work together to fight inflation and achieve a soft landing for the global economy.

Consolidating the fiscal position, while protecting vulnerable groups.

Rising levels of public debt following the COVID-19 pandemic have raised the issue of fiscal consolidation now and in the coming years for many countries. While economic recovery and surging inflation may have helped to reduce debt-to-GDP ratios somewhat, the ratios remain high and well above pre-pandemic levels in most countries.

Fiscal deficits need to be brought down to rebuild fiscal space, and this is urgent for those with already unsustainable public debt levels. Moreover, many low-income countries face the daunting challenge of meeting their sustainable development goals (SDGs) that has been disrupted by the pandemic and that requires large fiscal spending, and many advanced and emerging market economies will have to address mounting spending pressures, including those from infrastructure investment, climate change mitigation and adaption, and provision of pension and healthcare in response to population ageing.

Fiscal consolidation requires both expenditure and revenue measures. The exact mix of consolidation measures will depend on country circumstances. In general, the expenditure measures involve cutting current expenditure by improving government efficiency and eliminating untargeted subsidies (such as on fuels), while protecting public investment and targeted support for the most vulnerable groups. The revenue measures include hiking taxes on incomes, properties, consumption (e.g., VAT and sin tax), and emissions and environmental

pollution and improving tax collection and administration. In cases in which countries are in or at high risk of debt distress, achieving debt sustainability may require not only fiscal consolidation, but also debt restructuring. Successful fiscal consolidation requires mitigating negative social and political repercussions by means such as early and regular engagement with key stakeholders and putting in place an effective communication strategy.[5]

Accelerating structural reform to address binding constraints to long-term growth.

The pandemic in the past several years diverted the attention of policy-makers to managing the health crisis, slowing down the progress in implementing structural reform. This could have negative implications for long-term global potential growth. With the pandemic over now, it's high time to shift gear to address binding constraints to long term development and boost potential growth. Higher physical capital investment including spending on infrastructure is key to boosting potential growth. There are large gaps between current spending on infrastructure

and the level needed to meet development goals, and narrowing or eliminating these gaps can not only boost long-term growth, but also support short-term economic recovery. In particular, investment in green infrastructure can support economic growth, while contributing to tackling climate change (see more discussions in Part 4 of this report). Boosting global potential growth also requires increased investment in human capital to make up the losses caused by the pandemic and fill in the gaps that existed before the pandemic. It has been noted that improvements in education can boost labour force participation, as better-educated workers tend to be more firmly attached to labour markets. According to World Bank estimates, reforms associated with higher physical capital investment, enhanced human capital, and faster labour-supply growth could raise annual potential growth by 0.7 percentage point over the period 2022-30, both globally and in developing countries.[6] Global potential growth can be further boosted by reforms to improve business environment and strengthen governance, thereby facilitating private investment and stimulating innovation.

Image source: Patricia Breuer Moreno

[5] Vybhavi Balasundharam, et al. "Fiscal Consolidation: Taking Stock of Success Factors, Impact, and Design". IMF Working Paper, WP/23/63, March 2023.
[6] World Bank. Global Economic Prospects. Washington DC. June 2023.

Image source: ©FAO/Atul Loke

Pursuing international cooperation and multilateralism to deal with common challenges.

The multiple challenges the world is facing make international cooperation and multilateralism even more important. To achieve a soft landing for the global economy, central banks should coordinate monetary policy closely through global processes such as G20. Policy coordination may enable the world's major central banks to achieve the goal of containing inflation at a lower cost than when each takes actions in isolation. It will also enable developing countries to better prepare for weathering external shocks. International cooperation in areas of coordinating climate policy, mobilizing green finance, developing and sharing green technologies, and building capacity is critical to accelerating the transition to the green economy and meeting the global climate goal. Countries should resolve trade disputes under the framework of the World Trade Organization. Pursuing multilateralism in addressing geo-political

tensions can reduce or prevent geo-economic and -financial fragmentation. Lastly, closer international cooperation is needed to help fiscally stressed low-income and lower middle-income countries to manage their fiscal difficulties through debt relief or restructuring. The global community should work together to ensure these countries also have needed financial resources to make significant progress in reducing poverty and achieving SDGs and to take climate actions, by providing more bilateral and multilateral funding support.

Chapter 2:
Global financial market review and outlook

The global financial market experienced large fluctuations through the first three quarters of the year, mainly due to challenges testing the resilience of the financial system in the aftermath of the Covid-19 pandemic. In March and April, several US regional banks, including Silicon Valley Bank (SVB), Silvergate Bank, Signature Bank and First Republic Bank (FRB), failed one by one due to their mismanagement of interest rate and liquidity risks. This triggered a market sell-off of bank shares in the world that posed a serious threat to the global financial stability. The repercussion on the other side of the Atlantic was a bank run on Credit Suisse, a globally systematically important bank with a history spanning more than a century. This event forced Swiss authorities to advance its merger with UBS to avert a blunt bank failure.

Adding to the banking system's severe strain, political and geopolitical risks also wreaked havoc on the global financial market. A standoff in the US Congress over the legislative debt ceiling brought the world's leading economic powerhouse to the brink of default in early summer. Concurrently, ongoing fallout from the Russia-Ukraine war and subsequent financial sanctions led to intermittent market dislocation. The escalating competition between the US and China also contributed to market volatility, amplifying the fragmentation risks of the global economy and financial system, as more sectors and businesses found themselves caught in the crossfire.

The substantial uncertainties surrounding policy changes and their outcomes further intensified market volatility. Investors were taken aback by the unpredictable nature of transatlantic monetary policy, set against a backdrop of persistent inflation. In Japan, the change in the central bank governorship marked an unexpected shift away from ultra-loose monetary policy and the experimental tool of yield curve control. At the beginning of the year, the reopening of China's economy fueled investor optimism for a robust recovery. However, the actual recovery fell somewhat short of expectations, leading to a significant market correction.

Despite the aforementioned drivers of fluctuations, the market has demonstrated remarkable resilience and exuberance thus far. Major developed economies' equity markets have consistently rebounded from their low points. As of mid-September, the MSCI G7 index is only about 10% below its previous high from 2021, despite a substantial increase in interest rates since then. The bond market suggests that the United States may experience a turning point in its monetary policy change early next year, while European countries may need to wait longer to witness the European Central Bank's first policy rate cut. At the same time, emerging market currencies are also finding some relief as the interest rate hikes in the US are coming to an end. Overall, the financial market appears to have incorporated a scenario of a soft landing.

Looking ahead, financial risks and vulnerabilities loom large. Uncertainties related to policy changes continue to cast a shadow. Persistent inflation could lead to a scenario of higher-for-longer interest rates and strained market valuations. It could be compounded by a slowdown in growth that occurred more swiftly and profoundly than anticipated. That being said, the confirmation of a soft-landing is still pending. A stagflation scenario, a combination of stubborn inflation and anemic growth, will lead to sharp corrections of the market. The monetary authorities and financial regulators should keep vigilant on the associated vulnerabilities to guard against systemic risks.

In the meantime, geopolitical risks, such as the Russian-Ukraine conflict and US-China competition, show no signs of receding in the foreseeable future. They have substantially increased the risks of financial fragmentations as some countries resort to unilateral economic sanctions and weaponization of economic policies in order to weaken their rival countries. As a consequence, the rising fragmentation risks of global financial system leads to the recent surge of interest in de-dollarization. Although the US dollar continues to be the dominant currency of the current international monetary system (IMS) in terms of its crucial role in invoicing international trade, settling cross-border transactions, and serving as a store of wealth for individuals and nations, the current trend towards de-dollarization may be more sustainable given the support of many emerging markets. Nevertheless, even the most optimistic advocates of de-dollarization cannot envisage that the USD abdicates from its dominance of the IMS soon. Moreover, it is important to note that any change in the IMS could bring about greater volatilities and risks as history has shown.

2.1 Two important risk events and their impact on international capital flow

Before diving into the development of global financial market, it is crucial to revisit some important risk events early this year which put global financial stability to test. Two notable episodes of financial market turmoil emerged, namely the crisis in US regional banks and the standoff in the US Congress over the Federal government debt ceiling. Although these events originated in the US, their impacts were felt worldwide. Fortunately, due to the timely intervention of the authorities, these risk events did not escalate into a perfect storm in the global financial system. However, they still constitute a warning for the global financial system. With the US dollar's dominance in the international monetary system, adverse events in the US financial system can easily spill over to the rest of the world, particularly impacting emerging markets.

US regional bank crisis

In March and April, there was a series of failures among US regional banks, including

Silicon Valley Bank (SVB), Silvergate Bank, and Signature Bank, due to a rapid withdrawal of depositors. The repercussions of these bank failures quickly spread to other parts of the world and caused market gyrations, aided by the dissemination of sensational news through social media. It once seemed that a systematic collapse of the global banking system was imminent. Swiss authorities responded swiftly by announcing a state-supported merger between Credit Suisse and UBS, as panicked investors scrambled to reduce their exposure to Credit Suisse, pushing it to the brink of liquidation. This forced merger marked the first failure of a globally significant bank since the 2008-2009 global financial crisis.

Fortunately, the authorities responded with prompt policy actions. In addition to the merger of the Swiss banks, the US Federal Deposit Insurance Corporation announced full protection for depositors of stressed banks to prevent further deposit flight. The situation stabilized as summer approached, although concerns about financial stability continued to linger among investors.

Reflecting on this episode, investors will find several underlying structural factors that will persist at least in the near future. Firstly, the rapid and unpredictable fluctuations in

Fig. 2.1: Persistent monetary tightening weighing on the liquidity of US banking system

US Bank Deposits
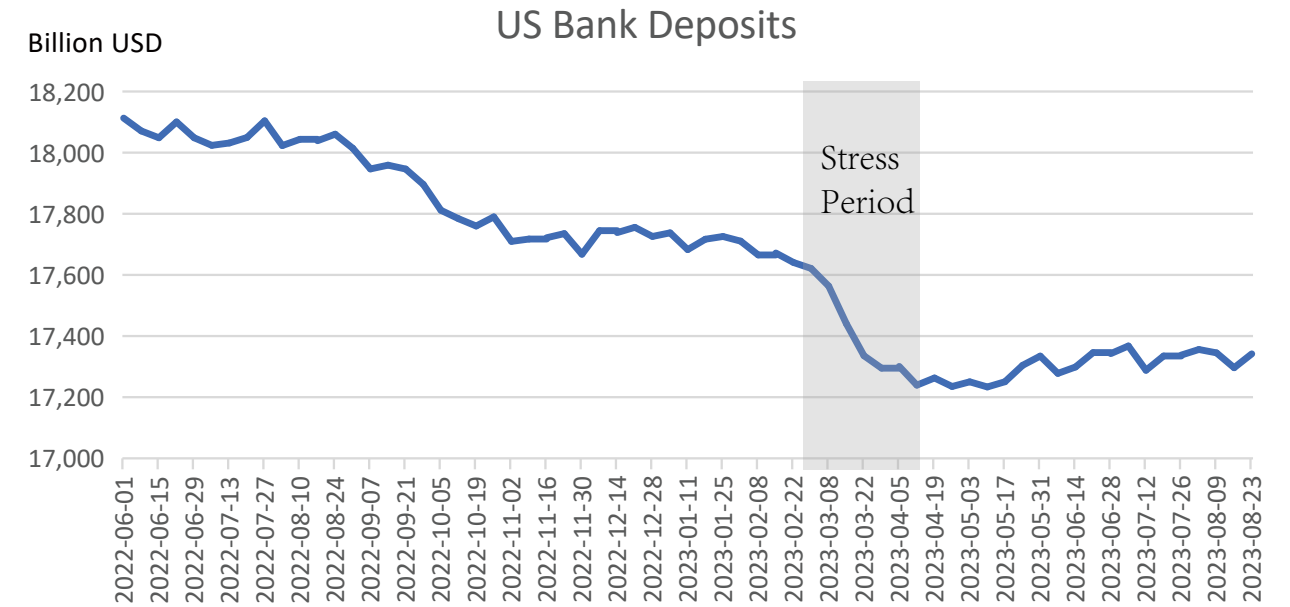
Source: US Federal Reserve and IFF

liquidity within the banking sectors of the US and Eurozone can be attributed to the swift changes of monetary policy in recent years. (Fig 2.1) The ultra-loose policy measures implemented during the Covid-19 pandemic, followed by a rapid tightening in response to surging inflation, created significant liquidity challenges for banks. The US Federal Reserve reported a decline of $597 billion in uninsured deposits in the US banking system in the first quarter of 2023, equivalent to a sequential change of -7.8% from the end of 2022 or a year-on-year decline of -15.2%. This placed immense pressure on regional banks heavily reliant on uninsured deposits, such as the failed SVB and Signature Bank.

Secondly, the rollback of regulations by the US Congress also contributed to the crisis in the country's regional banks. In an attempt to relieve regulatory burdens on small and medium-sized banks, the Trump administration pursued an amendment to the Dodd-Frank Act in 2018. This amendment aimed to raise the threshold for enhanced regulatory standards from $50 billion to $250 billion, exempting medium-sized banks

from stringent requirements such as stronger capital and liquidity rules, comprehensive resolution plans, and rigorous stress testing. Unfortunately, this relaxed supervision encouraged risk-taking behavior among some beneficiary banks, including SVB, Signature Bank, and First Republic Bank, and partially contributed to their failures.

Lastly, social media played a significant role in catalyzing the banking crisis. During the period of strain on the banks, various social media platforms, particularly Twitter, demonstrated their ability to quickly spread negative news about the banks, undermining market confidence. Patrick McHenry, the chair of the House Financial Services Committee, even referred to the collapse of SVB as the "first Twitter-fueled bank run." One recent study[7] provides empirical evidence of how social media amplified balance sheet risks of stressed banks and accelerate the outflows of uninsured deposits. The study quantified that US banks with high exposure on Twitter experienced a 6.6 percentage point greater decline in stock market value leading up to the failure of SVB. Moreover, the convenience

❼ Cookson, J. Anthony and Fox, Corbin and Gil-Bazo, Javier and Imbet, Juan Felipe and Schiller, Christoph, Social Media as a Bank Run Catalyst (April 18, 2023). Université Paris-Dauphine Research Paper No. 4422754, Available at SSRN: https://ssrn.com/abstract=4422754 or http://dx.doi.org/10.2139/ssrn.4422754

of digital banks makes it extremely easy to run a bank: investors do not need to queue up at the bank door but just move their fingers to complete deposit withdrawals. In the age of social media and digital banking, bank runs can happen with lightning speed and on a scale not comparable to that of a decade ago.

The US congress standoff of Federal government debt ceiling

The resilience of the US economic and financial system was tested by the 2023 US debt ceiling crisis, which was another significant event with far-reaching consequences. On January 19, 2023, the US federal government reached its predetermined debt ceiling set by Congress. Consequently, theTreasury was unable to issue new debt until a new debt ceiling was agreed upon, raising concerns about the government's ability to fulfill its financial obligations, including debt repayments, salaries for federal employees, and payments for programs like Social Security and Medicare.

The standoff surrounding the debt ceiling was primarily a political issue. The debt ceiling has been raised multiple times throughout history. However, the increasingly polarized political landscape in the US led both Republicans and Democrats to adopt a brinkmanship strategy during negotiations for raising the debt ceiling. The inability to raise the debt ceiling created significant uncertainty in financial markets, resulting in heightened volatility and declining equity prices. The cost of insuring US debt against default surged, reflecting rising investor concerns about the risk of a US default.

On May 27, President Biden and House Speaker Kevin McCarthy reached a deal to increase the debt ceiling while capping federal spending. The resulting bill, known as the Fiscal Responsibility Act of 2023, passed the House on May 31 and the Senate on June 1. President Biden signed it into law on June 3, effectively ending the crisis.

However, the standoff had serious consequences. In August, Fitch Ratings, one of the major international credit rating agencies, downgraded the US Long-Term Foreign-Currency Issuer Default Rating (IDR) from 'AAA' to 'AA+'. Fitch Ratings justified this downgrade by citing the erosion of confidence in fiscal management due to

Fig. 2.2: Elevating pressure on the US fiscal situation

Billion USD

Fiscal Deficit — Total Public Debt
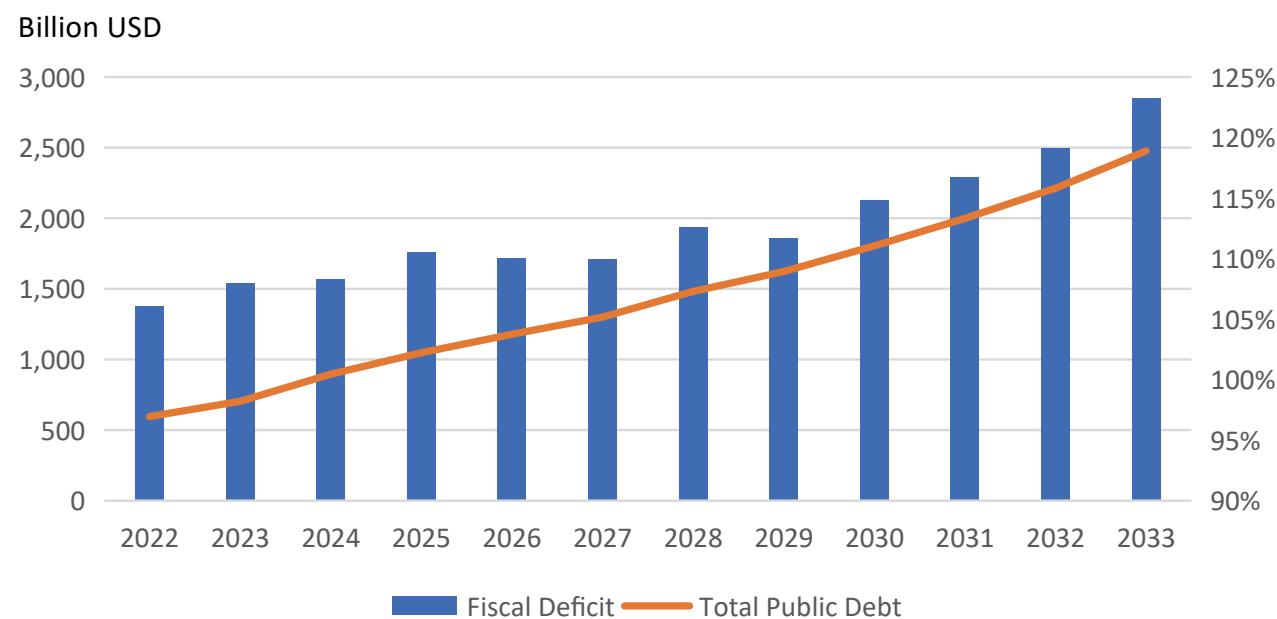
Source: CBO and IFF

Fig. 2.3: IIF Tracker: Total Portfolio Flows into Emerging markets

IIF Tracker: Total Portfolio Flows into Emerging Markets
$ billion

- China Debt Flows
- China Equity Flows
- EM ex-China Equity Flows
- EM ex-China DebtFlows
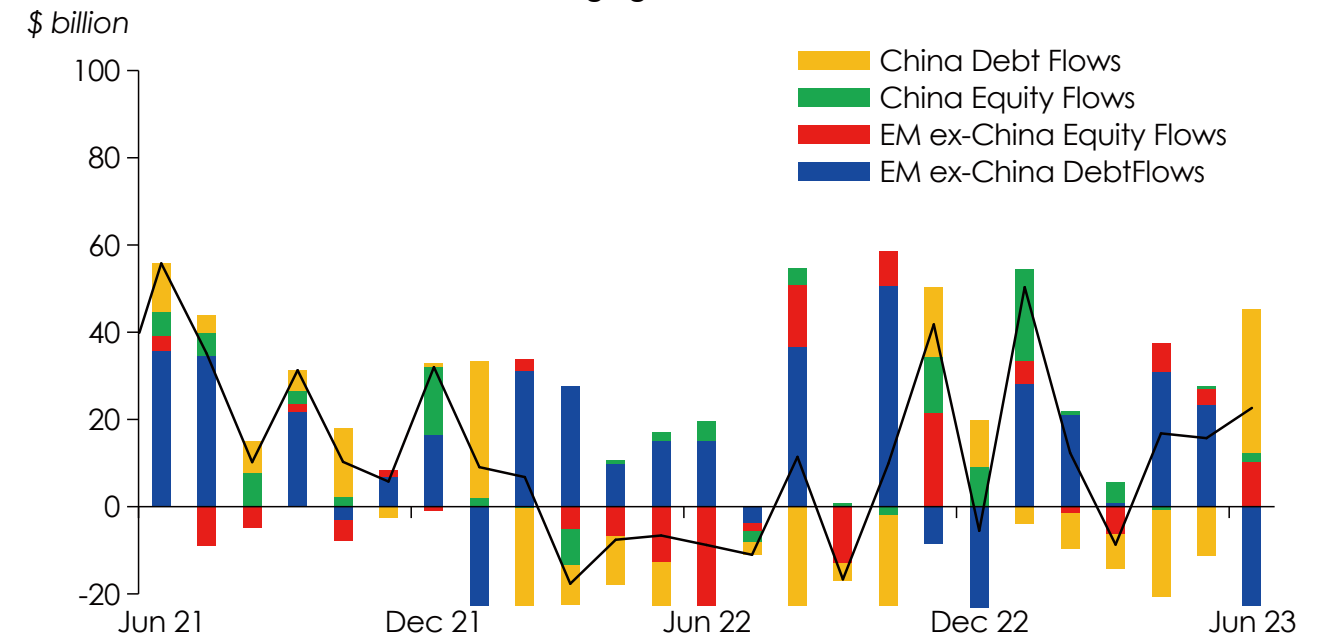
Source: Bloomberg, IIF,National Sources.

Source: National Sources, Bloomberg, IIF, IFF

repeated debt-limit political standoffs and last-minute resolutions. According to the bipartisan CBO's projections, the US fiscal situation is set to deteriorate in the next decade. (Fig 2.2) Going ahead, this could lead to more standoffs in the Congress and greater volatilities in the market.

Risk events' impact on international capital flow

The abovementioned risk events have exerted significant impacts on international capital flows along with other factors. As shown in Fig 2.3, international capital flowed back to emerging markets strongly thanks to the economic reopening of China and optimistic market expectations towards the policy rate decision of major central banks. At the beginning of the year, people anticipated that the inflation will lose their momentum soon in advanced countries, causing monetary authorities to halt their interest rate hikes.

The outbreak of US regional bank crisis reversed the trend in March as investors' risk appetite deteriorated quickly. Fortunately, the adverse impact of the US regional bank crisis is proved to be short-lived. International capital flows to emerging markets resumed its recovery from April. The worries over the US debt ceiling in May slowed the moment for a while. But funds continued to flow to emerging market as a whole in June and July on investors' improved risk appetite as well as their reignited hope for the end of policy rate hikes.

2.2 Currency performance heavily influenced by policy rates

Through the first three quarter of the year, the USD has shown a large degree of two-way fluctuations, mirroring significant gaps between the Fed policy decisions and market expectations that stem from high uncertainties of inflation outlook. In the first quarter, the stubborn inflation outturns sent the DXY to above 105 as the market realized that the tightening policy cycle is likely to hold longer than previously expected. The outbreak of US regional banking crisis in March-April led to the plunge of the DXY in the ensuing months as the market believed that the Fed has to end its policy tightening soon in the face of financial instability. Accordingly, the DXY once fell below 100 in mid-July, the first time since April 2022. However, the DXY bounced back in summer. In mid-September, the DXY rose above 105 again.

On the flip side, the performance of other currencies against the USD depends on to what extent their central banks follow the US Fed to tighten their monetary policy. (Fig 2.4) Among the advanced economies, a number of currencies, including the Euro, Sterling, Swiss Franc, and Danish Krone, appreciated against the USD, albeit to different degrees, compared to their levels at the beginning of the year. Over the same period, the Canadian dollar was almost unchanged while Norwegian Krone and Swedish Krona depreciated to a certain degree.

The Japanese Yen has exhibited a large degree of depreciation against the USD since the beginning of the year. As of September 25, the exchange rate of Japanese Yen versus USD depreciated to 148.8, 13.2% lower than the level of end-2022. Apparently, the BOJ's tinkering of YCC tool failed to offset the impact of the widening yield gap between the US and Japan. Moreover, the Japanese authorities seem comfortable with a weak currency and have been reluctant to intervene into the FX market to boost its currency value.

Among the emerging market, their currency performance since the beginning of the year has been quite in tandem with their policy reactions to the US Fed. For some emerging markets that actively follow the US Fed to hike their policy rates, their currencies tended to show a greater strength. On the contrary, a number of emerging markets, mainly in Asia, which tightened their monetary policy at a pace milder than the US or even loosened their monetary policy, witnessed relatively weaker performance of their currencies.
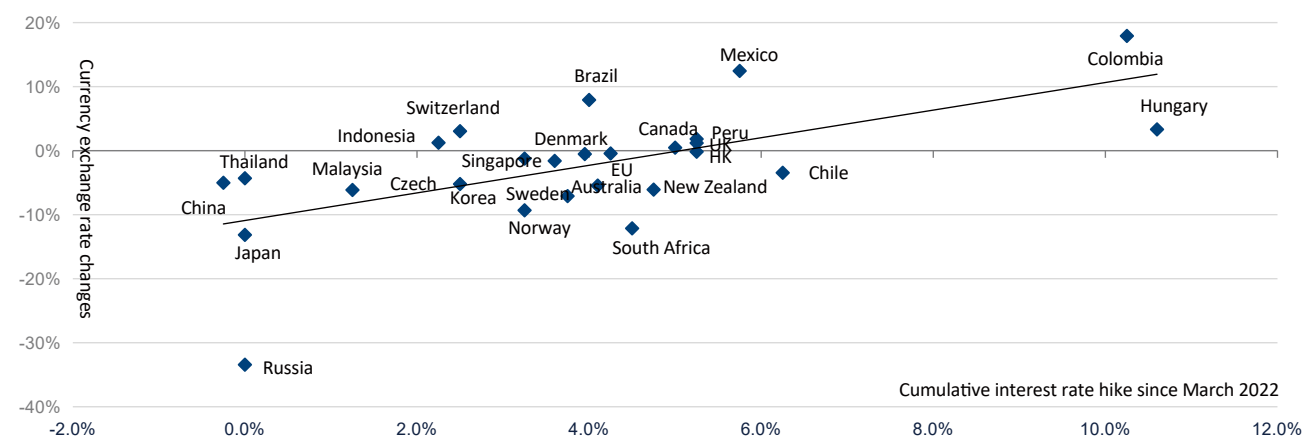
The outlook of currencies and portfolio flows is still bearing great uncertainties. Although the policy rate hike in the US is expected to come to an end soon, the currently high interest rate could be maintained till mid-2024, due to persistent inflation. Meanwhile, the balance sheet reduction of the Fed, along with the ECB, is set to continue in the following months. That being said, the overall monetary condition of major developed economies still tilts towards the tightening side. It will put persistent pressure on the currencies of emerging markets.

2.3 Performance of other major financial assets

Global financial assets are largely driven by monetary authorities' policy conducts as well as the market expectation of their further actions. Among the asset classes, the performance of sovereign bonds in advanced economies appear to be weak due to their monetary authorities' persistent tightening efforts. As shown in Fig. 2.5, the year-to-date (as of September 25) returns of US and German 10 year Treasury bond are -5.6% and -3.4% respectively, reflecting the fact that the market underestimated the magnitude of policy rate hikes in the current tightening cycle at the beginning of the year. Comparatively, the sovereign bonds of emerging markets, as represented by JP Morgan's EMBI Global Core Index, fare better than their peers of advanced economies. The Index registered a positive growth of 1.9% till September 25, showing that investors' sentiment of emerging markets have somewhat recovered from the low point nine months ago.

Global stock markets depict a different picture from the sovereign bond market. In Fig. 2.5, almost all the stock index of advanced countries reap good returns in 2023. Particularly for the NASDAQ index of the US and Nikkei 225 in Japan, both of them increase by above 25% in the first three quarters of the year. It is noted that such a gain is achieved in amidst of a number of risk events, including the US regional bank crisis and Congress standoff of debt ceiling. Indeed, both index has been through violent ups-and-downs early this year. However, stock markets of advanced economies become optimistic again towards the end of summer despite the tightening monetary conditions and lingering risks in the US banking sector.

At the same time, the stock markets of emerging economies underperform thus far. The MSCI Emerging Market Index, which are composed of large-and-mid-cap listed firms across 24 Emerging Market (EM)

Fig. 2.4: Currency Performance versus accumulated interest rate hikes (as of August 15, 2023)

Source: WIND and IFF

Fig. 2.5: Year-to-date return of selected financial assets (as of September 25, 2023)
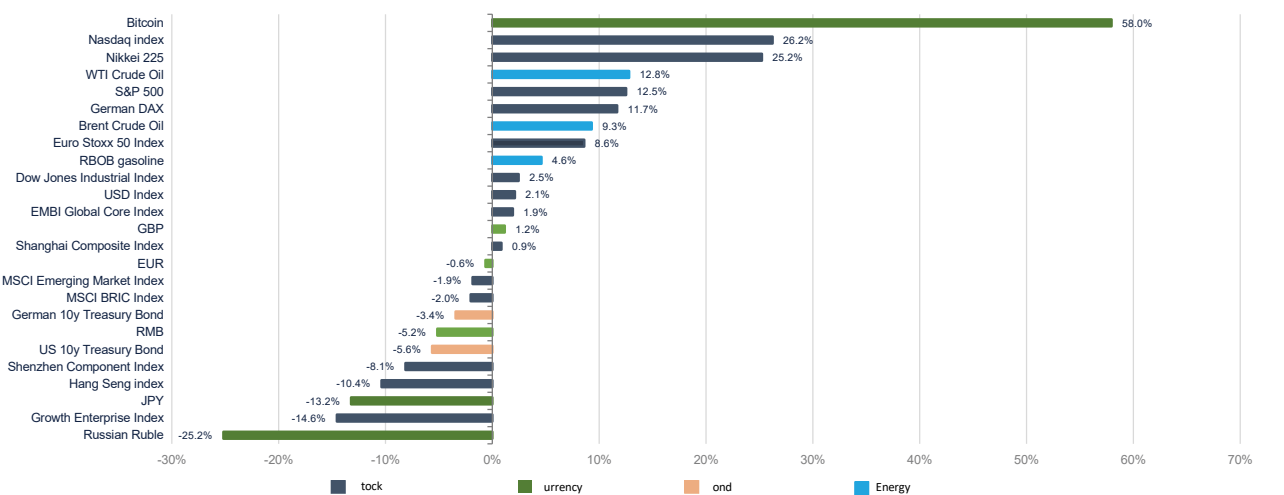
Source: WIND and IFF

economies, registered a slightly negative return so far this year. In China, Shanghai Composite Index registered a merely growth of 0.9% while Shenzhen Composite Index and Hang Seng Index declined by -8.1% and -10.4% respectively, indicating that the actual recovery of China's economy since its reopening in November 2023 has somewhat fallen short of investors' expectations.

Energy prices appear to be strong albeit with large up-and-downs along the path this year. The WTI or Brent crude oil futures increased by 12.8% and 9.3% compared to nine months ago respectively. After the Russia-Ukraine war comes to its second year, the market still has concerns over the war's adverse spillover to the global commodity market. Over the same period, the price of RBOB gasoline futures increased by 4.6%, suggesting the still strong fundamentals in the US economy.

The price of Bitcoin experienced a strong rebound from last year's legendary landslide. Even so, its current price is still below half of its historical peak recorded in November 2021. The primary culprit of the crypto assets' woes in 2022 is the fast policy tightening of major central banks, which led to a disorderly deleveraging in the universe of crypto assets.

2.4 The interest rate risk of higher-for-longer

The global financial system have successfully weathered a host of risk events since the start of the ongoing policy tightening cycle in the aftermath of the Covid-19 pandemic, including the recent US regional bank crisis and congress standoff of debt ceiling. To a certain extent, it has proved the effectiveness of regulatory reforms on global financial system in the aftermath of 2008-2009 global financial crisis. Meanwhile, the authorities' interventions helped to prevent the risk contagion to other regions and other parts of financial system. Nevertheless, market participants have no reason to be complacent about the risk outlook of global financial

system given that the existing financial vulnerabilities, known or unknown, could quickly lead to new risk events and pose systematic challenges to financial stability. In our opinion, the most likely catalyst of new risks events is the extended period of higher interest rates.

As discussed in Chapter 1, the inflation pressure could be persistent due to not only volatile energy and food prices in amidst of the ongoing Russia-Ukraine war but also disrupted global supply chains amid the ever-strengthening de-globalization trend. The monetary authorities of major advanced economies are likely to maintain their policy rates at the current levels for a longer time after the pause of further hikes.

Such a higher-for-longer scenario of interest rates could have significant impacts on almost all the important sectors in the economy and pose serious challenges to financial stability. In particular, it will raise debt servicing costs for households, businesses and governments, making it increasingly difficult for borrowers to service or refinance their debt. In turn, financial strains of these borrowers will affect the lenders through the channels of bank loans or market debt issuances. The asset quality of financial institutions will deteriorate if high interest rates hold longer.

High interest rates will also weigh on market valuation of financial assets, in particular the assets with longer duration. It could significantly amplify market volatility and even lead to liquidity crunch. Moreover, the related valuation adjustments could further aggravate the mismatch between the asset and liability sides of financial institutions, adding difficulties to their liquidity management in an environment of persistent monetary tightening. That being said, the US regional bank crisis could be repeated in the US or somewhere else if large-scaled revaluation of FI holding assets drive their customers to move deposits and investment away from them in a short time.

Fig. 2.6: Real residential property price developments in selected economies (y/y changes)
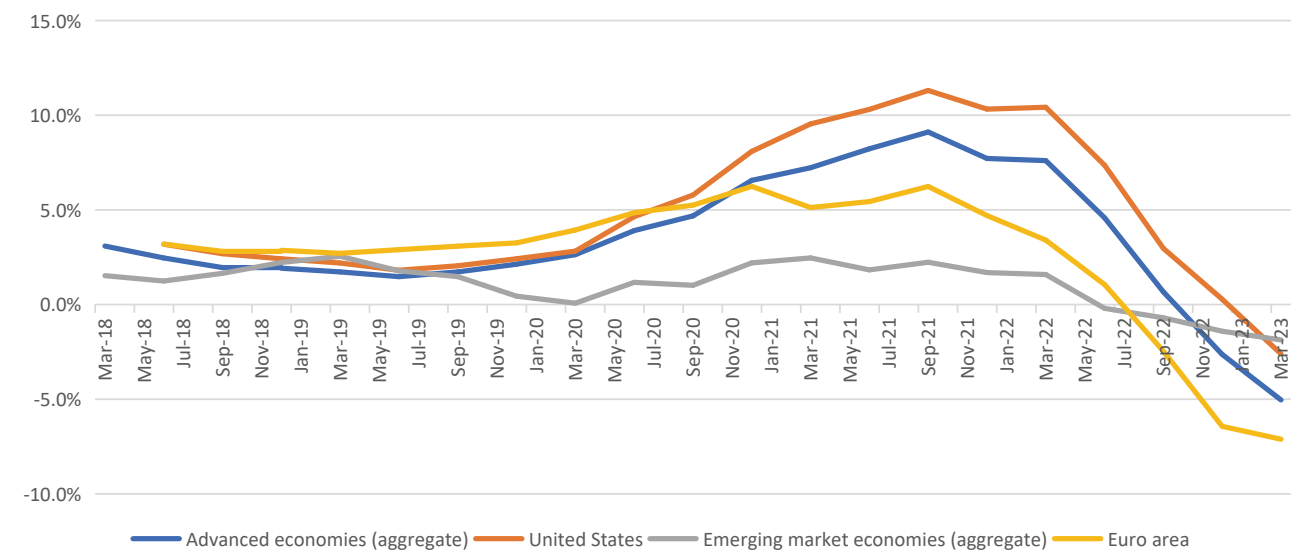
Source: BIS and IFF

In addition to the banking sector, the impact of high interest rates is pronounced in a number of areas including Nonbank financial intermediaries (NBFIs) and the property market. The NBFI ecosystem is very broad and highly heterogeneous across different regions. As financial intermediaries, the majority of NBFIs share the features of leverage operation, liquidity mismatch and high levels of interconnectedness with other parts of financial system. Indeed, part of NBFIs are particularly vulnerable to the interest rate changes due to the risks associated with these features. For example, the UK pension funds, an important form of NBFIs, slid into a crisis in September 2022 when a sharp rise of UK gilt yields led to large mark-to-market losses for them. Moreover, as analyzed by the IMF's Global Financial Stability Report of April 2023, asset management companies, insurance companies, hedge funds, structure finance vehicles and central counterparties are also likely to fall victims of high interest rates.

The property sector is also sensitive to interest rate changes. As shown in Figure 2.6, the property prices started to correct last year, albeit at different paces. In emerging markets, the property market correction came as early as the second quarter of 2022, immediately

after the US Fed started its rate hiking course. The residential property markets in advanced economies held well before the last quarter of 2022. It might be due to the fact that a lion's share of the mortgages loans are extended with a fixed rather floating rate. As such, households in these jurisdictions are less directly exposed to higher interest rates. For example, 80% of mortgages in the US were originated with a fixed rates lasting 15 years or more. This ratio is significantly higher than around 50% in Germany, which can partially explain why the US housing prices hold firmer than their Eurozone peers. Moreover, as pointed out in section 1, the monetary policy tightening is set to last longer in the Eurozone than in the US. Looking forward, the residential property sector in Europe might be subject to a greater pressure from high interest rates than the US.

2.5 Financial fragmentation risks give new impetus to de-dollarization

Rising geopolitical tensions have intensified concerns about the risk of global financial fragmentation. The ongoing Russia-Ukraine

have already prompted a number of advanced countries to impose various forms of financial sanctions on Russia, including the freezing Russia's central banks' asset and removing many Russian banks from the SWIFT system, aiming to weaken the country's financial capacity and severe its connections with the external world.

Given that geopolitical tensions show no signs of receding in the Middle East, Korean Peninsula, and more recently US-China relations, the market worries about the possibility that similar financial sanctions could be weaponized in the future, along with other forms of restrictions including embargoes, trade wars, seizure of assets, limiting access to capital and technology, screening of investment etc. People's concerns could eventually lead to global financial fragmentation. The de-dollarization could be one of unintended consequences of the financial fragmentation.

The USD dominance as an international currency

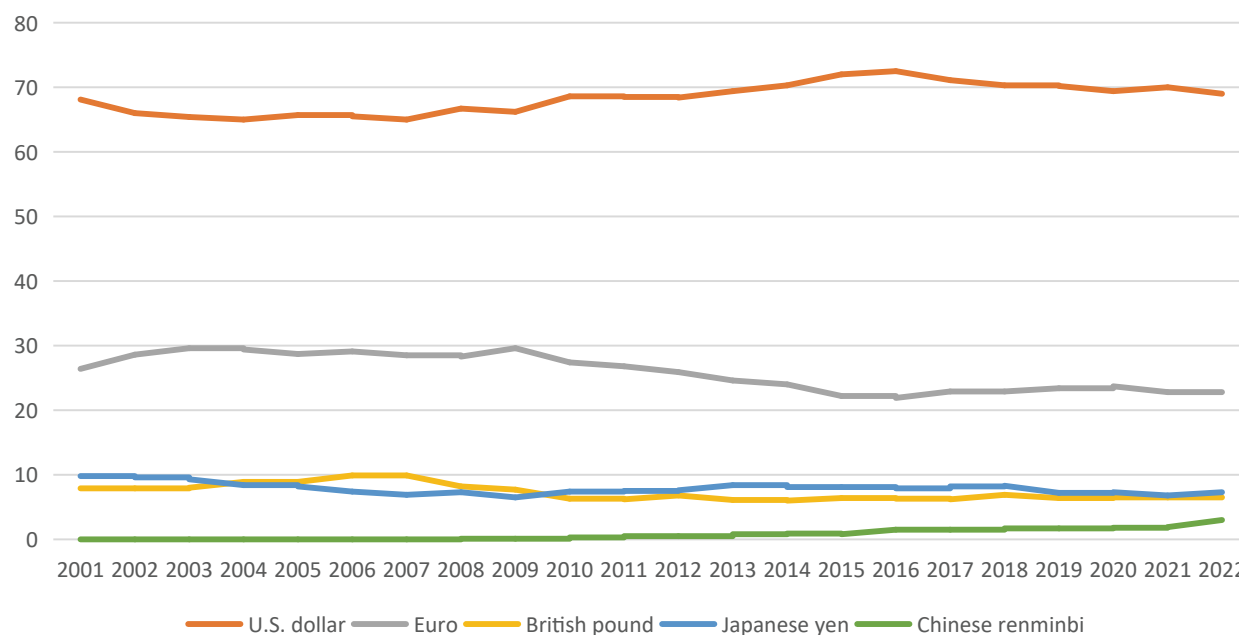The US dollar has been the dominant currency in the current international monetary system (IMS) for a long time, evidenced by Fig 2.7. It is widely used to settle cross-border transactions, both in trade and finance. It is the primary invoicing currency for major global commodities, including crude oil, copper, iron ore etc. USD-denominated assets make up the majority of foreign reserves held by governments and monetary authorities around the world. Furthermore, the private sectors outside the US also consider the greenback to be an essential form of storing their wealth.

To gain a better understanding of the USD's dominant role in the current IMS, it is helpful to examine it through the lens of the international currency's functions: serving as a unit of account, a medium of exchange, and a store of value. (Table 2.1)

The interest in the de-dollarization is on the rise

There has been a recent surge in interest among the international community regarding de-dollarization, which is being evidenced by a number of emerging signs. A few Gulf countries, including Saudi Arabia and the United Arab Emirates, are currently

Table 2.1: USD dominance in IMS (functional view)

Functions of International Currency	USD dominating performance in the areas
Unit of Account:	• Primary invoicing currency for major global commodities, including crude oil, copper, iron ore etc. • From 1999 to 2019, the USD was used for 96% of trade invoicing in the Americas, 74% in the Asia-Pacific region, 20% in Europe, and 79% in the rest of the world
Medium of exchange	• In addition to cross-border invoicing, the USD cash serves as a means of payment outside of the USA for overseas residents. • The banknotes (cash) of the USD have the largest amount of overseas circulation, estimated to be around USD 950 billion as of Q1 2021 (versus Euro: USD 350 billion equivalent)
Store of Value	• As of Q4 2022, the USD still accounted for 58% of globally disclosed official foreign reserves (versus Euro: 20%), although this has declined significantly from its position of 71% in 2000. • In private sector, more than 60% of foreign debt instruments are issued in USD, well ahead of the Euro (23%).

exploring the possibility of settling their crude oil exports in currencies other than the USD. In May, Brazilian President Lula and Argentine President Fernández vowed to devise a mechanism that would allow their local currencies to be used in bilateral trade instead of the USD. Furthermore, President Lula flagged the idea of creating a common currency for BRICS countries at their August summit in South Africa.

It is not a coincidence that the issue of de-dollarization has gained momentum under the current circumstance. Many emerging markets have long been fed up with the adverse spillovers of US monetary policy, which forced them to synchronize their policy with the Fed regardless of their economic situations. Apparently, the USD's hegemony of the current IMS constitutes the institutional foundation for such spillovers.

Moreover, the escalation of US-led financial sanctions against other countries have substantially raised emerging markets' concern about "currency weaponization" and prompted them to diversify their portfolios away from USD-denominated assets. Some countries that are devising or have already established the international clearing system of their local currencies. They are preparing for the worst scenario of global economic fragmentation.

Will this time be different?

It is not the first time for the USD hegemony to meet with grave challenges. Over the past seven decades after the World War II, the dominant role of the USD in the IMS has been tested during some episodes, including the breakdown of Bretton Wood system, the fast rise of Japanese Yen in the IMS during

Fig. 2.7: Index of International Currency Usage

Source: Federal Reserve, "The International Role of the U.S. Dollar" Post-COVID Edition,2023 by Carol Bertaut, Bastian von Beschwitz, and Stephanie Curcuru, IFF

1980s, the creation of the Eurozone etc. Nevertheless, the USD can always adapt to the violent changes of the international environment and secure a grip of dominance in the IMS.

A couple of factors suggest that this time might be different from previous challenges to USD hegemony. First, past challengers were US allies, and their currency competition took place amid deepening economic and trade ties. However, the US now appears determined to push for some degree of economic fragmentation with major competitors, particularly China and Russia. This rising risk of economic fragmentation could lead to a bifurcation of the global financial system and increased use of alternative currencies as discussed in the previous section.

Second, technological progress has made it possible to replace the USD in many scenarios. The rapid growth of electronic payment technology has reduced the demand for cash, and international travelers can now use mobile payment options instead of USD banknotes. Additionally, the development of cryptocurrencies has given rise to new

digital assets that could potentially become global safe assets in the future. Central banks worldwide are also exploring Central Bank Digital Currencies (CBDCs) to prepare for upcoming currency competition.

Nevertheless, even the most optimistic advocates of de-dollarization cannot envisage that the USD abdicates from its dominance of the IMS soon. The current de-dollarization trend, which even seems more sustainable than in the past, can at most lead to certain diversification of international currency usage but can barely shake the USD's dominance. In particular, we expect that the diversification will proceed on the following fronts in terms of its international currency functions.

Unit of Account:

Other currencies are going to erode the share of the USD in invoicing global commodity trade. In this respect, not only China is trying to denominate their imports of crude oil and iron ore in the RMB but also BRICS countries set out to push for the commodity trade invoicing in local currencies.

Moreover, there are more options available for invoicing or settling the international trade between non-USA countries. The Bank of International Settlement is piloting an umbrella program (M-bridge) to facilitate the local-currency clearing between countries. Several countries proactively invite foreign institutions to participate in their self-devised clearing system for cross-border settlement.

Medium of exchange

The popularization and development of electronic payment reduces the demand for cash. Although many foreigners will continue to hold the USD banknotes as an asset, their role as a payment means is set to be weakened among the international travelers.

This trend will become even more pronounced if more central banks unveiled their CBDCs. The size of greenback's overseas circulation will diminish.

Store of Value

Other countries used to favor USD denominated assets as their foreign reserves because they were the most liquid assets during bad times. Nowadays, more and more countries feel the need to guard against financial sanction risks associated with their foreign reserves. Therefore, it become a natural choice for many countries to diversify their portfolios towards gold and towards nontraditional reserve currencies, such as the RMB.

Moreover, central banks of emerging markets can consider to sign bilateral currency swap lines with their peers of big economies, China's PBOC or ECB etc. These bilateral currency swap lines can perform as a liquidity backstop if the country falls into a liquidity crunch.

Box: Financial vulnerabilities deteriorate in China but the authorities have adequate policy levers to maintain the stability of financial system

Following the Covid-19 pandemic, China's financial stability is facing significant challenges both domestically and externally. Domestically, the recovery has been slower than expected, which has prolonged the process of restoring financial health for households and corporations. The real estate sector, particularly private developers, has been heavily impacted by sluggish property demand and stringent regulations. Many developers have struggled to meet their debt obligations, leading to concerns about the stability of the sector.

Externally, the high-interest-rate environment in overseas markets, coupled with rising geopolitical risks, has put pressure on the exchange rate of the Chinese currency, the RMB. This has raised concerns about a potential downward spiral between currency depreciation and capital outflows. These factors have contributed to negative market sentiment regarding China's financial risks. Despite these financial vulnerabilities, it is unlikely that they will lead to systemic risks due to a combination of institutional and policy factors. The Chinese authorities have sufficient tools at their disposal to ensure the stability of the financial sector. They can implement various measures and policies to address the challenges and mitigate risks as needed.

Financial Vulnerabilities

Real estate market

After experiencing more than two decades of rapid growth, China's real estate market entered a period of adjustment in 2021 due to the impact of the Covid-19 pandemic and the implementation of strict regulations by the authorities. The market quickly lost momentum as households became more cautious about purchasing homes. Real estate developers, particularly those with stretched balance sheets, bore the brunt of this significant adjustment. Many private developers, including some of the largest ones, were unable to meet their debt obligations when housing sales plummeted. This further discouraged Chinese households from buying houses amidst the uncertain market conditions.

The challenges faced by the real estate market have put increasing pressure on China's financial sector. Apart from the development loans borrowed by real estate developers, the mortgage loans taken by Chinese households have also resulted in a substantial exposure of banks to the real estate sector. Additionally, numerous non-banking financial institutions, often referred to as the shadow banking sector, have their own exposures to the real estate market. For instance, reports have indicated that certain trust companies have distributed wealth management products (WMPs) to clients that are based on real estate assets. With the real estate sector encountering difficulties, clients may face difficulties in withdrawing their funds.

In light of these circumstances, the risks to the financial sector will persist and potentially worsen as long as the real estate market remains in turmoil. The exposure of banks and non-banking financial institutions to the real estate sector, coupled with the challenges faced by developers and the reluctance of households to engage in property transactions, create an ongoing concern for the stability of China's financial system. Monitoring the situation in the real estate market and its ripple effects on the financial sector will be crucial in assessing the potential risks and taking appropriate measures to mitigate them.

Indebtedness of corporate sector and local governments

China's corporate debt stands among the highest in the world, posing significant concerns for its financial stability. According to the Bank for International Settlements (BIS), the ratio of gross corporate debt to GDP in China was 158.2% as of Q4 2022. This exceeds the average levels of advanced countries (91.4%) and emerging markets (106.7%). The rapid accumulation of corporate debt in China can be attributed to the country's investment-led growth model, which encourages borrowing for infrastructure and real estate development.

Simultaneously, China's local government debt has also experienced substantial growth since 2017. The official figures from China's finance ministry indicate that local government debts amount to approximately RMB 37 trillion, equivalent to 30% of total GDP. However, this figure does not include implicit debt, which some experts estimate could double the total amount of local government debt if considered.

The high levels of debt in both the corporate and local government sectors create the potential for a wave of defaults during an economic downturn. The sluggish demand in the property market has already led to numerous real estate developers defaulting on their debt instruments or loans. If this wave of defaults spreads to other companies and local governments, lenders will face significant deterioration in the quality of their holdings. This situation could lead to systematic risks throughout the entire Chinese financial sector.

Financial Vulnerabilities

China's financial vulnerabilities are exacerbated by the high-interest-rate

environment in overseas markets. In order to stimulate domestic demand, Chinese authorities may need to implement looser monetary and fiscal policies. However, this could widen the interest rate differential between China and other countries, potentially dampening the exchange rate of the Chinese currency. Additionally, rising geopolitical risks have prompted some international investors to redirect their investments away from China's financial market.

The rapid depreciation of the currency, coupled with increasing capital outflows, creates the potential for significant systemic risks through a downward spiral effect. The initial depreciation of the currency may prompt more investors to withdraw their funds from the country. Subsequently, the escalating capital outflows put further pressure on the exchange rate, leading to a self-reinforcing cycle. These dynamics pose challenges to China's financial stability. The potential for a depreciating currency and capital outflows can impact the overall health

of the financial system, potentially creating systemic risks.

The aforementioned financial vulnerabilities require close monitoring and timely intervention from the authorities. However, several factors suggest that the chances of these vulnerabilities evolving into systematic financial risks in China remain low.

Firstly, the Chinese government exercises strategic control over the country's financial system. It has significant influence over major banks, financial institutions, and corporate sector borrowing and investment. This control enables proactive management of financial risks and the prevention of individual risk events from escalating into systematic risks. The government's ability to exert control makes it highly unlikely for a "Lehman moment" scenario to occur in China.

Secondly, China's financial system is relatively closed, with measures in place to restrict the free movement of capital into and out of the country. This insulation helps safeguard the

Chinese financial system from global financial shocks and reduces the risk of capital flight.

Thirdly, the Chinese government has made sustained efforts over the past decade to manage vulnerabilities and enhance the financial safety net. For instance, to address the real estate bubble, China previously implemented restrictive requirements on mortgage down payments, with a minimum of 30% for the first home and 70% for the second home. Only recently have authorities started to lower these down payment requirements to stimulate housing demand. Furthermore, since 2018, China's authorities have been regulating shadow banking activities, leading to a substantial decline in associated risks, as stated in the People's Bank of China's 2022 financial stability report. This regulation helps prevent contagion from the real estate sector to the financial sector.

Lastly, both China's public and private sectors possess important cushions against potential financial shocks. The Chinese government maintains a large amount of foreign exchange

reserves, amounting to USD 3.16 trillion as of the end of August 2023. These reserves serve as a buffer against external financial shocks, allowing for currency stabilization, support to the banking system, and fiscal stimulus during downturns. Additionally, China's household sector maintains a high saving rate, which has even increased recently due to precautionary motives. The high domestic savings provide ample liquidity to China's banking sector.

In sum, the likelihood of China's financial vulnerabilities escalating into systematic risks is currently low. The strategic control of the government, the relatively closed financial system, ongoing efforts to manage vulnerabilities, and the presence of important cushions in both the public and private sectors contribute to the resilience of China's financial system. However, continued vigilance and proactive measures will be essential to maintain financial stability in the face of evolving challenges.

Chapter 3: Review and Outlook on Global Green Finance Innovation and Policy Development

Foreword

The urgency of combating global warming and the imperative demand for sustainable development have prompted the international community to come to an agreement that addressing climate change is a universal challenge for all mankind at present and for a long time to come. To protect the environment, the trend of green development has become unstoppable, and the green finance market has entered a stage of rapid development.

Since 2022, despite the global market grappling with various adverse factors such as geopolitical tensions, economic downturns, energy crises, and food crises, the overall performance of the green financial market has remained relatively stable. The green development and progress have also received growing attention, and a series of positive consensus and agreements have been reached at international conferences. On November 6, 2022, at the 27th session of the Conference of the Parties of the UNFCCC (COP 27) all parties agreed to establish the Loss and Damages Fund to provide financial supports for climate-vulnerable countries to deal with negative consequences caused by climate change; the International Sustainable Standards Board (ISSB) officially issued its inaugural standards—IFRS S1 and IFRS S2 on June 26, 2023, which are the world's first unified sustainable development disclosure standards; in addition, China has launched and implemented climate investment and financing pilot program. These consensus and agreements have further promoted the efficient operation and high-quality development of the green finance market.

This report will review the latest trends and dynamics for different green financial instruments, gain insights on the new international green policies and mechanisms, and look prospectively to the future development of the green finance market.

I. Why green finance

In retrospect, the essence of green finance is to reconcile the imbalance between rapid human development and the natural environment protection, to correct market failures, with structured financial instruments, by putting prices on environmental rights, and to allocate social resources in a more efficient manner. At present, the market particularly distinguishes green finance from the traditional finance market, because for green projects, in addition to calculating the return on investment, financial institutions need to particularly identify projects' green attributes and measure their positive externalities to the environment. For projects with proven strong additional environmental benefits, non-market means, such as policy incentives shall be exerted to help environment-friendly projects acquire better and lower-cost financing sources if needed. Alternatively, carbon pricing/emission pricing mechanisms are also effective measures to force companies to pay for the additional environmental costs if they emit more pollutants, while climate-friendly companies and green projects could acquire additional financial returns by capitalizing on green benefits. In addition, distinguishing green finance also helps financial institutions with environment-related risk assessment and management.

The establishment of the Sustainable Development Goals (SDGs) by the United Nations in 2015 and the adoption of the Paris Agreement at the 21st Session of the Conference of the Parties (COP 21) to the UNFCCC are the two important milestones in promoting global action on sustainable development. To rapidly transition to green, low-carbon, and sustainable growth mode, the world needs to invest heavily in green and low-carbon technology research and development, and infrastructure construction, resulting in a huge demand for green finance. However, the green finance market still faces huge challenges to operate efficiently. First, the total amount of green finance required to achieve the goal of limiting global warming to 1.5 degrees Celsius as set by the Paris Agreement is huge, but the total green finance market is still too small, accounting for less than 5% of the overall financial market. Second, public sector funding and policy guidance have limited abilities to channel and scale up private sector funding into green and climate change initiatives. Green projects are often carried out in developing countries where the market mechanism is immature, which brings problems such as high investment cost, high risk, and information asymmetry. In 2020, the public sector invested more than $83.3 billion to help developing countries cope with climate change (Details shown in later chapters), but such great amount of funding only catalyzed 13.3 billion euros from the private sector, accounting for less than 16% of the total official climate finance flows. Third, the low-efficiency usage of green money due to market information asymmetry. Fourth, the maturity mismatch between green funds and green projects, since general green projects usually have a large investment in the early stage of the project and a long repayment period, while banks generally have a shorter debt maturity.

To promote further development of green finance, on the one hand, further actions shall be adopted to explore green finance instruments including the use of concessional loans, credit guarantees, blended financing and other instruments to improve risk-sharing mechanisms, to mobilize more private sector investment and ultimately to alleviate the maturity mismatch issue. On the other hand, Governments of all countries shall continuously develop effective policy and regulatory frameworks to further cope with market failures, and scale up the green finance market. In addition, for a smooth green transition, more attention is required on sustainable information disclosure, and climate risk management mechanisms.

Green finance has no unified definition, and the inconsistency of definition is also a challenge of green finance market development. Currently, major products in the current green finance market include green bonds, green loans/credits, green funds, guarantees, carbon credits, green insurance (such as climate or flood insurance), green leases, and green financial derivatives. Green finance covers green investment coming from private and public funds, including multilateral and bilateral financial assistance to support developing countries in mitigating and adapting to climate change. In addition, the concept of "climate investment and financing", which is currently frequently mentioned in China, has also been clearly defined as an important part of green finance. According to UNEP, the definitions and their scopes of green finance and several other financial terms on environmental rights are summarized as follows:

Figure 1 Alternative definitions of new finance
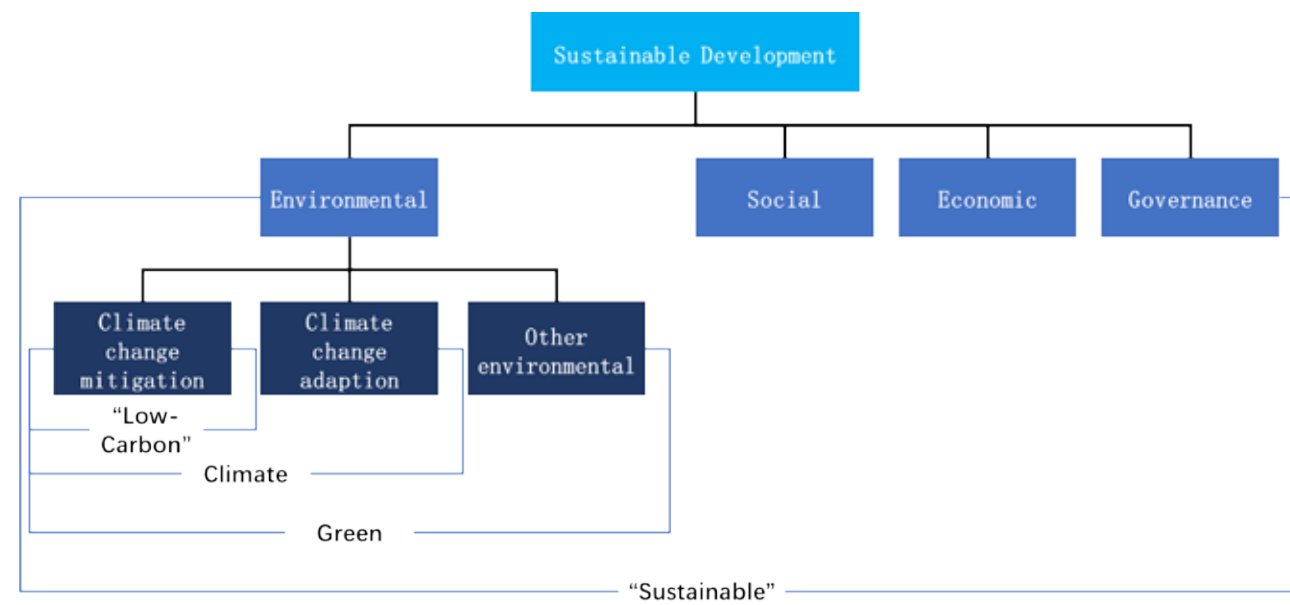
Source: United Nations Environment Programme. 2016. Inquiry: Design of a Sustainable Financial System - Definitions and Concepts - Background Note.

II. Review of the Green Finance Market Dynamics

Green investment and financing products are crucial tools to support green, low-carbon and sustainable development projects in all countries. In 2021, the overall green finance market experienced record-breaking growth, with green bond issuance almost doubled and green credit growing by more than 80%.

Turning to the carbon market, the European Union carbon market saw continuous growth in prices throughout 2021, reaching a historic high of 100.7 per ton at the beginning of 2022. After a slight dip in the second half of 2022, carbon prices again grew to nearly 100 per ton in March 2023 as the compliance deadline was approached. The voluntary carbon market also experienced rapid growth in 2021 and reached total market size of $2 billion, with its market size nearly quadrupling compared to 2020. In 2022, despite overall economic downturn pressures, the resurgence of the COVID-19 pandemic, and geopolitical conflicts in various countries,

the green finance market continued to remain steady.

In terms of green finance policies, since the end of 2021, policies, standards, and regulatory frameworks in the overall green finance market have been continuously improved. At COP26, the Glasgow Climate Conference, Parties reached a consensus on the implementation rules and procedures of the Paris Agreement. In addition, since the end of 2021, several new major climate policies have been adopted . These new climate policies and regulations are expected to have profound impacts on the overall trends and development of the green finance market, presenting new challenges and opportunities for various industries and businesses.

This chapter will introduce the performance of major green finance instruments, international market mechanisms, such as green bonds, green credits, carbon markets (including voluntary and compliance carbon markets), public climate funds, and individual countries' policy updates from the end of 2021 to 2023.

3.1 Green Financial Products

3.1.1 Green Bonds

Green bond is currently the most mature and widely used financial products in the field of green finance, and it dominates the current landscape of the green financial product market. The green bond market experienced a significant growth in 2021 and maintained high issuance level in 2022. According to data from the Climate Bonds Initiative (CBI), the global issuance of green bonds reached a total of $487.1 billion in 2022, with 741 issuing institutions from 51 countries and regions worldwide. Among them, China, the United States, Germany, the Netherlands, and France are the major issuing countries in the global green bond market. To be noted, in 2022, China surpassed the United States for the first time and became the largest issuer of green bonds worldwide.

As for currency composition of issued green bond, the Euro continues to maintain its dominant position. In 2022, the Euro (EUR) accounted for 42% of the total newly issued green bonds, followed by the US Dollar (USD) at 29% and the Chinese Yuan (CNY) at 10%. This correlation reflects the close relationship between the green bond issuance market and currency choices. In fact, Europe has been the world's largest green bond issuance market since 2014.

Figure 2 Green Bond Issuance in Major Issuance Markets in 2022
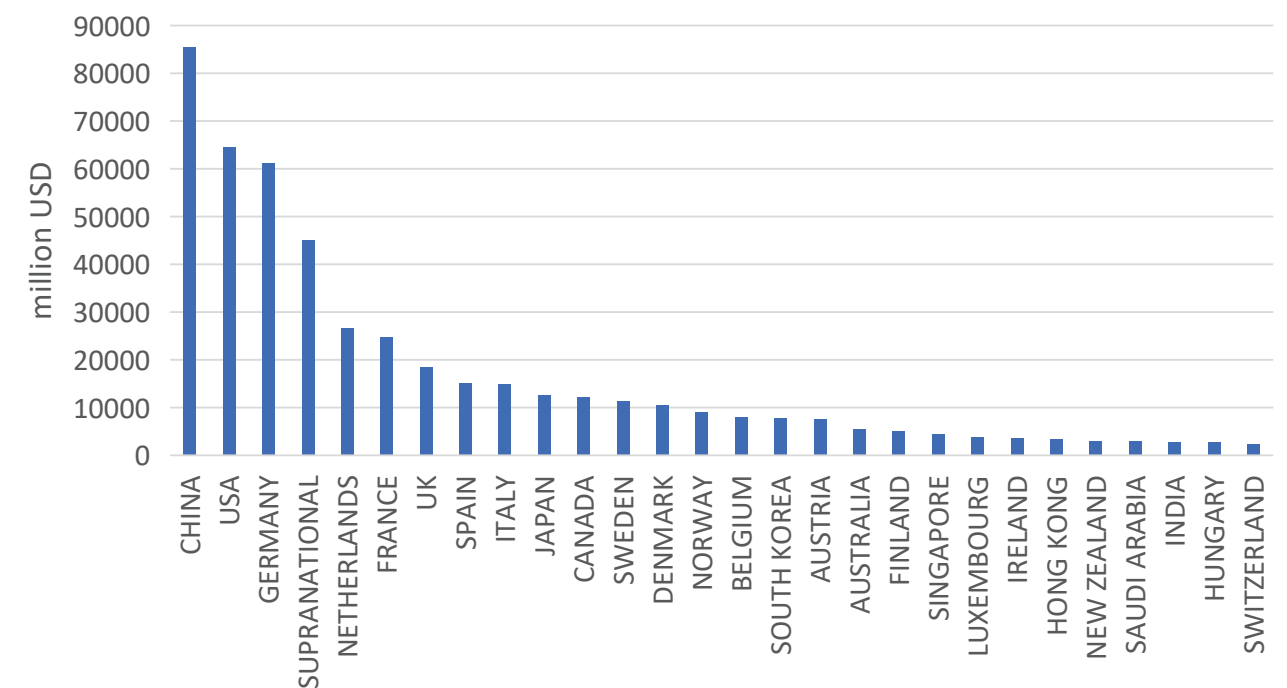
Data Source: CBI

Figure 3 Currency Composition of New Global Green Bond Issues in 2022
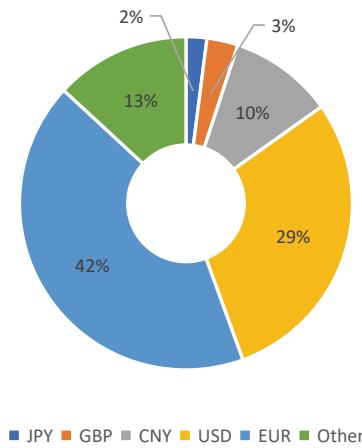
Data Source: CBI

In terms of industry classification, in 2022, out of all funds raised through green bonds globally, 37.3% of the funds were allocated to the energy sector, 29.5% went to the construction sector, and 19.72% were directed towards the transportation sector. Correspondingly, according to data from the International Energy Agency (IEA), energy, construction, and transportation sectors are currently among the top five sectors for carbon emissions in the world.

Figure 4 Global Green Bond Fund Allocation from 2014 to 2022

Data Source: CBI

It's worth noting that, although the global green bond market experienced its first decline in a decade in 2022 (with a 16% decrease in issuance compared to 2021 and a 24% decrea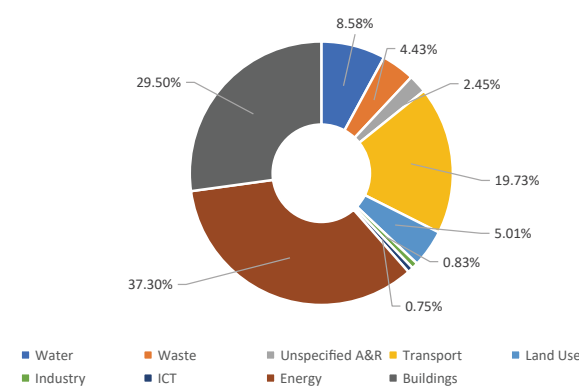se in the number of issuing institutions), the decline was more pronounced in Europe and North America, where green bond issuances decreased by 22.3% and 26.3%, respectively. In contrast, the Asia-Pacific region saw relatively stable green bond issuance, with an overall decline of only 6.9% compared to 2021. Combined with the overall performance of the market, the reduction in global green bond issuance is primarily attributed to the volatility of the global economic and financial performance, rather than the weakness of the green finance market itself.

Figure 5 Statistics on Green Bond Issuance
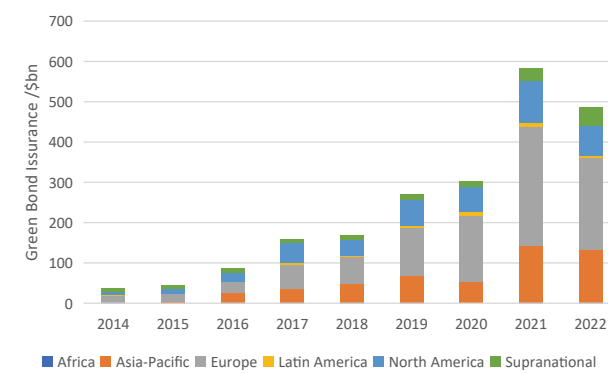
Data Source: CBI

In 2022, the impact of inflation caused by interest rate hikes and rising energy prices led to a decreased willingness among countries to issue bonds. This resulted in a 28.9% decline in global bond issuance in 2022 compared to 2021. In that sense, the 16% decrease in green bond issuance shall actually be outperformed the overall global bond market.

Figure 6 Comparison between Global Bond Market and Global Green Bond Market
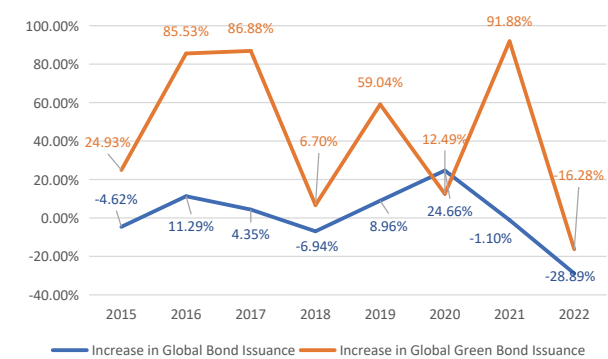
Data Source: CBI

Over the past two years, countries and international organizations have been working towards the mutual recognition of green finance standards to promote cross-border green capital flows. Previously, differences in the identification, assessment, and certification standards for green bonds among countries hindered the issuance and circulation of international bonds to some extent.

During the COP26, the International Platform on Sustainable Finance (IPSF), initiated by China and the European Union and other economic entities, released the "Common Ground Taxonomy (CGT)", a jointly recognized classification directory comprising 72 economic activities that make significant contributions to mitigating climate change. The Central Bank of Sri Lanka and commercial banks in Pakistan also referred to the CGT while developing local green finance classification directories. On 30 May 2023, China and the European Union officially launched Phase II of the "Common Ground Taxonomy." On 17 July 2023, the first batch of 193 Chinese green bonds that met the requirements of the "Common Ground Taxonomy" were labeled by the Green Finance Committee of the China Finance Association, marking the official adoption of the "Common Ground Taxonomy" in China. The mutual recognition of green standards among countries undoubtedly promotes further development in the green bond market.

Based on comparisons of the Common Ground Taxonomy, it can be seen that China's evaluation standards for green projects are primarily qualitative, and lack of quantitative criteria.

Except those activities such as the manufacturing of new energy equipment like photovoltaics where China has taken the lead in the development, the European Union generally has more stringent or more detailed assessment criteria, as well as more detailed disclosure requirements for projects' capital usage. However, starting from 2022, China initiated its climate investment and financing pilot program and has tried to formulate more systematic and detailed evaluation and information disclosure requirements for climate-friendly projects, which would further improve the evaluation standards of China's green projects.

3.1.2 Green Credits

Green credits are loans extended to raise funds for "green projects." Green loans are also one of the most commonly used debt financing tools for green projects. Unlike the decline in green bond issuances in 2021, the green loan market maintained robust growth in both 2021 and 2022. According to the Environmental Finance Database, the global issuance of green loans reached a record high in 2022, totaling $51.3 billion, representing a 43.7% increase from the previous year. These loans were issued by 221 institutions, nearly doubling from the previous year. In terms of financing costs, on average, green enterprises applying for loans from green banks tend to receive a discount of 50 to 59 basis points (Hans Degryse, 2023) compared to non-green enterprises, resulting in lower financing costs. China also introduces special-purpose loans to support low-carbon and energy-efficient development. For example, the People's Bank of China launched carbon reduction support tools at the end of 2021 to support the development of key green areas such as clean energy, energy conservation, environmental protection, and carbon reduction technologies. Through a direct lending mechanism known as "lend first, borrow later," the People's Bank of China provides funding support equivalent to 60% of the principal for qualified carbon reduction loans issued by financial institutions to relevant enterprises in key carbon reduction sectors, with interest rates as low as 1.75%.

While green loans, like green bonds, are essential tools in the green finance market, it's crucial to note that it's difficult to unify the statistical caliber in green loan

Figure 7 Global Green Loan Issuance and Number of Issuers
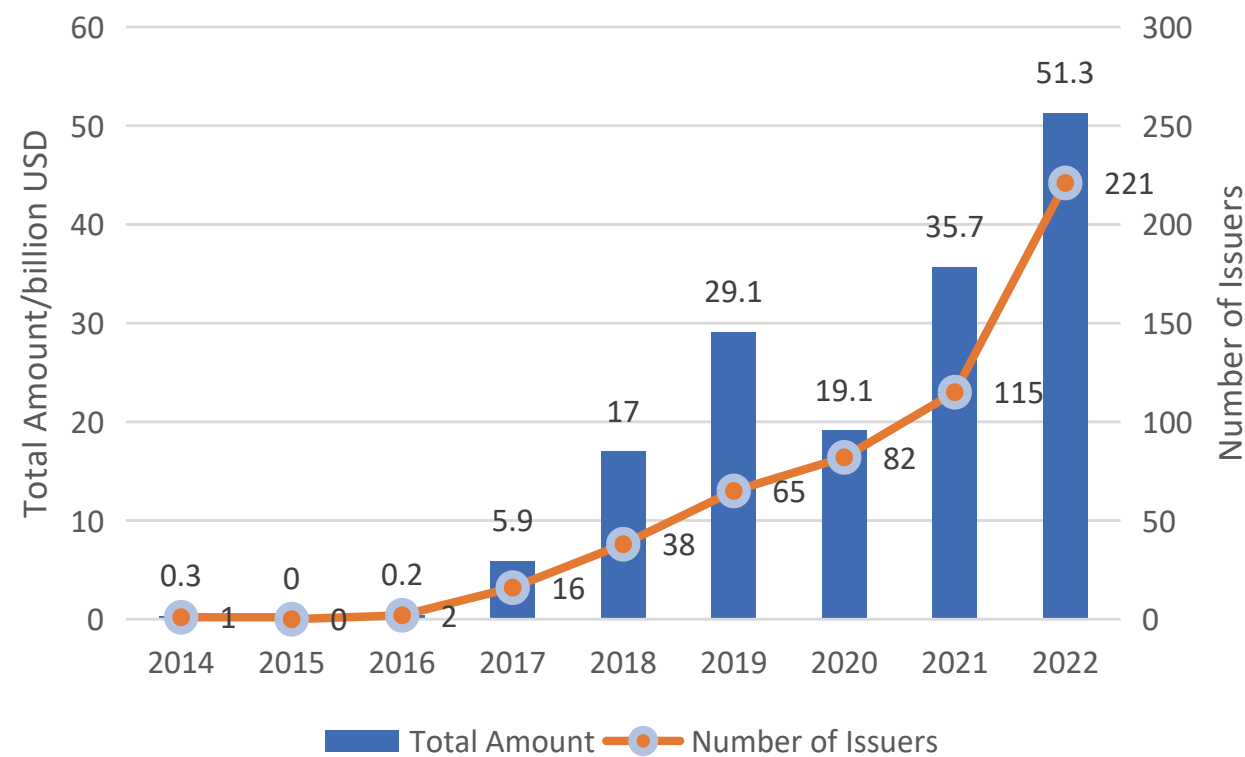
Data Source: Environmental Finance Database

certification standards and the comparability is poor among different countries and institutions, because different countries and institutions have great differences in green loan certification standards. Green bonds typically need to circulate in the secondary market, thus the certification standards within the same market are the same and are similar across different markets. While loans often involve bilateral transactions between the borrower and the lender. In many cases, even within the same market, different institutions may have varying green loan standards. Such differences can make it challenging to harmonize the statistical criteria for green loans. Therefore, the comparability of green credit scale between different markets will depend on the comparability of statistical caliber.

3.2 Carbon Markets

The carbon market is an important part of green finance. The carbon market uses market mechanisms to price carbon emission rights, which is currently the most mature market attempt to realize environmental benefits. The growth of the carbon market reached its highest level in nearly a decade in 2021 and remained high in 2022. The carbon market is further divided into carbon quota market (compliance carbon market) and voluntary emission reduction market. The following sections will analyze and illustrate the recent dynamics and development trends of carbon markets over the past two years.

3.2.1 Compliance Carbon Market

The compliance carbon market, also known as the cap-and-trade market or carbon quota trading market, is one of the carbon pricing mechanisms, another commonly used carbon pricing mechanism is the carbon tax. In a compliance carbon market, governments or international organizations typically employ a cap-and-trade mechanism, where policymakers set a total emissions

limit for a country or region and divide this limit into tradable emission allowances or permits. These emission allowances can then be bought and sold in the market. Carbon-emitting entities (such as factories and power plants) can purchase these allowances to comply with their emission limits, and entities with lower emissions can sell excess allowances for profit.

3.2.1.1 Global Compliance Carbon Market

Among all the carbon markets in the world, the most well-developed and widely followed carbon emissions trading market is the European Union Emissions Trading System (EU ETS). This is one of the largest and earliest-established carbon markets globally. The EU ETS covers carbon emissions from all 28 European Union member states, as well as Iceland, Liechtenstein, and Norway. This market currently encompasses sectors such as energy, industry, and aviation. According

to data from the World Bank, as of the end of 2022, there are a total of 73 carbon pricing mechanisms in operation worldwide, covering approximately 23% of global carbon emissions. The following chart, based on data from the International Carbon Action Partnership (ICAP), illustrates the carbon trading price trends for some of these major compliance carbon markets:

Overall, carbon prices are gradually rising. In 2022, developed countries such as Europe and the United States experienced significant inflation and rapid price increases, along with economic downward pressure. Nevertheless,
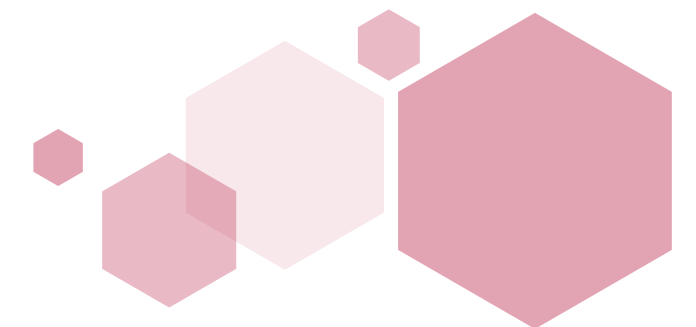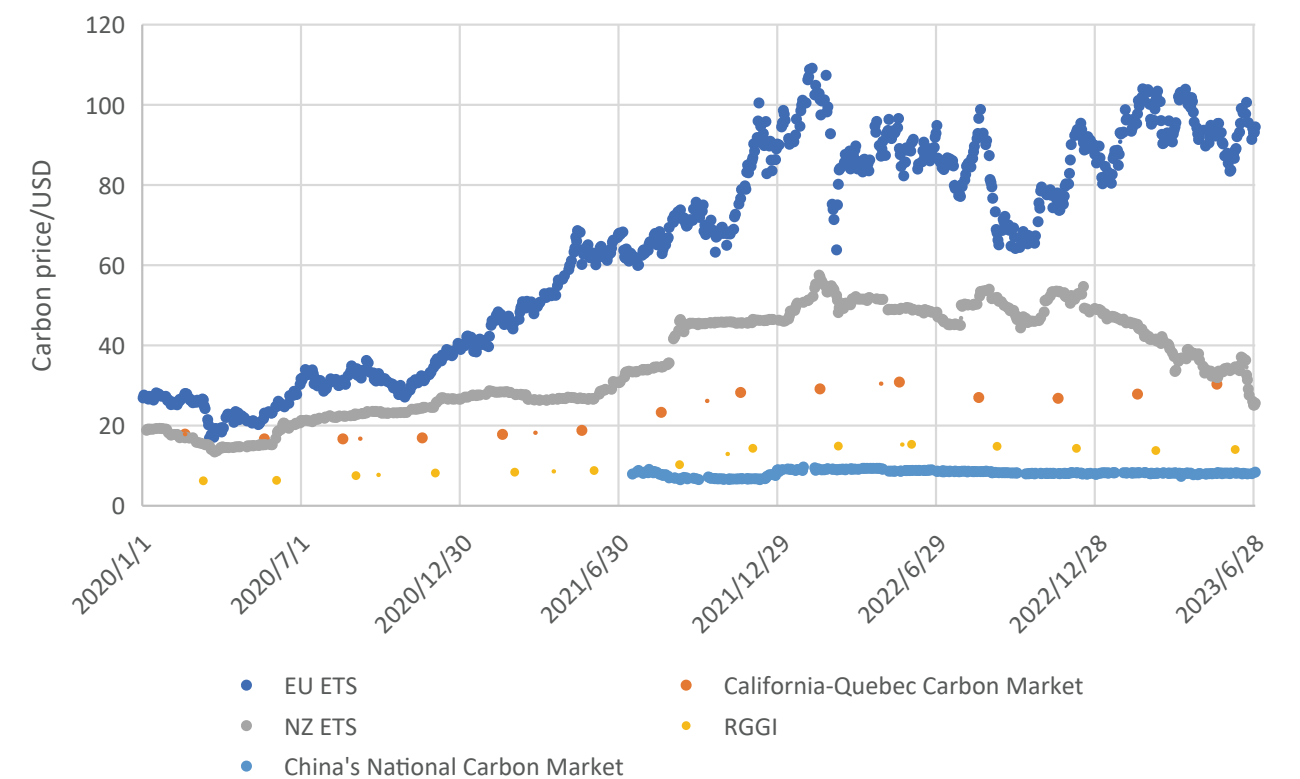

Figure 8 Carbon Emission Allowance Price Fluctuations in Some Carbon Markets

- EU ETS
- NZ ETS
- China's National Carbon Market
- California-Quebec Carbon Market
- RGGI

Data Source: ICAP

compared with the beginning of the year, the carbon prices at the end of 2022 remain stable, demonstrating carbon market's price resilience and stability in the face of inflation.

As demonstrated from the figure above, it shall be seen that there are substantial differences in carbon prices among different markets. For example, in China's national carbon emissions trading market, which began operating after 2021, carbon prices fluctuated around $10, representing only about one-seventh of the prices in the European compliance carbon market. The reasons for such significant differences are multifaceted, such as the supply of emission permits, marginal emission reduction cost, market maturity and other factors. These factors collectively affect the final carbon prices and price trends for each carbon market. Taking the European Union's carbon market as an example, its climate target is to reduce greenhouse gas emissions by 55% compared to 1990 levels by 2030. To ensure the timely achievement of EU's climate goals, the compliance carbon market quota supply needs to match its climate objectives. In 2021, the European Union Emissions Trading System (EU ETS) officially entered into fourth phase. The fourth phase of the EU Emissions Trading System in 2021 increased the annual total

emission reduction factor from 1.74% to 2.20% compared to the third phase, and raised the manufacturing sector's free allocation benchmark to make the emission reduction target more stringent, which ultimately led to more active trading in the EU carbon market in 2021 than other carbon markets (CEEP BIT, 2022). In contrast, developing countries face significantly different situations in the supply and demand dynamics of their carbon markets due to variations in climate targets, policy measures, and market conditions. China's climate targets are to peak emissions before 2030 and achieve carbon neutrality by 2060. Currently, China is still in the emissions peaking phase, the overall free quota allocation accounts for a relatively large proportion, resulting in lower compliance pressure on enterprises. Additionally, China's carbon financial derivative trading is still in its preliminary stages and limited to regional pilot carbon markets, with relatively low overall trading volume and liquidity, the further affecting the equilibrium of carbon supply and demand.

Recently, there has been discussion about establishing a global unified carbon pricing mechanism. However, at present, there are substantial differences in emission reduction targets, development stages, and economic

structures among different countries. The uniform carbon price may distort the status and role of the carbon market, and lose the carbon markets' price discovery function in the local emission rights capitalization process. Furthermore, according to the UNFCCC principle, developed and developing countries share a "common but differentiated responsibility" for global climate action. Having a unified carbon price is against this principle and is unfair to developing countries, thus the idea of having a unified carbon pricing mechanism is difficult to implement in short term.

3.2.1.2 China's Compliance Carbon Market

China's carbon market, comprised of the compliance carbon market, i.e., national carbon market, and regional pilot carbon markets including Beijing, Tianjin, Shanghai, Chongqing, Hubei, Guangdong, Shenzhen, and Fujian, currently operates in parallel. The Chinese compliance carbon market generally applies both free allocation and auction, with free allocation being the dominant approach and auction accounting for a smaller proportion. Starting in 2022, several pilot carbon markets began accelerating their practice of auctions. For example, in November 2022, Beijing held its first auction since 2013, generating a total revenue of 113 million CNY (16.4 million USD). In August 2022 Shenzhen also conducted its second auction since 2014 (World Bank, 2023). As of the end of 2022, according to the data of the Shanghai Environment Exchange, the total trading volume in China's carbon markets had exceeded 10 billion CNY (1.37 billion USD).

China's national carbon market currently only covers the power generation sector. The power generation industry is the first sector to be included in the national carbon market mainly because it has the highest carbon emissions, accounting for more than 40% of the national emissions. Additionally, power industry enterprises are generally large at

scale, having good quality data collection, which makes it easier for supervision and operation as the first sector to be included in the carbon market. According to the national plan, during the "14th Five-Year Plan" period, China's national carbon market will gradually and systematically expand to cover all eight high-energy-consuming industrial sectors: power generation, building materials, steel and iron, non-ferrous metals, petrochemicals, chemicals, papermaking, and aviation.

3.2.2 Voluntary Emission Reduction Markets

The voluntary emission reduction market refers to the carbon trading market formed and participated by enterprises on their own initiative. Unlike compliance carbon markets, the primary trading instruments in voluntary emissions reduction markets are carbon credits. Currently, the voluntary emissions reduction market mechanisms are mainly composed of three categories:

- National voluntary emissions reduction mechanisms in various countries, such as China Certified Emissions Reductions (CCER).
- International carbon reduction mechanisms, such as the Clean Development Mechanism (CDM).
- Third-party independent voluntary emissions reduction mechanisms, such as Verified Carbon Standard (VCS), Gold Standard (GS), Carbon Registry (CAR), etc. These mechanisms aim to reduce or offset greenhouse gas emissions through the implementation of sustainable projects. They differ in terms of the sectors they cover, the methodologies for project registration, and the types of carbon offset credits issued.

Carbon reduction credits verified and issued through these three categories of mechanisms are known as carbon credits and are traded in the voluntary emissions reduction market. One carbon credit is

Figure 9 Issuance of Carbon Certificates for Major Mechanisms, 2014-2022
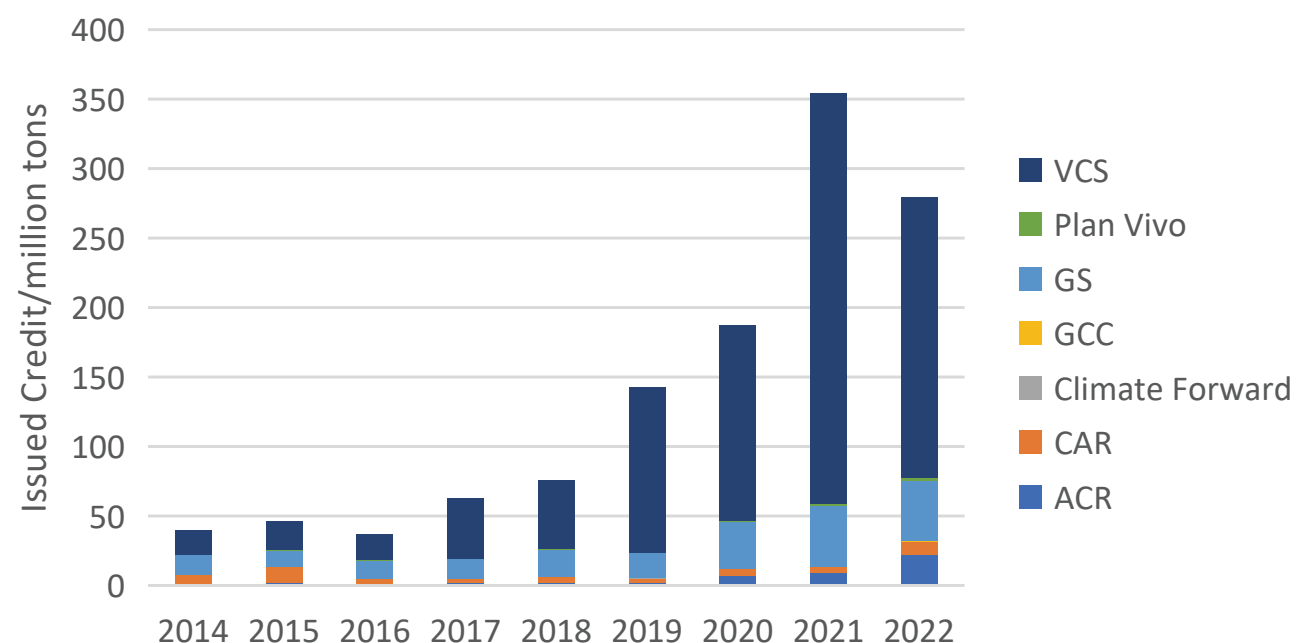
Data Source: Climate Focus Voluntary Carbon Market Dashboard

equivalent to one metric ton of carbon dioxide equivalent emission reduction. In the voluntary emissions reduction market, individuals, organizations, or companies can voluntarily buy and sell certified emissions reduction units, such as carbon offsets and emission reduction certificates.

3.2.2.1 Global Voluntary Emission Reduction Mechanism

According to the latest report from the World Bank, as of the end of 2022, out of the 475 million carbon reduction credits issued in the global voluntary carbon market, 58% were issued by third-party independent voluntary emissions reduction mechanisms and standards (275 million). The voluntary emissions reduction market continued to expand in the past two years. In 2021, the global voluntary emissions reduction market grew rapidly, reaching a historic high of 2 billion USD, which is four times the market size in 2020. It is estimated that by 2030, the size of the voluntary emissions reduction

market will reach between 10 billion and 40 billion USD (BCG, 2023).

Due to various factors, including the impact of the global macroeconomic situation, the issuance of global carbon reduction credits decreased by 21% in 2022 compared to 2021. Apart from the impact of macroeconomic factors, several uncertainties, including the lack of a unified regulatory framework and monitoring mechanism, might constrain the integrity and quality of carbon markets and carbon credits. First, the global voluntary carbon market has not yet established a unified specification and supervision mechanism on emission reduction activity. Due to the lack of uniform carbon credit quantification, certification and issuance regulations, the carbon credits issued by the voluntary carbon market face questions about double counting, lack of additionality, and lack of contribution to sustainable development, resulting in some carbon credits being accused of "greenwashing". At present, carbon credit issuing agencies are improving the transparency of emission

reduction activities and improving the quality of carbon emission reduction credits through mandatory information disclosure and exploring the use of digital monitoring reporting and verification (MRV) technology. Secondly, some national governments, such as Indonesia, are restricting the trading of carbon credits between their own countries and the international carbon market, which caused concerns among international carbon credit buyers. Those countries worried about that the sale of carbon credits may affect their ability to meet the target of National Determined Contributions, and therefore restrict the participation in the international market for voluntary carbon emission reduction credits.

3.2.2.2 China's Voluntary Emission Reduction Mechanism: CCER

The China Certified Emissions Reduction (CCER) is the voluntary carbon emissions reduction trading market implemented in China. CCER projects cover multiple areas, including energy efficiency improvements, renewable energy development, forestry carbon sink and agriculture greenhouse gas emission reductions. The CCER mechanism has been in operation since 2015 and was suspended in March 2017, mainly because the limited demand for CCER leads to a small trading volume, and also because there are some operation issues . However, since China announced its national carbon emission peaking target and carbon neutral target in September 2020, there has been a growing call to restart the CCER. In June 2023, the Ministry of Ecology and Environment issued a note seeking public input on the greenhouse gas voluntary emissions reduction methodology proposals. On 7 July 2023, the Ministry of Ecology and Environment publicly solicited public opinions on the "Management Measures for Voluntary Greenhouse Gas Emission Reduction Trading (Trial)". The issuance of these two notes conveyed a clear message to the market that the government intends to accelerate the restart of the

voluntary emission reduction market. The CCER is expected to restart by end of 2023. The restart of CCER market will undoubtedly significantly increase the activity of China's national carbon market.

3.3 International Green Finance Policy review

3.3.1 Official Climate Finance flows

At the COP 15 of UNFCCC in Copenhagen, Denmark, a an agreement was achieved to mobilize $100 billion annually for developing countries by 2020. The 2010 Cancun Conference of the Parties (COP 16) agreed to establish the United Nations Green Climate Fund to take this business forward.

Currently, all funds provided through bilateral, regional, and multilateral channels, as well as private sector funds mobilized through public interventions, are counted towards the official climate finance goal. Additionally, various types of climate finance provided through financial instruments (grants, concessional loans, non-concessional loans, equity, guarantees, insurance) also count towards the $100 billion target. At the request of developed countries, the OECD collects statistics annually on the implementation of the $100 billion pledge by developed countries, and the latest available OECD official climate finance data is for 2020, as shown in Figure below.

The official climate finance flow is divided into two major categories: adaptation and mitigation in terms of the total amount, official climate finance flows from developed countries to developing countries have been on the rise since the Paris Agreement came into force at the end of 2016. In 2020, the total amount of official climate finance flows reached US $83.3 billion, but it still has not yet reached the promised target of US $100 billion per year.

Figure 10 Official Climate Finance by Sources
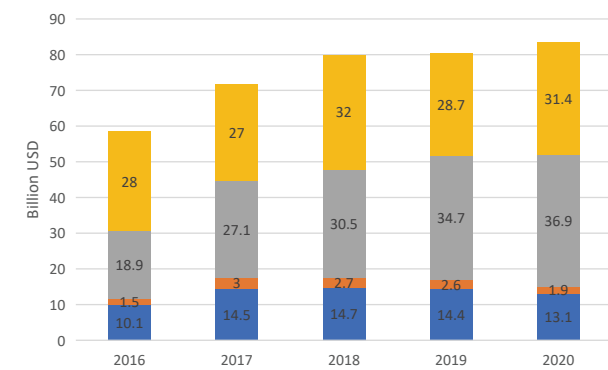
Data Source: OECD

In 2020, public climate finance (including bilateral funds from developed countries and multilateral funds) saw some growth and continued to share the largest part of the total climate finance (at $68.3 billion, accounting for 82%). Private sector funds mobilized through public interventions slightly decreased ($13.1 billion) compared to previous years, and climate-related export credits remained limited ($1.9 billion).

In terms of the use of climate funds, official climate finance primarily flowed into the area of climate mitigation, but the least developed countries and small island states receive a large proportion of climate adaptation funds. When looking at the overall amount, only about 8% of the funds provided by developed

Figure 11 Official Climate Finance by Purpose

Data Source: OECD

Figure 12 Official Climate Finance Flows Grouped by Income Countries, 2016-2020

Data Source: OECD

countries flew to low-income countries, and approximately one-quarter flew to Africa. Both regions are highly vulnerable to the adverse effects of climate change and are home to most of the world's poorest population (UN, 2023).
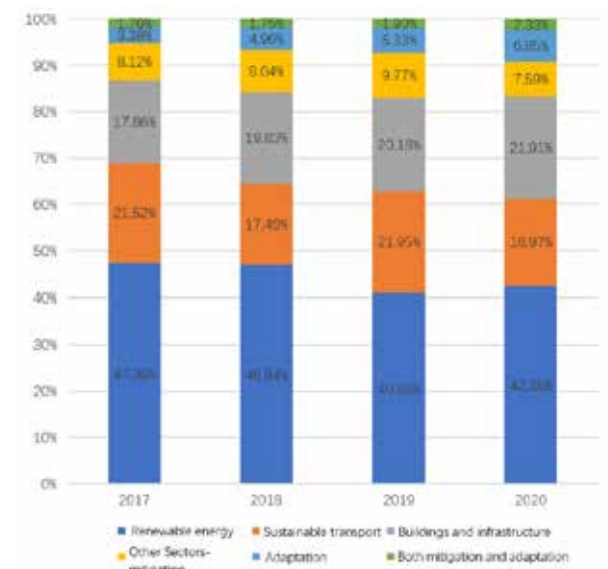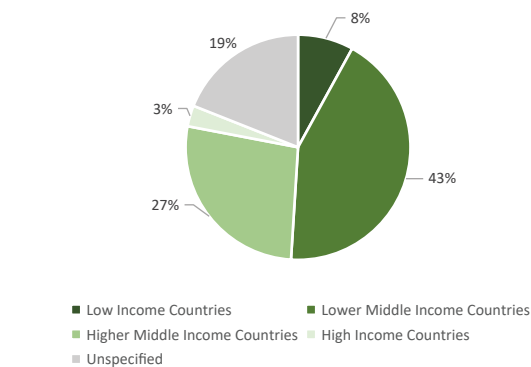
Regarding financial instruments, loans constituted the largest amount, accounting for over 70% of official climate finance flows and mainly flowing to middle-income countries. Equity investments and private sector funds mobilized by public climate finance of developed countries made up a smaller proportion. Moreover, private sector funds mobilized by public climate finance of developed countries showed growth from 2016 to 2017, stagnated from 2017 to 2019, and experienced a slight decline in 2020.

In recent years, developed countries tried to catalyze more private-sector climate finance by using public funds as seed investments. However, data suggests that leveraging private-sector climate finance with public funds remains challenging. The total demand for climate finance far exceeds $100 billion annually, thus it's a precondition using public finance resources to catalyze more private sector funding in order to reach the 1.5-degree Celsius target set by the Paris Agreement. As a result, more effective and innovative financial instruments, such as blended finance instruments and risk-sharing mechanisms, should be actively explored to mobilize more private sector capital flows to developing countries to address climate change.

In addition to the lack of effective mechanisms for attracting equity and private sector funds to developing countries, achieving the $100 billion per year target currently still faces other issues and challenges:

- Multilateral and bilateral banks provide most of the official climate finance flows, and their nature as risk-bearing institutions determines that they are more likely to use debt instruments to finance projects in middle-income countries with larger and more secure future cash flows back. This leads to a situation where countries in most need of climate finance, including the least developed countries and small island countries, are not the primary recipients of official climate finance.
- Many developing countries, especially the least developed ones, lack the capacity to formulate and implement climate finance projects, as well as to access and manage international funds effectively. This limits their ability to access more public finance funds.
- Small island countries and climate-fragile countries and regions need more adaptation investments. If these funding gaps are not filled soon, as climate disasters become more frequent over time, and the demand and supply gap may be scaled up even further.

Therefore, in addition to urgently meeting the annual $100 billion target, international climate funds should also further optimize and reform in its composition and structure to address climate change more effectively and to achieve the 1.5-degree Celsius warming target.

3.3.2 Carbon Boarder Adjustment Mechanism (CBAM) of the EU

The EU's CBAM Regulation (Regulation [EU] 2023/956) officially came into effect on 17 May this year. On 17 August, the EU formally published the transitional implementing rules for the Carbon Border Adjustment Mechanism (CBAM). According to implementation details, the CBAM will enter its transition period in October 2023.

During the transition period, traders are only required to report the implied emissions of their CBAM-covered imported products and are not required to pay for any financial charges. After the transition period, the EU will gradually impose a carbon border adjustment tax on the direct emissions of steel, aluminum, cement, fertilizer, electricity and hydrogen, and indirect emissions of some industries under certain conditions. In the transition phase, CBAM will provide higher free carbon allowances, which will be gradually reduced, and to zero in 2034.

The EU's CBAM is the world's first officially implemented one. Although the trade volume and carbon emissions initially involved by CBAM may not be substantial, it has opened a direct pathway to impact global industries and companies' carbon emission reduction efforts, profoundly affect international trade, international finance, and thus shape a new international political and economic order centered around carbon reduction.

The implementation of CBAM will prevent EU industries from losing competitiveness due to significant carbon reductions and will increase fiscal revenue for EU member states. However, its impact on certain developing countries, especially small economies, could be substantial. For instance, Mozambique is one of the severely affected economies as over 20% of its exports is aluminum to the EU countries. After the implementation of CBAM, Mozambique is expected to face an annual carbon border adjustment tax as high as 3500 million euros.

Currently, CBAM has a limited impact on China's overall export trade. According to data from the General Administration of Customs, in 2022, CBAM-covered steel and aluminum products accounted for

approximately 2.4% and 0.7%, respectively, of China's total exports to the EU. Exports of fertilizers, cement, and hydrogen were even smaller. Additionally, aluminum has relatively high indirect emissions, but CBAM currently does not account for indirect emissions from steel, aluminum, or hydrogen. Therefore, the direct impact on the aluminum export industry is limited. However, CBAM's implementation sends a clear signal to Chinese export companies, which will motivate them to conduct internal carbon accounting and implement carbon reduction measures, in preparation for the further expansion of carbon border taxes to other countries and industries.

Moreover, the implementation of the EU's carbon border tax has already prompted other developed countries to consider similar mechanisms. Currently, other developed countries, including the United States and Canada, have indicated their intentions to introduce their own CBAMs. On the other hand, the EU has mentioned that the industries subject to border carbon taxes in this instance are just the first batch, and more carbon-intensive industries may be gradually included in the CBAM in the future. Therefore, the scope of CBAM's impact extends far beyond what is currently seen.

3.3.3 Just Energy Transition Partnerships (JETP)

The Just Energy Transition Partnership (JETP) is a new international climate financing cooperation mechanism that emerged at the 26th Conference of the Parties (COP26) to the UNFCCC held in Glasgow. During COP26, France, Germany, the United Kingdom, the United States, and the European Union pledged to mobilize $8.5 billion to support South Africa in promoting just energy transition. Following South Africa, the second batch of countries joined JETP, including India, Indonesia, Vietnam, and Senegal. The group of donor parties has expanded to other developed countries, multilateral development banks, and national development banks.

Currently, South Africa, Indonesia, Vietnam, and Senegal have completed JETP negotiations and signed agreements with the donor parties. India began negotiations with the G7, as well as Norway, Denmark, and the EU, on JETP issues in October 2022 but has not been able to sign the JETP agreement due to its unwillingness to reduce domestic coal consumption. More details of the JETP agreements could be referred in the table below:

Table 1 Signing Status of the JEPT Agreements

Beneficiary Country	Donor	Signed Time	Amount	Targets
South Africa	France, Germany, the UK, and the US	2021.11.2	8.5 billion USD	Reduce emissions by 1-1.5 billion tons over the next 20 years and support South Africa in phasing out coal and accelerating the transition to a low-emission and climate-resilient economy.
Indonesia	The US, Japan, Canada, Denmark, the EU, France, Germany, Italy, Norway, and the UK	2022.11.15	20 billion USD in total, where 10 billion USD comes from public sector, and the other 10 billion USD is coordinated by the Glasgow Financial Alliance for Net Zero (GFANZ) from the first batch of private investments	By 2030, achieve the peak total emissions from the power sector, anticipating the expected emission peak. By 2030, limit carbon dioxide emissions from the power industry to 290 MtCO2e , lower than the baseline of 357MtCO2e . Establish the goal of achieving net-zero emissions in the power industry by 2050, advancing Indonesia's power sector net-zero emissions goal by ten years. Accelerate the deployment of renewable energy, aiming for renewable energy generation to account for at least 34% of the total electricity generation by 2030. Compared to the current plan, the total deployment of renewable energy during this decade is expected to roughly double.
Vietnam	The EU, the UK, France, Germany, the US, Italy, Canada, Japan, Norway, Denmark.	2022.12.14	15.5 billion USD in total, where 7.75 billion USD comes from public sector, the other 7.75 billion USD are from private money	Accelerate decarbonization of the power system, reducing the net-zero peak from the current 280 MtCO2e to 240 MtCO2e by 2035, with the goal of achieving a peak in power generation emissions of no more than 170 MtCO2e by 2030. Reduce the reserve capacity of coal-fired power projects in Vietnam, with the current planned peak capacity of 37 gigawatts aiming to reach a peak of 30.2 gigawatts. By 2030, ensure that at least 47% of electricity generation comes from renewable energy sources, surpassing the original plan of 36%.
Senegal	France, Germany, the EU, the UK, Canada	2023.6.22	2.5 billion EUR (2.635 billion USD)	Accelerate the deployment of renewable energy to increase its share in Senegal's installed capacity to 40% by 2030 and release a Long-Term Low Greenhouse Gas Emission Development Strategy (LTS) at COP28, followed by a new Nationally Determined Contribution (NDC) at COP30.

While JEPT is a way for developed countries to help developing countries achieve net zero transition and meet their climate commitments, within the current international energy landscape, the structure and approach of just energy transition investment for recipient countries (such as Indonesia and South Africa) has also attracted some critical discussions.

Currently, recipient countries usually heavily rely on cheap and high-emission energy sources like coal for power generation. These enterprises often carry significant debt burdens. On the other hand, the so-called "grants" announced as part of the partnerships actually involve a mix of various financial instruments, including grants, concessional and regular commercial loans, World Bank loans or guarantees, and uncertain combinations of private sector equity investments. The proportions of these different forms of investment are not explicitly outlined and the variations in investment forms can be significant. If recipient countries primarily receive commercial loans or equity investments, then after building new renewable energy facilities, these countries' power plants will be responsible for servicing existing coal-related debts plus new debts for constructing renewable energy generation facilities.

Therefore, despite the apparent magnitude of the Just Energy Transition Partnerships, if the financial structures received from JEPT do not align with the current situations in these developing countries, the debt burdens of these developing countries may be exerted even heavier. Hence, developed countries should refine the structure of the funding provided to ensure the realization of a genuinely "just transition" commitment.

3.3.4 IMF "Resilience and Sustainability Trust"

The International Monetary Fund's (IMF) Resilience and Sustainability Trust (RST) provides economically affordable long-term financing to low-income, vulnerable medium-income countries, and small economic entities. The Trust aims to help these countries establish external impact-resistant ability, ensure sustainable economic growth, and facilitate these countries' ability to maintain the long-term balance of payments and stability. This fund serves as a significant complement to the IMF's existing lending tools by offering long-term, low-cost financing sources to address long-term challenges, including climate change and pandemic preparedness. The funding for RST primarily comes from voluntary contributions from IMF member countries with strong external economic resources. This includes countries that wish to allocate Special Drawing Rights (SDRs) to low-income and more vulnerable medium-income member countries. RST aims to raise 33 billion SDRs (approximately 42 billion USD) to meet the anticipated lending demand and maintain adequate reserve accounts.

As of 30 June 2023, 13 member countries have signed donation agreements totaling 27.6 billion SDRs (approximately 36.7 billion USD) and have made good progress in finalizing these agreements to fulfill the commitment of 31.2 billion SDRs (approximately 41.5 billion USD). The specific contributions are as follows:

RST offers a repayment term of 20 years, with a grace period of 10.5 years. For RST borrowers, their financing is capped at 150% of the IMF quota or 1 billion Special Drawing Rights, whichever is smaller. In addition, an upper-credit-tranche (UCT) standard program with at least 18 months remaining at the time of the approval of the RST is also required. Additionally, RST is strictly tied to reform progress, with each RSF expenditure associated with a reform measure. These reforms can be a single policy action or could also be part of a series of reforms or linked actions. If a reform measure includes several actions, the RST shall not be paid until all actions have been implemented.

Table 2 Contribution of IMF Member Countries to the RST

	SDR (billion)	USD (billion)
Total Commitments	312	415
Of which: basket of contributions with loan resources	261	348
Total Received	276	367
Of which: basket of contributions with loan resources	225	299
Australia	9	12
Canada	14	18
China	60	80
France	31	41
Japan	50	66
South Korea	9	12
Lithuania	1	1
Netherland	12	16
Oman	0.4	1
Spain	14	19
The UK	25	33
Of which: independent contributions	51	68
Estonia	0.3	0.3
Germany	51	67

RST officially commenced operations on 1 May 2022, and as of June 2023, the first three countries—Barbados, Costa Rica, and Rwanda—have received final approval for RST funding. Costa Rica, Barbados, Rwanda, Bangladesh, Jamaica, Kosovo, Seychelles, and Niger have already received Reform-Supporting Financing (RSF) support to implement RST.

However, there are also critics of the rapid development of RST. Under the current RST rules, recipient countries may find it challenging to fully absorb funds from RST. There are in total 142 countries eligible for RST, and only 26 of them have Upper Credit Tranches (UCT) programs that exceed 18 months, and the maximum borrowing amount of these 26 countries is only $16.1 billion. This implies that the IMF needs to negotiate UCT programs with more countries to enable them to access RST funding, which adds more complexity and resource costs to the RST process. Overall, the rapid development of RST presents certain challenges, and the IMF may need to continuously adjust its policies and rules to ensure that more countries can be fully benefit from the program and effectively absorb funds from the program.

3.3.5 The Latest Developments in Other International Policies

3.3.5.1 UNFCCC COP27

The COP27 conference, held in Sharm El Sheikh, Egypt, in November 2022, concluded after a two-day extension, with mixed results. On the positive side, COP27 adopted the "Sharm El Sheikh Implementation Plan" and established "Loss and Damage Fund" for vulnerable countries and regions. The establishment of the fund marks a positive progression in resolving this long-standing unresolved issue. Additionally, the conference reaffirmed the goal of limiting global warming to 1.5 degrees Celsius and called for a global reduction in greenhouse gas emissions by half by 2030. COP27 also released the first report from the High-Level Expert Group (HLEG) on Non-State Entity Net-Zero Commitments, which criticized "greenwashing" behavior and provided a roadmap for net-zero commitments.

On the other hand, the United Nations Environment Programme released the Emissions Gap Report 2022 before the opening of COP27, pointing out that according to the current climate policy implementation efforts, the global temperature is expected to rise by 2.8°C above pre-industrial level by the end of this century, and even with the full implementation of the nationally determined contributions, the temperature rise is expected to be limited to 1.8-2.1°C. Current policy mechanisms and nationally determined contribution commitments are insufficient to achieve the goal of limiting global warming to 1.5°C.

3.3.5.2 ISSB Releases Its First Set of International Sustainability Disclosure Standards.

On 26 June 2023, the International Sustainability Standards Board (ISSB) officially released the "International Financial Reporting Sustainability Disclosure Standard No. 1 - General Requirements for Sustainability-Related Financial Information Disclosure" (IFRS S1) and the "International Financial Reporting Sustainability Disclosure Standard No. 2 - Climate-Related Disclosures" (IFRS S2). Both standards will come into effect from 1 January 2024. Different countries could adopt transitional measures before formal disclosure, depending on their specific circumstances. The disclosure requirements outlined in IFRS S1 are designed to enable companies to report to investors on the sustainable-related risks and opportunities faced by companies in the short, medium, and long term. IFRS S2 specifies specific climate-related disclosures to be used in conjunction with IFRS S1.

The ISSB was initiated by the International Financial Reporting Standards Foundation (IFRS) and was announced at COP26 in Glasgow in 2021. The primary responsibility of the ISSB is to develop sustainability reporting standards that align with International Financial Reporting Standards (IFRS). The IFRS S1 and IFRS S2 are the first set of the globally applicable environmental and climate-related disclosure standards. These standards play crucial roles in the development of sustainable finance and are a key component of financial institutions' disclosure principles and frameworks. Standardized and unified sustainability reporting frameworks help investors in the climate and environmentally friendly sectors to better compare companies' performance in the field of sustainability, reduce investment risks stemming from information asymmetry, improve investment efficiency, and enable investors to use green funds more efficiently, thus enhancing the environmental benefits generated per unit of investment.

3.3.5.3 Main Green Finance Outcomes from G20 in past Two Years

The G20 Sustainable Finance Working Group's 2022 report presented several recommendations, including the establishment of a transition finance framework, enhancing the credibility of financial institutions' net-zero commitments, improving the accessibility of funds, and reducing the cost of financing through sustainable finance tools. The transition finance framework consists of five pillars and 22 principles that must be followed. Transition finance primarily supports the process of traditional high-emission industries transitioning from high-carbon to low-carbon emission mode. Traditional carbon-intensive industries often face financing difficulties in investing transitioning projects due to discrepancies with emission scenarios in a net-zero carbon emission context. However, the decarbonization of traditional industries is a necessary step to reach net-zero emission goal, and the decarbonization process requires enormous amount of funding. In addition, issues such as carbon lock-in and just transition also require careful scrutiny. Therefore, the reassertion on transition finance has significant positive implications for developing countries.

The 18th G20 Leaders' Summit took place in New Delhi, India in 2023, with the theme "One Earth, One Home, One Future." The Sustainable Development Finance Working Group of the Summit achieved meaningful consensus and outcomes, and highlighted following three aspects (G20 Sustainable Finance Working Group Deliverables, 2023):

- Creating mechanisms that can mobilize resources for climate financing in a timely and adequate manner, including using policies and financial instruments to catalyze the deployment and implementation of low-carbon technologies.
- Promoting financing activities aligned with Sustainable Development Goals (SDGs), including expanding investment tools that prioritize social impact and enhancing data collection and reporting related to natural climate.
- Building the capacity of the sustainable development financing ecosystem. One of the tasks is the Technical Assistance Action Plan (TAAP). In the context of technical assistance, the Sustainable Development Working Group has released a dedicated TAAP, outlining short-term (2023-2025) and medium-term (2023-2028) goals aimed at government and financial institutions:

- Creating an enabling environment to enhance capacity-building services.
- Tailoring capacity-building plans.
- Enhancing capacity-building for transition finance and other SDG-related initiatives.

3.4 Updates on Green Finance Policies and Standards in Different Countries

In addition to international advocacy and policy development, countries have also shown continuous progression in green finance policy. This section highlights a few representative policy updates, including China's climate investment and financing pilot program, the climate change-related provisions in the U.S. inflation reduction bill, and the progress made by ASEAN countries in green project identification and assessment standards.

3.4.1 China's Pilots for Climate Investment and Finance

In December 2021, the Ministry of Ecology and Environment, along with other eight ministries, initiated the Climate Investment and Financing Pilot Program. In August 2022, they announced the list of 23 selected pilots aiming at exploring replicable experiences in climate investment and financing practice. The first batch of the 23 pilots includes 12 municipalities, 4 regions, and 7 national-

level new districts. These pilots will focus on those areas such as curbing the non-planned development of high-carbon projects, orderly development of carbon finance, strengthening carbon accounting and information disclosure, mode and tools innovation for climate investment and financing, policy coordination, building a national climate investment and financing project program, enhancing climate talent development, and enhancing international cooperation on climate-related fields.

The development of the Climate Investment and Financing Project Program is at the core work of the pilot program, which will be a powerful tool for the country to practice climate investment and financing instruments. It also enables the country and local regions to have a platform to demonstrate practical actions and contributions to addressing climate change. The project program can act as a platform for the tripartite cooperation among government, enterprises and banks, helping both supply and demand sides of climate finance to identify high-quality projects, reducing information asymmetry, and improving the efficiency of industry-finance docking. As of the end of 2022, all 23 pilots have initiated the development of project program. By the end of 2022, the Pilot Program has collected more than 1,500

projects with investment demand of 2 trillion CNY.

3.4.2 Inflation Reduction Act of 2022, USA

On 16 August 2022, the Inflation Reduction Act of 2022 (IRA) was signed into law. This is a significant piece of legislation introduced by the U.S. government to address inflation issues and strengthen domestic manufacturing. The IRA aims to raise $737 billion over five years, with $369 billion allocated to address climate change and enhance energy security. Therefore, IRA is widely seen as the largest-ever climate investment bill in U.S. history, even the bill appears to be addressing inflation concerns. The IRA, combined with existing federal and state-level policies, can drive emissions down by approximately 40% by 2030 compared to 2005 levels. Without the IRA, the emissions reductions during the same period would only be in the range of 25% to 34% (Jason, 2022).

The IRA covers two core aspects of climate investment:

- The legislation will significantly stimulate the development of the U.S. solar industry. It extends the 30% investment

tax credit (ITC) for centralized and distributed PV plants on the demand side. Additionally, the law introduces tax credits on the manufacturing side, and provides subsidies at various levels across the entire photovoltaic production chain, including polysilicon, silicon wafers, cells, modules, backplanes, inverters, and more. For a long period of time, the United States has had one of the highest photovoltaic installation costs globally. This legislation will reduce the construction costs of photovoltaic systems in the U.S., potentially increasing the total installed photovoltaic capacity from 123 GW to around 560 GW, thus promoting the low-carbon transformation of the U.S. energy system.

- The IRA also offers new tax-cut policies for the new energy vehicle industry. It removes the previous cap of 200,000 vehicles per automaker for subsidies and provides a maximum of $7,500 in tax cuts per electric vehicle for low- and middle-income individuals who purchase EVs. However, since U.S. automakers are heavily dependent on Korean suppliers for power batteries, they may find it challenging to qualify for the subsidies provided by the IRA, especially after the minimum content requirements of 40% for raw materials (with a significant proportion from the United States or countries with free trade agreements with the United States) and 50% for battery components (completion of battery component manufacturing within the United States) came into effect on January 1, 2023.

It's worth noting that, although the IRA represents a new phase in U.S. climate policy, certain concessions were made to fossil fuel usage to gain support from the Republican side. Policies in support for the fossil fuel industry were not completely removed, which, to some degree, weakens the bill's effectiveness in addressing climate change.

In terms of global market impact, the IRA currently has a relatively minor impact

on Chinese companies. On the contrary, South Korean companies would have been significantly affected since the legislation resulted in the loss of all subsidies for their products. The implementation of IRA will certainly promote the U.S. climate ambition, but it needs more time observing and assessing its further impact on domestic manufacturing capacity, its influence on global supply chains, and its impact on multinational corporations.

3.4.3 ASEAN Capital Markets Forum (ACMF)

The ASEAN Capital Markets Forum (ACMF), a high-level mechanism of capital market regulators from the 10 ASEAN countries, has been leading the development of green finance policies in ASEAN. On 27 October 2022, the 37th Chairman's Meeting was held in Phnom Penh, Cambodia, under the auspices of the Securities and Exchange Commission of Cambodia (SERC). At this meeting, ASEAN countries reached a consensus on improving the ASEAN green finance policy framework: ACMF approved and launched the 'ASEAN Sustainable-Linked Bond Standards (ASEAN SLBS)' and the 'ASEAN Sustainable and Responsible Fund Standards (ASEAN SRFS)'. The 'ASEAN Sustainable-Linked Bond Standards (ASEAN SLBS)' aim to enhance the transparency, consistency, and uniformity of ASEAN sustainable-linked bonds, which will facilitate the development of the new asset class, reduce due diligence costs, and assist investors in making more informed investment decisions. The 'ASEAN Sustainable and Responsible Fund Standards (ASEAN SRFS)' further expand ASEAN's sustainable asset categories and specify minimum disclosure and reporting requirements to mitigate "greenwashing" risks.

Furthermore, ACMF provided strong support for the second edition of the 'ASEAN Taxonomy'. Following the publication of the first ASEAN Taxonomy in November 2021, the ACMF has partnered with the International

Table 3 ASEAN Polices Updates

Country	Time	Development
Indonesia	Nov. 2022	Release of "Indonesia Green Taxonomy (Version 1.0)"
Indonesia	Nov. 2022	Release of "Environmental, Social, and Governance (ESG) Framework and Manual"
Indonesia	Feb. 2023	Mandatory Carbon Trading Phase One for Coal Power Plants
Malaysia	Apr. 2022	Release of "Good Governance Principles for Government-Linked Investment Companies (PGG)"
Malaysia	Dec. 2022	Release of "Malaysia Capital Market Sustainable and Responsible Investment Taxonomy (SRI Taxonomy)"
Malaysia	Dec. 2022	Establishment of Bursa Carbon Exchange (BCX)
Singapore	Jan. 2022	Requirement on Climate Disclosure by Listed Companies
Singapore	Feb. 2023	"Singapore Green Taxonomy" enters final public consultation stage

Sustainable Development Standards Board (ISSB) to promote sustainable information disclosure across ASEAN and refine the 'ASEAN Taxonomy'. The second edition of the 'ASEAN Taxonomy' was released on 27 March 2023, which enhanced the 'Basic Framework' of the first taxonomy and incorporated additional contents. These policy updates in ASEAN have also spurred domestic policy developments within ASEAN member countries, and the table below highlights some of the recent developments:

Ⅲ. Outlooks of Future Green Finance Development

Overall, after experiencing record growth in 2021, the statistical/labeling green finance market, which is dominated by green bonds and green credits, continued to perform robustly in 2022 against the backdrop of the global economic downturn and increased market uncertainty. As for policy updates, in the past two years, despite the influence of economic fluctuation and political instability, overall, both international organizations and individual countries have made significant policy progress in the field of green finance. Such major policy progression includes the efforts to unify standards internationally, implementation of incentivizing mechanisms and the efforts to channel more capital flow to the green sector. Looking ahead, the further development of the green finance market requires substantial progress and continuous attention in the following areas.

To constantly improve incentivizing policy pathways to nudge the momentum of the green finance market. Public policy is a tool to adjust market failure. The negative externalities caused by environmental pollution and greenhouse gas emissions could not be adjusted solely by the market force, and it requires the guidance and regulation from public policy side. To some extent, climate policy is as important to green finance markets as monetary policy is to traditional financial markets. As mentioned in the beginning of this chapter, the essence of green finance is to correct the market failure for the public goods, and the correction must not only rely on the self-discipline of other participants in the market, and the policy adjustment mechanism will always be the most important instrument for the sound development of the green finance market. Therefore, it will need to continue to actively guide the green finance market development through policy intervention.

To improve the efficiency of capital use and pay attention to the evaluation of projects' green externalities. At present, green finance markets usually neglect the assessment of green projects' additional environmental benefits. Current financial products in the green finance market, including green bonds and green loans, are generally labelling on projects and then doing statistical summaries. This is because that the market has not yet developed appropriate ways to accurately identify and quantitatively evaluate the "additional" emission reduction and/or other environmental benefits created from the green projects, so such labelling behaviour does not always have significant additional emission reduction or pollution reduction. In addition, regardless of the various green finance policies, the current green support instruments usually offer discount interest rate and other financial concessions only based on the type of projects, but not on the projects' funding gaps, which is not the efficient use of the limited green finance. Therefore, more attention should be paid to improving the utilization efficiency of green fund. It is then urgent to effectively utilize different risk preferences and types of green financial products to improve the optimal investment portfolio of green funds for maximum emission reduction benefits, and leverage private capital to finance those projects with strong environmental additionality.

To further reduce market information asymmetry. For green projects, project data collection, submission and disclosure are crucial for investors to know the nature of the project. It is difficult for the current data acquisition and reporting mechanism to achieve the detailed and accurate reporting of project green characteristics. The application and development of cutting-edge technologies such as the Internet of Things, blockchain and digital Monitoring, Reporting, Verification (MRV) in the field of green finance may be the effective means to address information asymmetry in the green financial market. The application of these cutting-edge technologies should help improve the statistical accuracy of projects' environmental data, and the Internet of Things and blockchain technology will boost green project identification and enhance the accuracy of project's environmental data collection, monitoring and evaluation, which will help address the distrust issue caused by asymmetric information in the voluntary carbon market. Further, the development and usage of artificial intelligence will also empower the identification of low-carbon assets, the quantification of transition risks, and the disclosure of climate information. Solid World and Climate Warehouse have made good progress in this area: Solid World set up a liquidity pool for long-term carbon forward contracts, which applied blockchain technology by setting up a liquidity pool on the blockchain network to pre-sell future carbon credits; while Climate Warehouse has prototyped, tested, and developed a digital infrastructure to build an end-to-end ecosystem for carbon market, including a metadata platform to connect and aggregate registry information (the Climate Action Data (CAD) Trust), digital MRV systems, national carbon registries, tokenization instruments, and a knowledge-sharing and capacity-building enhancing platform. Therefore, it is very necessary to further study and explore the full use of digital technology and artificial

intelligence technology to improve the quality of the green project data collection and reporting while ensuring cost control, and address the issue of green finance market information asymmetry.

To emphasize green equity capitalization mechanism. The development of green finance market is a process of constantly exploring and trying to use market-oriented means to solve the negative impact caused by human activities on the environment. It is the biggest challenge for green finance practice to accurately and effectively capitalize environmental rights and interests among all others, while carbon market may be the best try in facing such challenge. The global carbon pricing mechanism is developing unevenly, for instance, the derivatives market (such as carbon futures, and carbon forwards, etc.) is quite behind in most countries except for the European Union and a few developed countries. It should be noted that in 2023 China is accelerating the restart of its CCER market while other voluntary carbon markets are improving their methodologies to ensure data quality, which implies that the voluntary emission reduction market would have a steady growth and would gradually become the focus for capitalizing environmental rights and interests. Therefore, more attention should be paid to enhancing the quality of carbon credits and capitalizing mechanism for the green equity, while encouraging enterprises to actively participate in the voluntary emission reduction market.

Financial institutions should reduce their carbon footprints and environment risk on their portfolio. Financial institutions are important parts of the green finance market. In the context of frequent global climate disasters, financial institutions need to strengthen their environmental risk management and improve the climate resilience of their holding portfolios. Therefore, the holding portfolio's carbon footprints accounting, climate information disclosure framework, and climate risk management practice shall be the focus of financial institutions in the future. In 2021, the Glasgow Net Zero Financial Alliance was established by the banks in some developed countries to advocate financial institutions to comply with the Paris Agreement by earlier achieving near-zero emissions from their holding portfolios. Banks such as Barclays have set low-carbon targets, aiming to achieve near-zero emissions from their facilities and electricity by 2030, while meeting commitments to near-zero CO_2 emissions from their holding portfolios by

2050. Prior to the official release of the ISSB, major financial institutions had also begun to actively utilize frameworks such as TCFD (Task force on Climate related Financial Disclosure), and PCAF (Partnership for Carbon Accounting Financials (PCAF)) for sustainable information disclosure practice. In addition, since 2021, financial institutions of China, the United States, and some European countries have completed the first-round trial of climate stress tests. It is foreseeable that climate risk management will be normalized, streamlined and standardized in operation in banks and non-bank financial institutions. In China, banks and other financial institutions are holding a high proportion of coal assets, therefore, it would be a great challenge for China's policymakers and financial institutions to manage low carbon transition risks by avoiding "climate hard landing".

To increase the accessibility of green finance resources by developing countries. Although climate finance continues to flow from developed to developing countries through multilateral, bilateral and other channels, accessibility to such climate and green finance is still limited in developing countries. In many cases climate-friendly project owners do not know how to access public climate finance or the best financing

options for their projects. In that sense, it is urgently needed for multilateral organizations to simplify green project financing process, make more efforts to improve climate finance accessibility and provide clear guidance and support during the financing process for developing countries. At the same time, the developing countries should also strengthen their capacity building, actively disseminate relevant green finance knowledge, and help climate-friendly project owners connect with appropriate financing resources in more efficient and high-quality manners.

Finally, it shall be highlighted that addressing climate change is a great challenge to, and responsibility of, all countries and all mankind. Whether countries can maintain sustained cooperation will directly determine the success or failure of the global efforts to address climate change and achieve sustainable development. Therefore it is urgent to emphasize and call on the international community to maintain a positive and open attitude for collaboration, seek solutions to disputes through international cooperation, and make best use of the annual COP of the UNFCCC and various multilateral and bilateral conversation mechanisms, for jointly coping with climate challenges.

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Chapter 4: Big Data, Artificial Intelligence and Blockchain Finance

4.1 Overview of Global Digital Financial Development

4.1.1 The concept of digital finance

4.1.1.1 What is digital finance?

Different countries and organizations around the world have given different definitions of digital finance. The IFF Global Finance and Development Report 2022 points out that digital finance reflects the mutual integration and interpenetration of digital technology and traditional finance and is a new technology and new business model based on traditional finance. It represents not only a new financial business model and a new financial development stage, but also a continuation of the sustainable development of the financial industry. Compared with traditional finance, digital finance is more information-driven, Internet-based and intelligent. Data and information technologies, mere tools in the past, have become important resources, platforms, and means of production. They have transformed the economic and financial structure and brought vitality to the economy and financial system.

Specifically, digital finance involves technology layer and their application layer. The development of information technology is the prerequisite and driving force of digital finance. State-of-art technologies including cloud computing, Big Data, Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, and 5G technology are widely applied in the finance sector. The continuous expansion of the depth and breadth of the applications of technologies in financial services has not only promoted the digital transformation of traditional financial institutions, but also given rise to new financial services such as digital currency, digital banking, digital insurance, digital payment and DeFi (decentralized finance).

4.1.1.2 Development patterns for digital finance

The IFF Global Finance and Development Report 2022 analyzed and reflected on the development of global digital finance and the rationale behind that from the aspects of technologies and their applications. In terms of applications, the report summarizes the current status of new financial services including digital banking, digital insurance, and digital brokerage from the perspective of financial institutions. As the digital technology keeps advancing, the new pattern of "technology + finance" has drawn extensive attention worldwide, and a favorable development environment has been created for it in terms of infrastructure, investment and financing, and policy support. Different from last year's, this report analyzes the more "generalized" new patterns of digital finance based on the application of information technology, from the perspective of "technology + finance".

- Digital technology rebuilds the financial ecosystem

With the wide application of digital technologies such as Big Data, cloud computing, IoT, AI, Blockchain, and 5G, the financial ecosystem has been revolutionized in terms of data volume, arithmetic power, and algorithms. And various digital technologies are interconnected and mutually reinforcing, and the entire process of data acquisition, data storage, data analysis, and data application has improved .

In terms of data, the field of digital finance is data-intensive. With the development of technology, Internet platforms such as social media, online transactions, search engines, and mobile applications generate massive amounts of data, supplemented by the real-time data, sensor data and monitoring data generated by Internet of Things (IoT) devices, sensors and monitoring systems. In terms of data transmission, 5G technology (which utilizes high-band wireless spectrum and large-scale multiple-input and multiple-output (MIMO) antenna technology) and various other innovative means such as new network architecture and edge computing have enabled high-speed, low-latency, and high-reliability communications. These technologies provide key support for a variety of emerging application scenarios, and have enabled a significant increase in the efficiency of data transmission. In terms of data storage, Big Data technology adopts distributed storage to store data across multiple nodes in order to improve storage efficiency and reliability. Specifically, technologies such as distributed file systems (e.g., HDFS), columnar databases (e.g., HBase), and object storage systems (e.g., Amazon S3) can slice the data into multiple data blocks or objects and store them on multiple nodes. At the same time, data backup, data encryption, access control and other technologies are used to protect data integrity and privacy. In terms of data analysis, Artificial Intelligence algorithms such as deep learning, natural language processing, and image recognition can automate the analysis and prediction of large amounts of financial data, which allow

financial institutions to better identify market trends and risk factors, which in turn improve the accuracy and efficiency of decision-making. Cloud computing technology can provide efficient data computing capabilities to process massive financial data in a short period of time, and improve the processing speed and analysis accuracy of financial data through complex data analysis and model training.

In addition, Blockchain technology utilizes block-chain data structure to verify and store data. It uses distributed node consensus algorithms to generate and update data. It uses cryptography to ensure secure data transmission and access. Blockchains also utilize automated script codes to form smart contracts to program and manipulate data, which improves the quality and efficiency of financial services in the whole process. Particularly, because of its technical features of openness and transparency, non-tamperable time-stamping, and consensus rules, Blockchain is a confidence machine, a technology that establishes trust between completely trustless nodes[2], which will rebuild the financial trust mechanism and bring about disruptive financial innovations.

- The differences and connections between Big Data, Artificial Intelligence and Blockchain Finance (BAB)

The essence of finance is "the flow of capital" from surplus party to deficit party. Relying on massive data, Big Data Finance analyzes the collected and stored data with cloud computing and other informatization methods through the process of ETL, modeling, development, and visualization to provide a basis for subsequent financial decision-making activities. Therefore, compared with traditional financial model, Big Data Finance is better at predicting the trends of asset prices, assessing individuals' and institutions' credit, allocating funds, and controlling financial risks[3].

Big Data Finance provides support for

financial institutions' decision-making mainly by mining valuable information from massive data. In a sense, it is result-oriented, while AI Finance emphasizes the intelligence generated by processing data. Based on the needs of different business scenarios, AI Finance applies technologies such as machine learning, deep learning, and natural language processing to develop intelligent financial solution through learning and self-adaptation, which gradually replace human decision-making and task execution. The revolutionary advantage of AI Finance lies in the radical increase of efficiency and comprehensively improving the efficiency, precision and intelligence of financial services.

However, human beings are emotional creatures, and behaviors vary greatly in different social environments. Therefore, a credit measurement tool based solely on computing lacks operability and accuracy. Taking credit evaluation as an example, the People's Bank of China credit reference system and Zhima Credit, which have enormous user behavior data, are also unable to eliminate defaults due to the lack of accurate assessment, identification, early warning and risk control of customers who fail to repay their debts. The main reason for this is the lack of technical solutions and ecosystem to accurately measure credit and integrate credit in everyday production and consumption scenarios. Therefore, Big Data Finance and Artificial Intelligence Finance have not fundamentally solved the problem around information. From a technological dimension, Blockchain is a chain data structure combining data blocks chronologically. It is a distributed ledger and a distributed architecture that cryptographically protects data from being tampered with or forged. In the Blockchain system, the cost of the fraudulent behavior of members (nodes) is higher than the potential benefits. Since the costs and benefits can be accurately calculated and published in advance, it is clear that rational participants

Figure 1-2 Big Data, AI, and Blockchain Finance Lead Global Digital Finance Development

Source: IFF Institute

will not have the motivation for default or fraud, thus establishing a "trust system that does not require trust". Currently, Blockchain Finance has made disruptive innovations such as cryptocurrencies and DeFi (decentralized finance), which play an important role in cross-border payments and supply chain financing. Therefore, going from zero to one, Blockchain Finance is the newest finance form.

Big Data, AI and Blockchain Finance have different focuses, but they are all important aspects of digital finance. Big Data Finance uses large volumes data for analysis and decision-making; AI Finance simulates the human brain to achieve intelligence; and Blockchain Finance focuses on decentralization and transparency. They can combine and facilitate each other. For example, by combining Big Data and Artificial Intelligence, financial institutions can analyze customers data and market trends. They can apply machine learning technology to provide customers with customized financial services; Blockchain technology provides a more secure and reliable way of storing and sharing data, thus improving the efficiency and quality of Big Data Finance; in terms of smart contracts, Blockchain technology can automate contracts and bring transparency whereas AI technology can help process

natural language clauses and risk assessment in the contracts.

Figure 1-1 Digital Technology Transforming the Financial Ecosystem
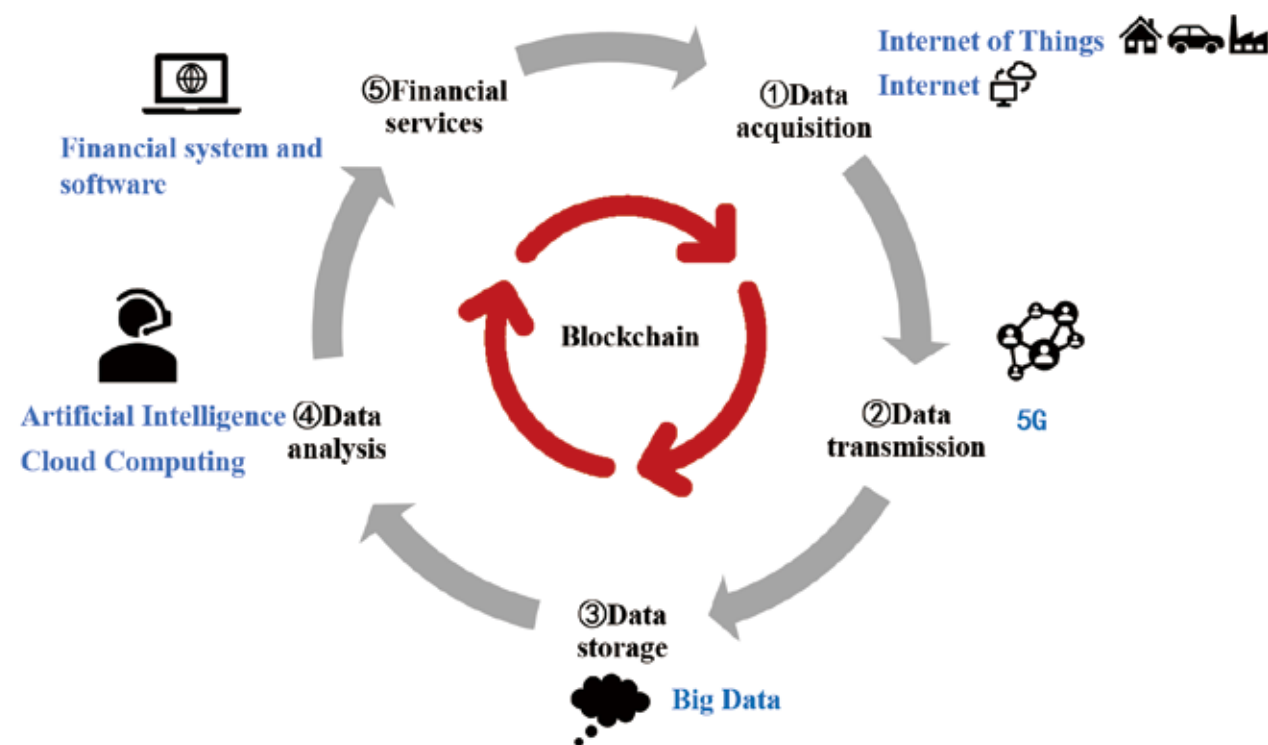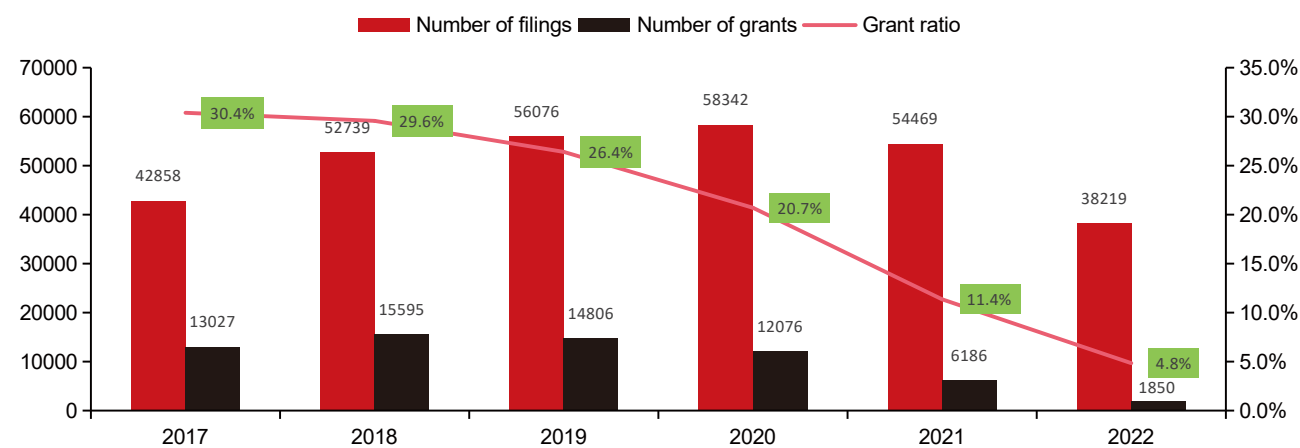

Source: IFF Institute

4.1.2 Global digital finance development from the perspective of patent

In recent years, financial technology has emerged globally. Financial institutions, Internet technology companies, traditional financial IT service providers and other types of organizations are leading the digital transformation of the financial industry through the utilization of Artificial Intelligence, Blockchain, cloud computing, Big Data and other technologies. As a result, the number of related patent applications has increased significantly. In the development of digital finance, financial institutions competitive edge hinges on technological innovations and their applications, which also give them a head start in digital finance competition. Patents, as an important criterion for digital financial innovation, can reflect the status of global digital finance development.

4.1.2.1 Analysis of total global digital finance patent

• Annual figures

Over the past six years (2017-2022), 302,700 digital finance patents have been filed globally❶. Patent filings increased year-on-year from 2017 to 2020, and peaked at 58,000 in 2020, with an average annual growth rate of about 10 percentage points. The applications dropped in the following two years, especially in 2022 when the number of applications declined by 30% year-on-year. However, in contrast with the rapid increase in the number of applications, the global digital finance patent grants decreased year-on-year in 2017-2022. And only 4.8% patent filings were granted in 2022. It indicates patent bubbles in the global digital finance. And the quality of the patents needs to be improved.

• Country ranking figures

During 2017-2022, China led the world in the number of patent filings (178,900), followed by the United States (102,900) and Japan (44,000). China has become a top power of patents in digital finance, far surpassing the United States. However, only 16.6% of the Chinese patents were granted, lower than the global average of 21%. It shows that there is an imbalance between "quality" and "quantity" of patents.

Figure 1-3 Worldwide Digital Finance Patent Filings/Grants (2017-2022)
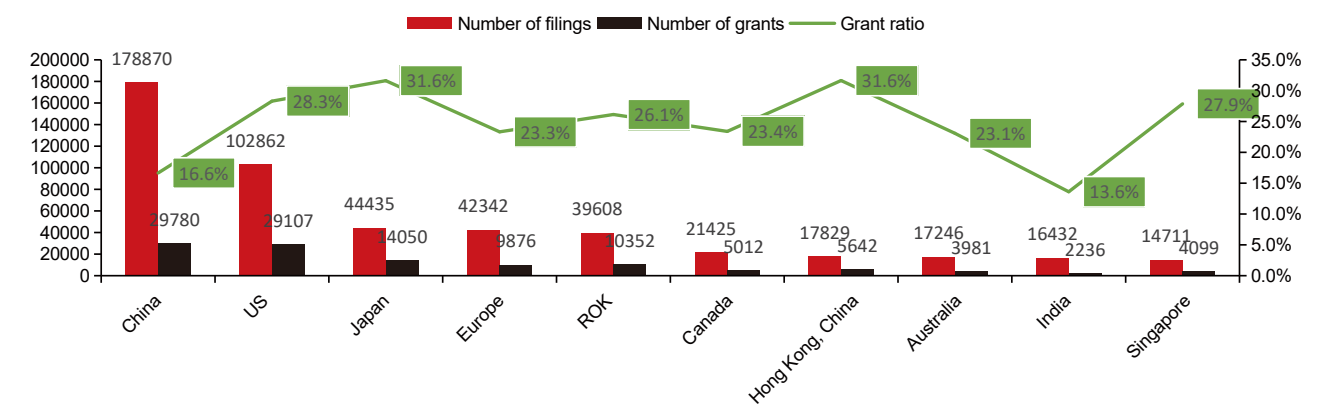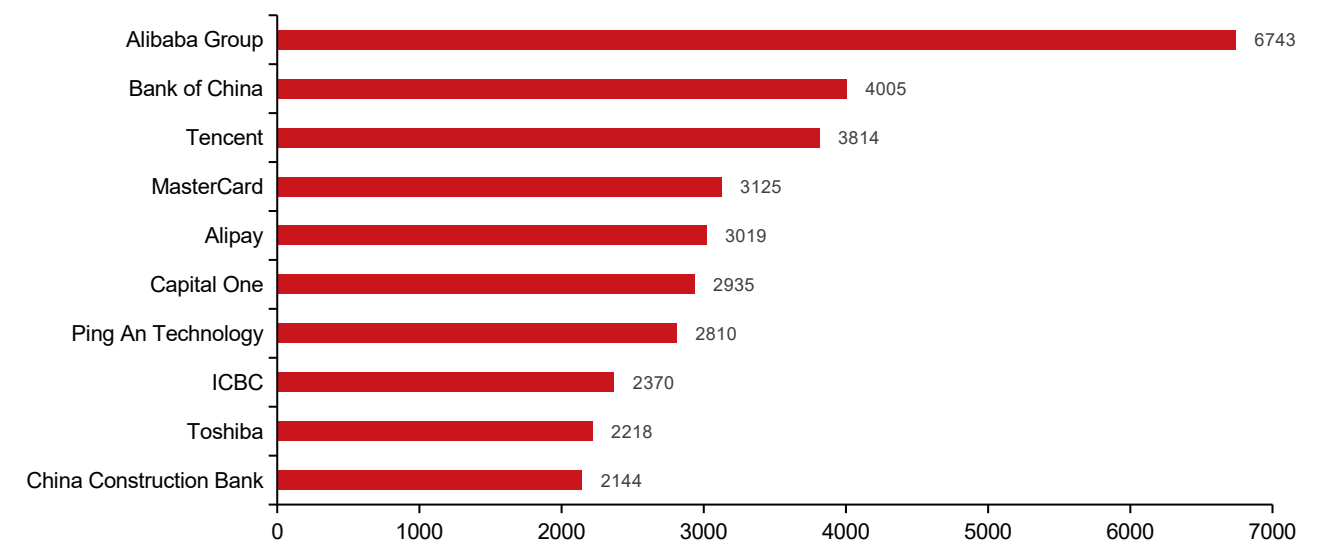

Data source: IFF Institute, PatSnap Patent Database

❶ The digital finance patents in this report, defined by the internationally recognized IPC International Patent Classification Numbers G06Q20, G06Q30, and G06Q40, are in categories that cover several application areas such as payments, tax, banking, and insurance.

Figure 1-4 Global Digital Finance Patent Filings/Grants (Top 10 Countries)

Data source: IFF Institute, PatSnap Patent Database

Figure 1-5 Worldwide Digital Finance Patent Applications (Top 10 Companies)

Data source: IFF Institute, PatSnap Patent Database

• Companies applying for patents

The world's digital finance patent applications are mainly filed by companies. During 2017-2022, the number of patent applications filed by companies around the world amounted to 239,900, accounting for 78% of the total filings. Among the top 10 patent filers, there were seven Chinese companies, namely Alibaba (6,343 filings), Bank of China (4,005 filings), Tencent (3,814 filings), Alipay (3,019 filings), Ping An Technology (2,810 filings), Industrial and Commercial Bank of China (2,370 filings), and China Construction Bank (2,144 filings). The rest of the filers were MasterCard (3,125 filings) and Capital One (2,935 filings) from the U.S. and Japan's Toshiba (2,218 filings). Although the Chinese banking sector began digital transformation later than Internet tech companies and foreign financial institutions, the number of patent filings by Chinese banks showed the rapid development of fintech in China in recent years.

4.1.2.2 Analysis of global patent in different digital finance practice

Due to the different focuses of companies in fintech, this report further analyzes the patent applications in three major divisions, namely banking technology, insurance technology and asset management technology.

Figure 1-6 National/Regional Banking Technology Patent Grants 2017-2022 (Top10)
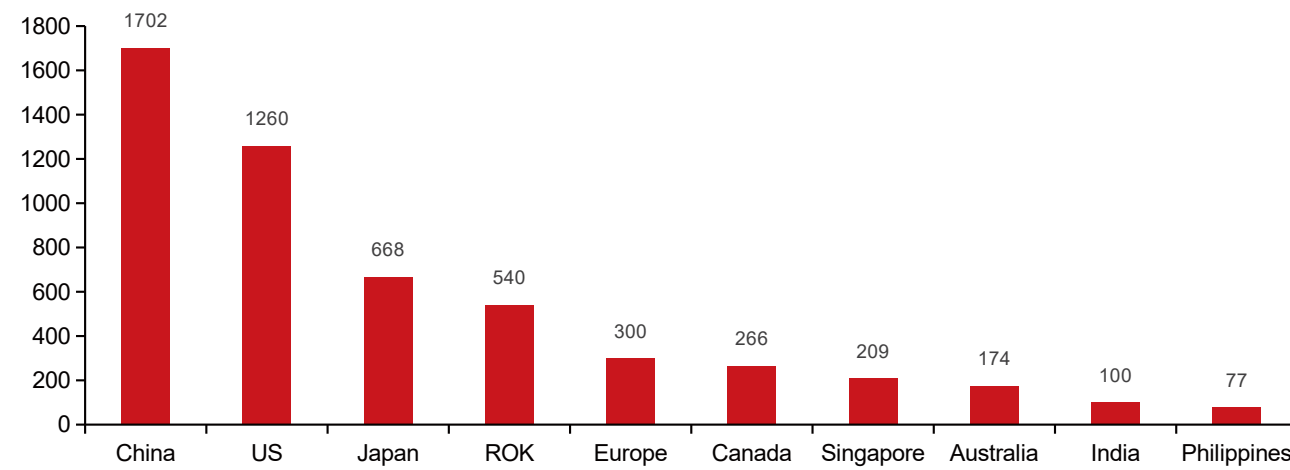
Data source: IFF Institute, PatSnap Patent Database

• Banking technology

In terms of the number of banking technology patents grants in the period between 2017 and 2022, the top 5 countries and regions were China (1,702), the US (1,260), Japan (668), the Republic of Korea (540) and Europe (300). Six of the top 10 countries were Asian, reflecting Asia's potential for growth in the banking technology. And the rise of digital banking is one of main reasons for the fast development of banking technology in Asia. Except Singapore, the financial systems in ASEAN and South Asia are not well developed and regular financial services are inadequate. For example, 60% of ASEAN's population do not have a bank account; and the credit card penetration rate in Indonesia and the Philippines is less than 2%,. These countries have a lot of room for the development of the banking industry. Moreover, most of the digital banking services in the Asia-Pacific are launched by tech giants or large financial institutions that have funds and technology. With a large population (60% of the world's population) and the adaptability and openness to new technologies, Asia is leading the global banking technology revolution.

In China, investments and innovation by tech companies such as Tencent and Alibaba led them to launch WeBank and MyBank, which are leading the development of digital banking and accelerated the digital transformation of Chinese commercial banks. Major commercial banks partnered up with fintech companies or set up fintech subsidiaries to focus on digital finance, which has greatly improved the efficiency and quality of banking services. According to statistics from PatSnap, the top 10 companies with the largest number of global patent grants in the field of banking technology in the past six years are Capital One (139), Alibaba (131), Bank of China (128), Alipay (98), Industrial and Commercial Bank of China (50), Ping An Technology (49), Tencent Technology (47), Bank of America (45), PayPal (42), and Sumitomo Mitsui Banking Corporation (38). Of these companies, six are from China, three are from the United States, and one is from Japan.

• Insurtech

In terms of the insurtech patent grants, China ranked first followed by the United States, with 1,080 and 968 filings respectively. In terms of regions, developed markets including Europe and the United States and emerging markets in Asia are leading the development of the insurance technology. In Europe and the United States, the long history of insurance and the aging population have given rise to a large demand for insurance. The vast majority of global investment and financing in the insurtech was made in these regions in recent years, incubating many unicorn companies. According to 01Thinktank, by the end of 2022, there were 49 insurtech unicorn enterprises globally, 36 of which are still in operation; 27 of which are from the United States. contributing to the prosperity of the U.S. insurtech sector. In contrast, emerging markets in Asia like China have realized the continuous development of insurtech on the basis of the low insurance penetration rate, rapid economic development and demographic dividend. In addition, China has the most insurtech patent grants thanks to the innovations made by technology companies such as Alibaba and the digital transformation of the insurers such as Ping An and Taikang.

As shown in the PatSnap patent database, the global top 10 companies in the insurtech patent grants from 2017-2022 were Ping An (306), Alibaba (176), Taikang Insurance (159), Allstate (62), State Farm Mutual Automobile Insurance (53), Hart Ford Fire Insurance (51), Alipay (46), IBM (28), Yhoo (20), and Swiss Re (19). Of these, five were from the U.S., four from China, and one from Switzerland. Chinese companies accounted for 75% of the total insurtech patent grants of the top 10 companies, and surpassed the US by only 112 patent grants (Figure 1-7). This shows that in China insurtech development is largely driven by big tech companies and top insurers, while there is less difference among enterprises in the US.

• Asset management technology

In terms of the number of asset management technology patent grants, the top 5 countries/regions from 2017 to 2022 were the US (510), China (428), the Republic of Korea (347), Japan (294), and Europe (285). The top 5 companies are Trading Technologies International (37), Chicago Mercantile Exchange Holdings (30), Alibaba (29), Tencent (20), and Rising Bull (16).

The United States is the global leader in asset management technology, mainly for two reasons:

Traditional securities industry in the United States is mature and has made huge investments in technology. Comparing the securities sectors in China and the United States, Wind data shows that as of December

Figure 1-7 National/Regional InsurTech Patent Grants 2017-2022 (Top 10)
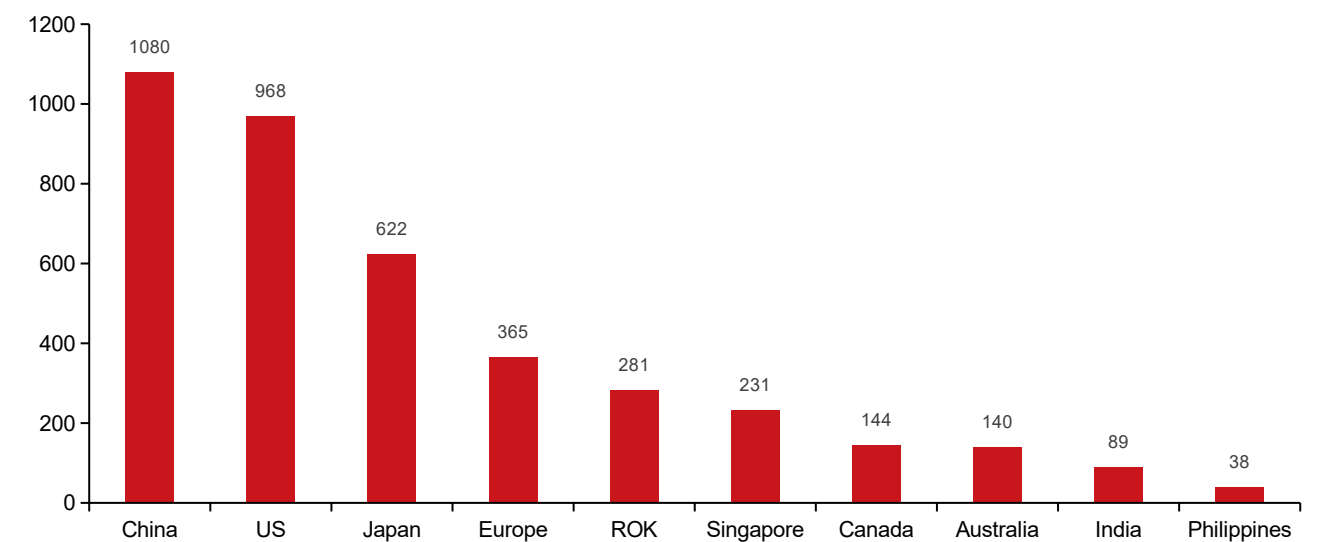
Data source: IFF Institute, PatSnap Patent Database

2022, Goldman Sachs' total assets were 10.04 trillion yuan, higher than the total assets of China's top 10 brokerages combined (7.18 trillion yuan); while China's top-ranked securities brokerage CITIC Securities' total assets were 1.3 trillion yuan. In addition, according to ArchForce data, JPMorgan Chase invested approximately $10 billion in tech in 2019, far exceeding other international securities firms, and Citi's tech investment amounted to $7.077 billion. However, Chinese securities brokerages' investment in technology was much less. In 2022, Huatai Securities invested the most in technology with 2.724 billion yuan, accounting for only 4% of JP Morgan's investment in 2019.

The digital transformation started earlier, and the competition is fierce. American companies Wealthfront and Betterment pioneered the application of Artificial Intelligence financial products, through the optimization of the programs to customize the design of portfolio allocation strategies. With the further application of Artificial Intelligence, Big Data, Blockchain and other innovative technologies, more asset management technology products become available and the competition is fierce. While maintaining their traditional businesses, the asset management technology companies
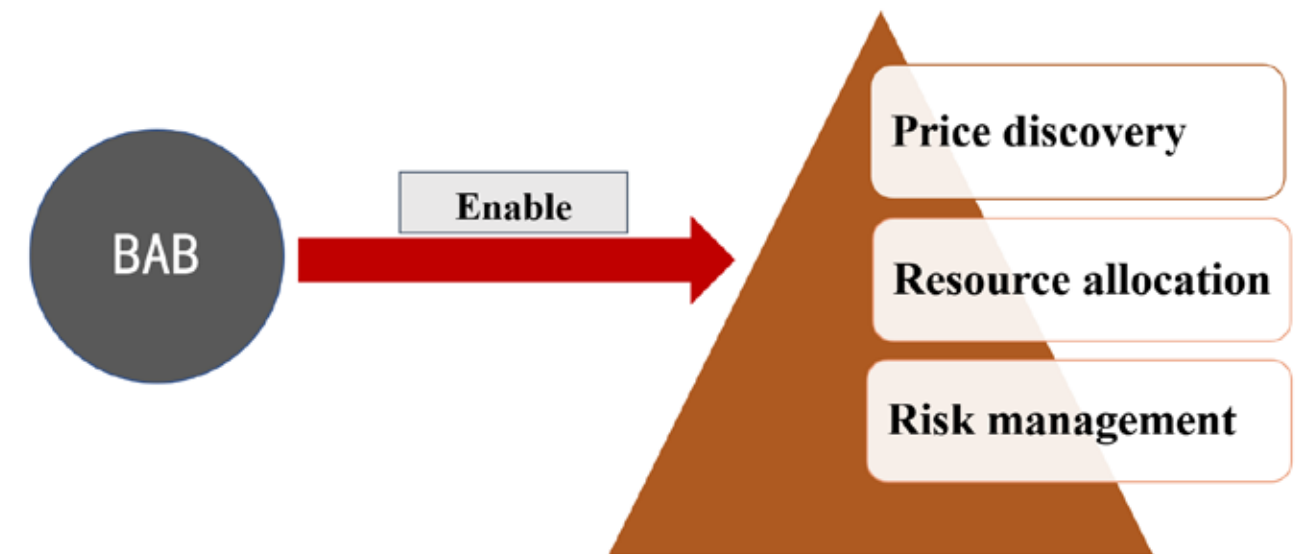
provided more value-added services, contributing to the development of asset management technology in the United States.

4.1.3 Analysis of the rationale of digital finance

Digital finance is still finance in nature, so price discovery, resource allocation and risk management remain its main functions. The rapid development of digital finance, especially with technologies such as Big Data, Artificial Intelligence and Blockchain, has expanded traditional financial services and played a crucial role in improving the operational efficiency of the financial market and optimizing the financial system.

4.1.3.1 Price discovery function

Price discovery is the process of setting the proper price of an asset or commodity in the marketplace through the interactions of buyers and sellers. With the accumulation of data elements using technologies such as Big Data, Blockchain and Artificial Intelligence, digital finance promotes more precise price discovery process. First, by analyzing and processing massive data, judgements are made on the properness of asset prices,

Figure 1-8 National/Regional Asset Management Technology Patent Grants in 2017-2022 (Top 10)

Data source: IFF Institute, PatSnap Patent Database

Figure 1-9 How BAB Enable Financial Markets
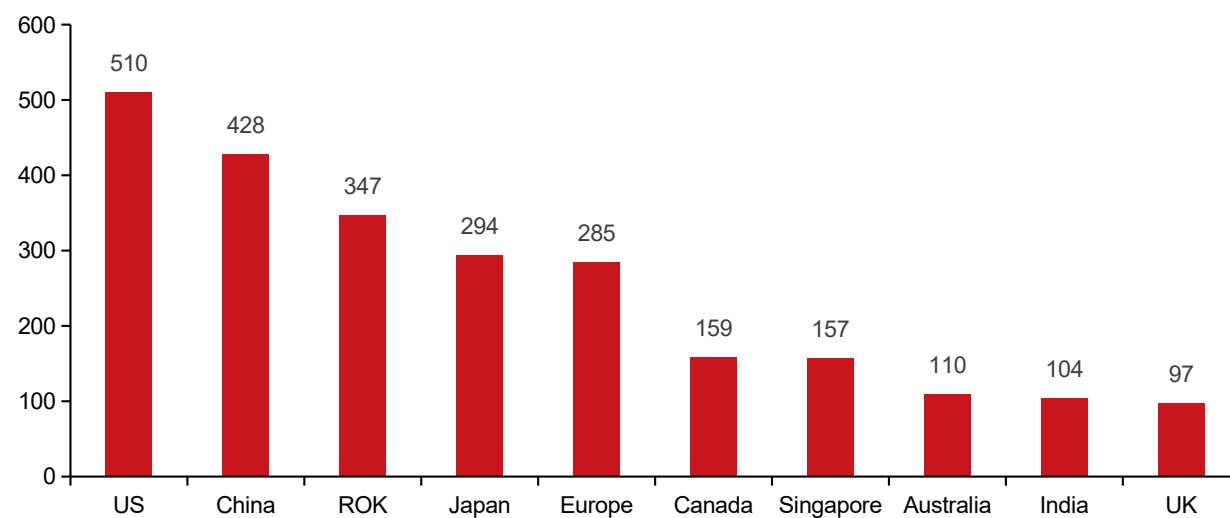

Source: IFF Institute

and new financial products can be created to meet market demands [4]. For example, some digital financial institutions create smarter and customized credit products and achieve more accurate price discovery by integrating and analyzing a massive amount of lending data, credit ratings and other information. Second, thanks to the decentralized and non-tampering Blockchain technology, market participants interact directly, free from intermediaries [5]. For example, market participants can set trading conditions on price, quantity and time period via smart contracts. When the conditions are met, the deal will be made automatically, free from human intervention and price manipulation; furthermore, the issuance and trading of digital assets provide market participants with more opportunities and asset choices, improving the price discovery function. Finally, digital finance utilizes intelligent decision-making technologies such as machine learning to improve market transparency and efficiency, further improving the price discovery function[6]. For example, digital finance utilizes natural language processing (NLP) technology to integrate massive news and data, and analyze

the degree of correlation through in-depth learning to provide market participants with more accurate and timely information; adaptive algorithms enable continuous learning and adjusting strategies to adapt to changes in the market, thus improving price discovery efficiency.

4.1.3.2 Asset allocation function

Asset allocation is the implementation of an investment strategy that attempts to balance risk versus reward by apportioning a portfolio's assets such as stocks and bonds. It aligns the proportions of the investment portfolio with the investor's expected rate of return, variance, liquidity and time horizon. Digital finance can expand the space of financial resources allocation through the spatial effect of financial inclusion. First, digital finance can increase the diversity and flexibility of financial products and services to meet the needs and preferences of different investors [7] . For example, digital currencies, commodities, and alternative investments have emerged in digital finance, providing investors with more choices and combinations. Second, digital finance can

make use of cutting-edge technologies such as Big Data, Artificial Intelligence and Blockchain to improve the efficiency and quality of the acquisition, analysis and transmission of financial information, and help investors make better asset allocation decisions [8]. For instance, intelligent investment advisors can utilize algorithms to analyze investors' risk preferences, investment goals and specific background information, and build the optimal investment portfolios and diversified investment solutions based on specific strategies. Finally, digital finance can lower the threshold for asset allocation and increase market participation and liquidity[9]. For example, convenient and low-cost transaction services are made available, such as digital payment, mobile banking, and online wealth management, so more people can participate in asset allocation, and have access to financial services and markets.

4.1.3.3 Risk management function

Financial activities are often accompanied by a variety of risks, such as credit risk, market risk, operational risk, legal risk, and technology risk. Smart digitalized risk control technologies such as automatic auditing, intelligent approval, Big Data credit collection, intelligent credit scoring models, and dynamic monitoring provide new ways of financial risk management. First, digital finance can utilize Big Data, Artificial Intelligence, Blockchain and other technologies to improve the ability of risk identification, assessment and monitoring, and help financial institutions and regulators identify and respond to potential risks in a timely manner [10]. For instance, the AI-based anti-fraud system, the Big Data-based credit scoring system, and the Blockchain-based identity authentication system are technical solutions that enhance risk management. Second, digital finance can provide diverse and flexible solutions for risk transfer and diversification via innovative products and services to help financial institutions and clients reduce risk exposure and losses [11].

For example, digital currencies, digital bonds, and digital insurance are new types of risk transfer tools in digital finance, and they provide more choices and combinations for financial institutions and clients. Finally, by establishing unified standards and norms, digital finance can improve the alignment and consistency of risk management, promote effective communication and cooperation mechanisms between financial institutions and regulators, and prevent and resolve systemic risks [12]. For example, as the use of AI and other technology continue to grow in finance, the U.S. National Institute of Standards and Technology (NIST) released the Artificial Intelligence Risk Management Framework (AIRMF) as a guidance for organizations to design, develop, and apply AI systems so that financial institutions and investors can control various types of risks.

4.2 Big Data, Artificial Intelligence and Blockchain Finance

4.2.1 Big Data Finance

4.2.1.1 Current situation of Big Data Finance

- Big Data storage volumes are growing rapidly around the world, with China and the U.S. as two hubs of global data

With the rapid development of the Internet of Things, e-commerce, and social networks, global Big Data storage volumes are booming, laying a foundation for the development of the Big Data industry. According to International Data Corporation (IDC), worldwide data storage volumes grew from 4.3ZB in 2013 to 53.7ZB in 2021, with an annual growth rate of 37.1%. In terms of the data generated by country/region in 2021, about 23% of them are from China, 21% from U.S., Data from EMEA (Europe, Middle East, Africa) around 30%, and 18% from APJ (Asia-Pacific and Japan). According to IDC, it's estimated that by 2025, China will create 48.6ZB data, 27.8% of the total global data. With growing data and more application-driven innovations, more business models and

abundant of market structures will emerge in the China's Big Data industry, which would imply a bright industry future.

- "Big Data Race" among nations worldwide

Since 2013, the tide of Big Data has swept the world and gradually become a major driver of financial innovations. Brand new products and services and business models showed up constantly including Internet monetary fund and quantitative investment under the support of FinTech. Regional and national strategies are released by governments around the world to ensure the advantages in the Big Data competition.

In the United States, private enterprises play the major role in the Big Data industry while its government mainly focuses on the top-down national and industrial strategies. In 2012, the White House launched The Big Data Research and Development Initiative, the first national development plan for Big Data in the world and set up the "advanced group guiding Big Data" which sought to harness the utilization of Big Data to accelerate the pace of innovation in the fields of science, engineering, security and education and boost up the predictive power on the economic and social development. At present, the United States has laid out an integral system ranging from development strategy, legal framework to practice plan

Figure 2-1 Global Big Data Storage and Growth Rate (2013-2021)
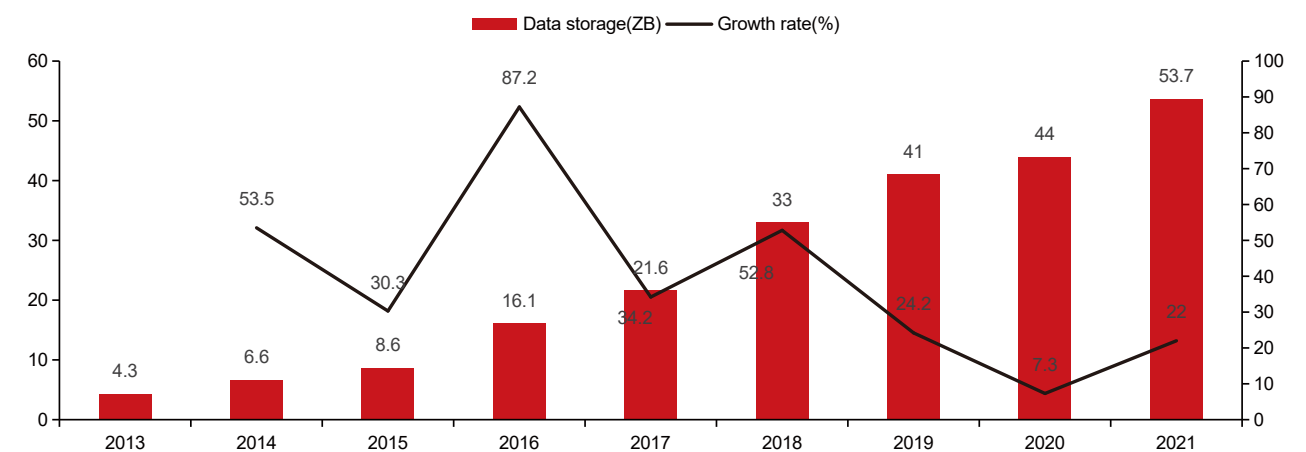
Data source: International Data Corporation (IDC), IFF Institute

and has already published four plans(Figure 2-2) since 2012. According to the plans, the US government aims to maintain its leading status in the Big Data industry, safeguard its national security, and improve the safety of the information network. In addition, the United States attaches great importance to the application of Big Data by the public sectors, and reiterates the governments should make their inner data open.

Despite of late start, the Chinese government has issued multiple policies considering the importance of Big Data for the economic development to ensure the high-quality development of the industry. According to related statistics, China has released more than 30 state-level policies on the Big Data industry (see Figure 2-3 for major policies). China has continuously strengthened the top-level design to materialize the mechanism based on the partial and integral policies. Moreover, Chinese government paid more attention on the delivery of the data value. In April 2020, the "Opinions on Building a More Complete System and Mechanism for Market-oriented Allocation of Factors" was issued, which identified data as the fifth production factor apart from the land, labor, capital, and technology. In November 2021, the "14th Five-Year Plan for the Development of Big Data Industry" was unveiled, and it further underlined data as an important production factor in the new era and a national basic strategic resource. The positioning of the Big Data in no doubt would accelerate the development of the digital economy.

As early as in the beginning of the twenty-first century, European countries have realized that data was a strategic resource, and have been paying attention to the storage, tapping and collection of variety of data. Currently, the policies on Big Data in the EU's and its members mainly focus on the protection, sharing and mechanism of utilization of
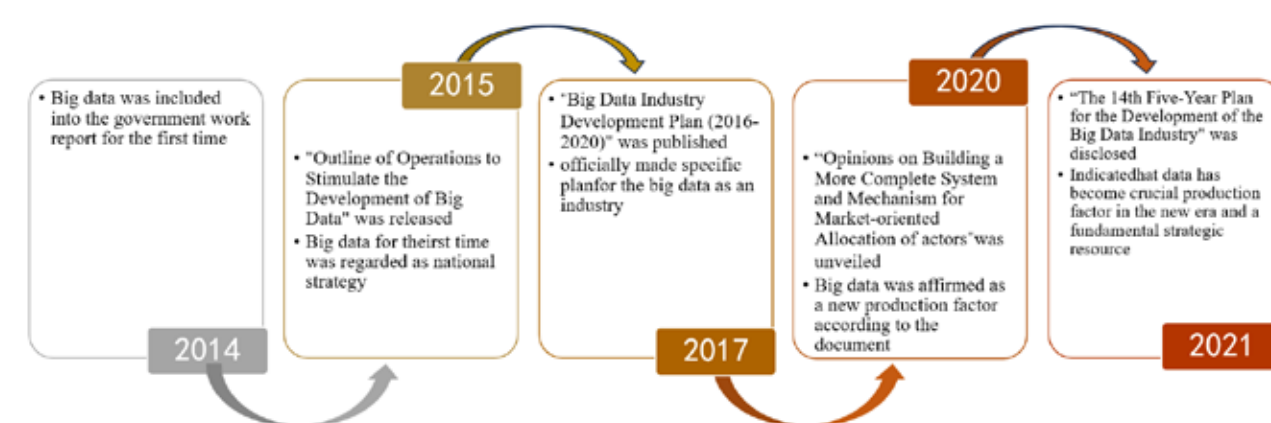
Figure 2-2 The U.S. Big Data Industry Policies
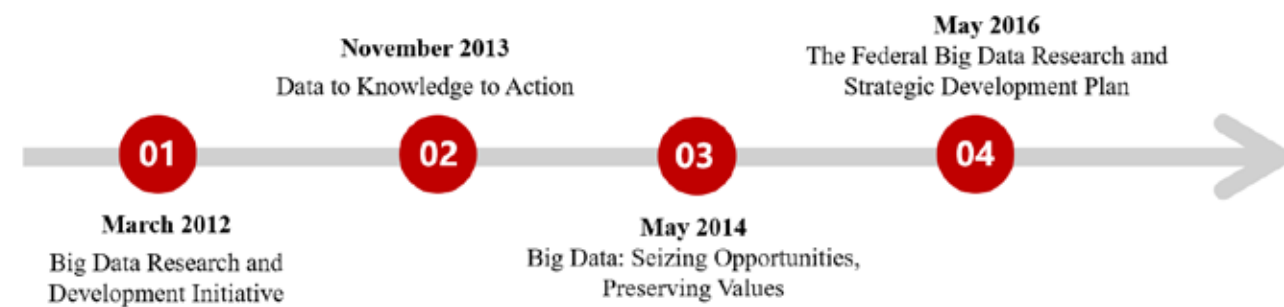
Figure 2-3 Milestones of China's Big Data Industry Policies

Big Data.. Three characteristics have been summarized as follows (see Table 2-1). Data unification. The EU sets the construction of common European data space and unified data market as its major goals to safeguard the integration and utilization of the data in the union which may be affected due to the internal differences among its members. Elevating the competitiveness. With the strong conventional industry, EU however has been left behind in the data industry. Therefore, the EU takes measures to increase investment on the industry, strengthen the technological sovereignty and support the digital utilization of SMEs in the region. Besides, it has also drawn up a series of industrial standards to protect the interests of companies inside the union. Highlighting the EU values. The EU regards the protection of personal data as its strategy and devotes to standardizing its paradigm around the world. In accordance with its values, EU, on the one hand, forms certain policy barriers through strict personal data protection rules to resist the U.S. expansion in the European data market based on the former's industrial advantages and weaken the competitive advantages of American Internet giants. On the other hand, EU improves the recognition of the European management model and amplifies its voice in the international data governance system.
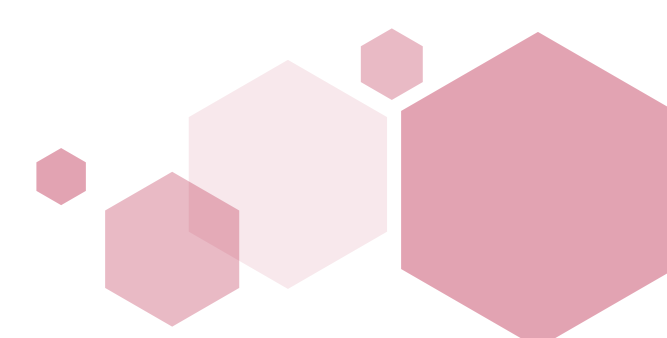
Table 2-1 EU's Big Data Industry Policies ❾

| Objectives	Specific policies
Data Unification	**Digital Single Market Strategy (2015)** • Demolishing the "institutional walls" among the 28 members to fulfill the free flow of data and promote the development of the digital economy in Europe **Data Governance Act (2022)** • Enhancing the data sharing inside EU and strengthening the data availability in order to cultivate an integral digital market
Elevating the competitiveness	**Open Data Strategy (2011)** • Promoting the openness and sharing of data, elevating data accessibility and usability to facilitate innovation and development by the businesses and individuals **Strategy to Promote Data-Driven Economy (2014)** • Focusing on the value chain of Big Data and call upon European countries to seize the opportunities generated by Big Data **European Data Strategy (2020)** • Enabling the EU to become the most attractive, most secure and most dynamic data- agile economy in the world
Highlighting the EU values	**General Data Protection Regulation (2016)** • Strengthening the regulation of data controllers and processors, and defending the rights of personal data, marking the establishment of the EU personal data protection mechanism **Digital Services Act, Digital Market Act (2020)** • Breaking monopoly of US Internet giants, fostering digital innovation, retaining the market order and regaining the European digital sovereignty, safeguarding fundamental individual digital rights

Source: Public information, IFF Institute

• China and U.S. lead innovation in Big Data Finance

The numbers of patent filings demonstrate that China and the United States take the lead at the Big Data Finance. According to WIPO, from 2017 to 2022, China filed 29,065 applications on Big Data Finance while the U.S. filed 14,607. The number from the two countries accounts for more than 80% of the total.

❾ Individual policies may have multiple strategic objectives, which are classified in this report according to their focus.

Figure 2-4 Numbers of Big Data Finance Patent Filings in 2017-2022 (Top 10)
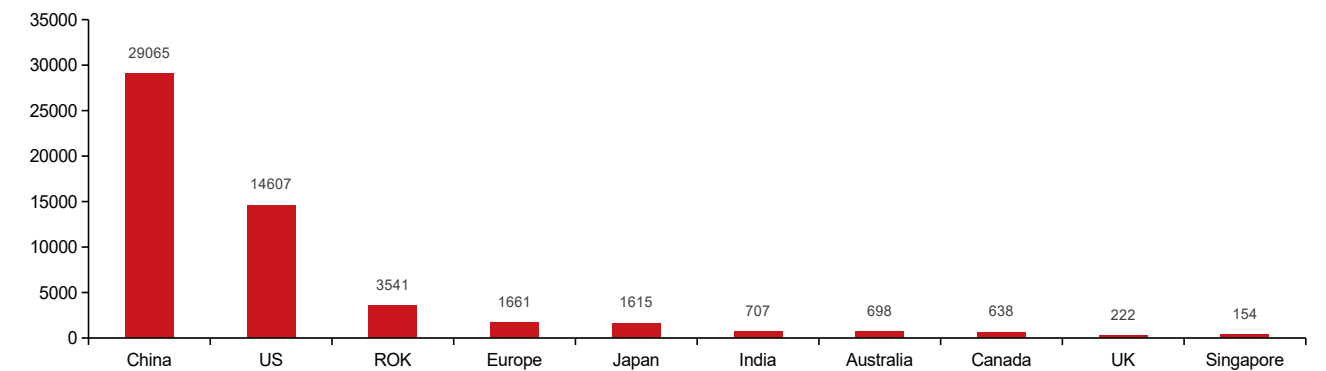
Data source: WIPO, IFF institute

## 4.2.1.2 Big Data Finance application scenarios and cases

Big Data is mainly applied to the product designing, customer profiling, precision marketing, and risk management of the financial sectors. As for the product designing, Big Data can be used to build comprehensive models of financial products, create the most suitable products for the market, and provide relevant solutions to optimize business based on the analysis of the information in the industry[13]. As for customer profiling, Big Data can be used to categorize customers according to their account status, trading habits, and investment preferences and figure out the most valuable and potential customers. Then the resources and service can be allocated accordingly. In terms of precision marketing, Big Data tools can predict the habits, hobbies and purchasing power based on the customer profiling. Therefore, it becomes feasible to recommend different financial services and products to different customers with reference to the marks they get from the Big Data. The costs in the process could be cut dramatically. Regarding risk management, Big Data finane could use technology to build up a risk ranking system based on the risk prevention models which can help identify the clients with default risk. Compared with traditional methods, the Big Data has more parameters thus could work more efficiently with lower costs.

• Case One: China's Ant Group utilizes Big Data Finance to safeguard consumers' funds

Ant Group identifies risks and prevents its customers from fund loss through Big Data Finance. The report titled "Ant Group 2022 Semiannual Report on Anti-fraud Governance" released by the group shows

Figure 2-5 Application Scenarios of Big Data Finance
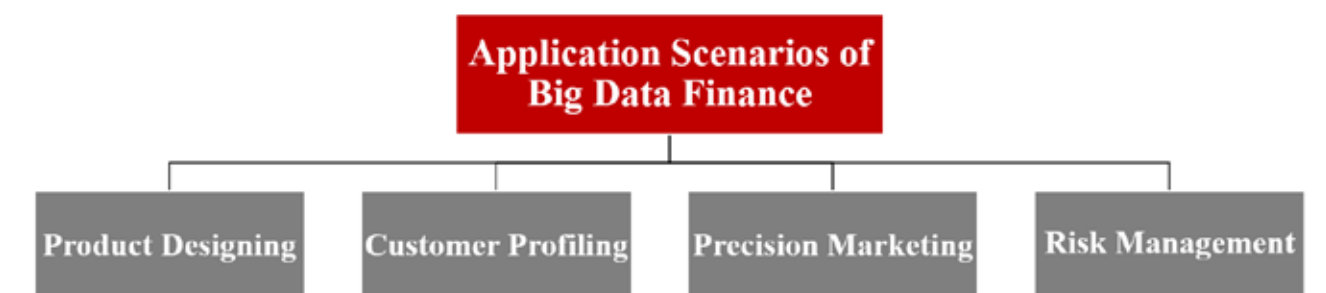
Source: IFF Institute

Figure 2-6 Workflow of SAS Fraud Management System Based on Big Data Finance

Source: IFF Institute

that its intelligent risk prevention and control system could scan and conclude a transaction completed within 0.01 second. This would benefit the security of payment and experience of users. According to the report, the technological system could update its database timely by aligning with the latest fraud models unveiled by official agencies on public security. It also puts more power on squashing the rampant "click fraud". The rate of customers' financial loss caused by this type of fraud has decreased by 36.9 percent in the first half of 2022. In addition, more than 10 million cell phones like Honor and Vivo have been equipped with the terminal "trusted privacy sandbox" provided by Ant Group in order to reduce the data flow and strengthen the security of users' information and funds. Moreover, 330,000 game minor players have been protected from variety of frauds in collaboration with game producers. The rate of typical scam identification has been up 30 percent as the capacity of analysis and detection through Big Data technology.

• Case Two: The global fraud management system by HSBC Hong Kong and SAS

On the basis of preventing credit and debit card fraud, HSBC has been worked with SAS, a leading global data analytic company, and developed a global fraud prevention and management system (SAS Fraud Management) serving fraud prevention for multiple-line businesses and related channels. By collecting and analyzing Big Data, the system could identify the abnormal transactions and sound the alarm rapidly.

According to the People's Bank of China, the global fraud rate on bank card was about 7.76BP (the ratio of the fraud amount per RMB 10,000 yuan), and the actual fraud loss rate was 4.17BP in 2005; The numbers of fraud rate in the United States and in Europe were 14.19BP and 5.29BP respectively while the fraud loss rates were 7.86BP and 1.38BP in the two regions., The new tools and services like the Internet banking, mobile banking, mobile payment facilitate the financial payment and transaction as well as the scams. With about $2.5 trillion in assets, HSBC is a world-renowned bank and financial institution and provides service to more than 100 million customers through 10,000 offices in 86 countries and regions. HSBC prioritizes the anti-fraud efforts referring to the payment card, online transaction, and even customer fraud etc. HSBC has deployed the SAS fraud management system in many business departments, and has successfully avoided many fraud-related losses. The system was expected to reduce 3 dollars in loss by investing 1 dollar in the first place but the real ratio is about 6:1.

4.2.1.3 Outlook for Big Data Finance development

Data is becoming increasingly important in financial business. Some financial institutions may collect "extra personal information", and there are some financial irregularities when running related businesses. In order to better protect personal information and rights and interests of customers, regulatory capabilities on the financial data are urged by all sides of the market. However, the most urgent

issue nowadays is to address the data rights for the purpose of data penetrability and accessibility. By clarifying the scope of data use and sharing, we can prevent the abuse or leakage of personal information, and reduce disputes and conflicts among data owners, users and processors, and improve the utilization efficiency of data. At present, many countries are promoting the safe protection and utilization of data. China, the United States and Europe are exploring effective data circulation mechanisms respectively, and are making efforts in the areas of data trading and circulation and the prevention of data monopolization, but no one has yet enacted official legislation on data rights.

On July 5, 2023, China released "the Implementing Opinions on Further Accelerating the Development of the Digital Economy by Better Utilizing Data Elements" which demonstrates that we should explore the establishment of a structurally classified data property rights system and improve the reasonable distribution solution on data revenues. The "structurally classified" principal considers the different sources, subjects and quality of data which would benefit the

data subjects from exercising their rights in the future. It's taken as the first step to build a data market in China. In addition, the document above makes it clear that individuals are entitled to ask the data buyers to pay them by how much time they ues and individuals could claim their rights if the users pay nothing without permission. In fact, this can partly restrict the data abuse and theft. This marks a critical step for China to establish its data rights.

4.2.2 Artificial Intelligence Finance

4.2.2.1 Current situation of Artificial Intelligence finance

• AI Finance racetrack under spotlight

According to the "2021AI Investment Report" by CB Insights, the AI industry in 2021 sees a sharp rebound from the slowdown in 2020. Both the volume and value of the trading hit record high and total $66.8 billion, 108 percent up year-on-year, are raised for this industry. Companies based in the U.S. and

China are in the leading positions with regard to the funding. The AI startups in the U.S. raised $10.5 billion for the 273 deals. From the perspective of industry distribution, AI Finance investment worldwide grew rapidly, with an average annual growth rate of 22.4% in the number of financing cases and 33.1% in the funding amount from 2015 to 2021 (see Figure 2-7).
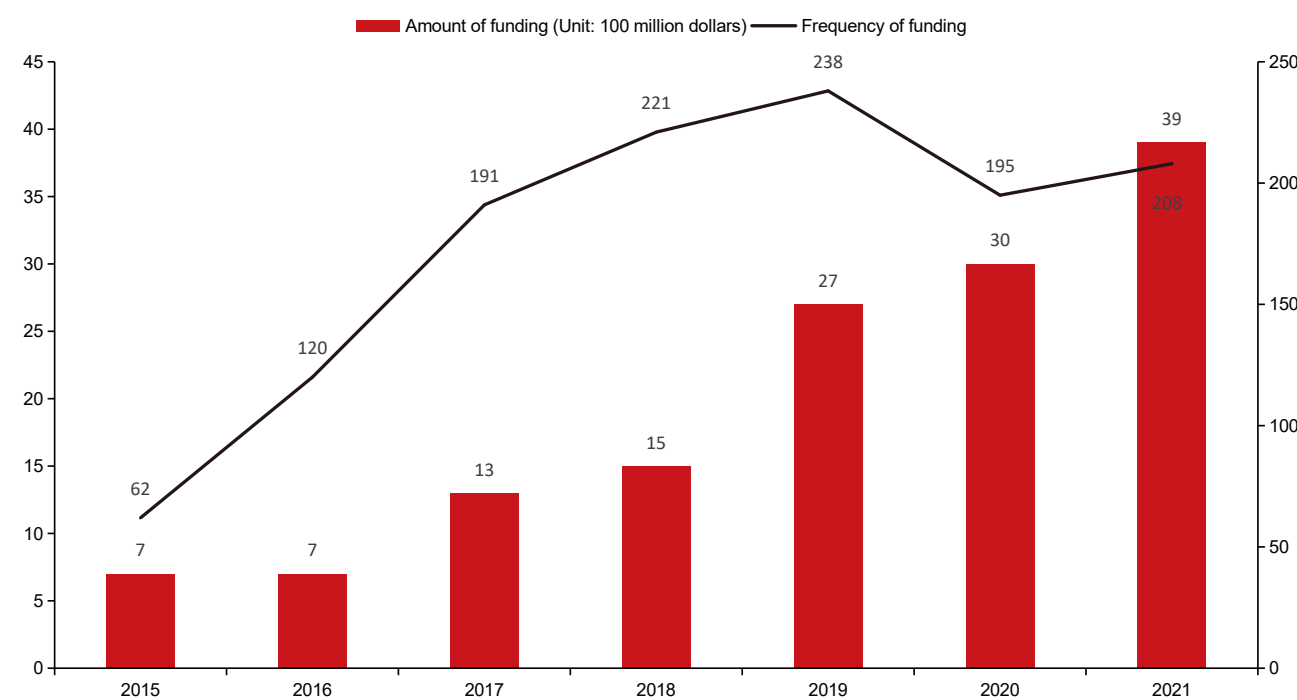
• AI companies in the U.S. are leading the world and helping AI Finance develop

In recent years, the U.S. government has speeded up the layout of Artificial Intelligence at the national strategic level, and issued a number of development plans. And lots of research agencies and labs related to AI got supported by U.S. government in the form of fund, talent, policies and laws. According to the CB Insights' 2022 AI 100 List, there are 16 unicorns with a valuation of over $1 billion out of the 100 companies from 10 countries and regions on the list. Seventy-three of the 100 selected companies are from the United States (US) ranking first, the United Kingdom second with eight companies selected,

Canada five, and China four. The others are from India, Sweden, Switzerland, Israel and Germany (see Figure 2-8).

In terms of citation of patent, China's citation of U.S. patent in AI is about 68% (see Figure 2-9). It shows that there is still a large gap between China and the U.S. in the field of AI. But with the construction and development of the digital economy and the digital society, more and more data would come out and can be utilized for the modeling, training and application of AI technologies.

Worldwide AI Unicorns Top100

US ■ UK ■ Canada ■ China ■ Other
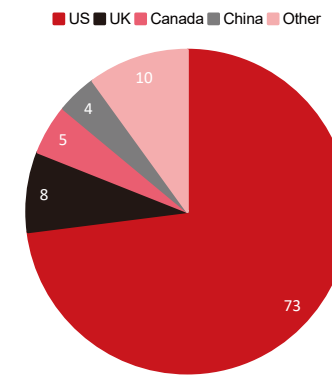
Data source: CB Insights, IFF Institute

Figure 2-9 China Citing Other Countries' on AI Patent[⑩]
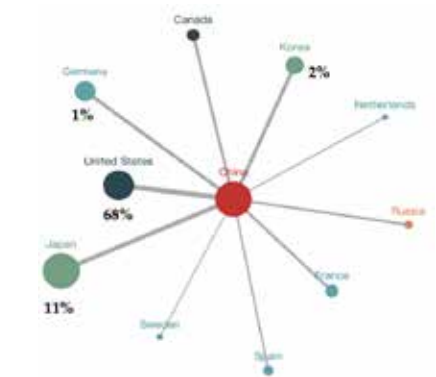
Data source: WIPO, IFF Institute

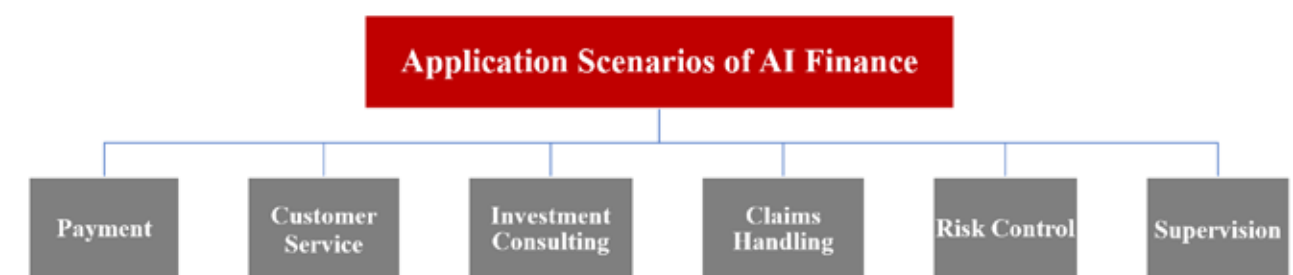## 4.2.2.2 AI Finance application scenarios and cases

AI Finance is applied and plays an important role in payment, customer service, investment consulting, claim settlement, risk management, and supervision through technologies such as facial recognition biometrics, machine learning algorithms, and knowledge graphs[14]. For instance, the intelligent investment consulting service based on a series of complex machine learning algorithms makes it possible to comprehensively assess the customers' risk appetite and financial situation, predict their investment objectives, and incorporate the portfolio theory to provide reasonable and customized asset management solutions. The intelligent risk management could identify

risky transactions on the basis of data analysis, and then block the deal and sound alarm automatically. That's the way for the AI to undertake the management of financial risks. It plays an important role in the whole process of lending business. The intelligent regulation allows the regulators to apply the Artificial Intelligence technology in the regulation of financial service institutions such as banks, insurers, as well as listed companies with the main focus on anomalies in high-frequency trading, algorithmic trading, and block trading.

• Case 1: ICBC RPA+AI Application

RPA (Robotic Process Automation) is a technology designed to execute repetitive work by stimulating human interactions.

Figure 2-7 Global Funding Amount/Frequency in AI Finance (2015-2021)

■ Amount of funding (Unit: 100 million dollars) — Frequency of funding

Data source: CB Insights, IFF Institute

Figure 2-10 Application Scenarios of AI Finance

Application Scenarios of AI Finance

| Payment | Customer Service | Investment Consulting | Claims Handling | Risk Control | Supervision |

Source: IFF Institute

⑩ The circles in the figure represent the number of patent applications in the field of AI, and the thickness of the lines indicates the number of patents cited by China from other countries. Due to the large disparity between the values, the original values are logarithmically treated in this report when plotting.

RPA will assist the financial industry in transforming of intelligent operation and make it possible that the forerunners in the banking industry will build an intelligent ecosystem together. ICBC launched the RPA technological research and platform development in early 2019, and now has realized scale application in various business areas to support the automatic and intelligent customer service and marketing, operations management, risk prevention and control, and other businesses. By the end of 2021, more than 60 institutions around the world have applied the RPA "digital employees" to handle nearly 700 business scenarios in the headquarters and branches across the entire banking business, saving the workload of more than 1,000 people for one year. RPA could take effect in the four scenarios, including the daily business processing efficiency statistics, daily conversion download, daily exchange rate download, and daily exception report query. And it has realized automatic query and push of reports and data, and has improved the level of refined management. The RPA could double the working efficiency of each employee and save 200 hours for a year.

• Case 2: Bank of America: Erica, AI-powered virtual assistant

Banks are committed to improving customer service. Online banking service is more convenient but not all customers can navigate through the websites or software to meet their requirements. So, banks have been working on simplifying the customer interaction experience. By introduction of AI technology, Bank of America devotes itself to serving its 25 million online customers with more intelligent skills. It launched Erica, a financial virtual assistant, to serve its customers via voice orders. A variety of tasks such as searching for past transactions, accessing additional information, analyzing spending habits, and providing guidance on financial decisions could be done by Erica as long as voice orders are given. Erica also incorporates technologies including

Artificial Intelligence, predictive analytics, and natural language processing as well as smart modules such as Subscription Monitor, Spend Path, FICO Score Updates, and Bill Reminder. In collaboration with Better Money Habits, the financial education platform of BOA, Erica could provide financial advice based on customers' spending habits. Erica was officially launched in March 2018 after an internal pilot in 2017. Erica now can respond to 200,000 different kinds of financial questions.

• Case 3: BNP Paribas Smart Chaser, a financial transaction risk prediction tool

In order to prevent losses caused by the failure of transaction, major financial institutions need to build up an early-warning system to ensure the success rate. However, if the financial staff spend too much time in checking the information of a single transaction, the efficiency will be affected adversely. BNP Paribas estimates that up to 30% of the transactions require manual intervention to fulfill it successfully. So, BNP Paribas developed Smart Chaser, a smart predictive analysis tool, and employed it in the trading process services to identify problems and risks. Smart Chaser analyzes data of thousands of trade failures and 100 correlates based on intelligent algorithms and identify patterns. Then it matches the current trading elements with the historical data and analyzes the results, including trading time, value, counterpart, and broker transaction history. Thereafter, Smart Chaser will actively pick up those transactions which need to be handled manually and then it would send an email to brokers so they could take action timely to avoid the trading failure.
According to BNP Paribas, the accuracy ratio of the Smart Chaser has reached around 98 percent. Smart Chaser will be installed widely as the first step in the AI Finance process of BNP Paribas. For the next stage, BNP Paribas plans to figure out automatically the potential trading warnings from counterparties and give responses without further manual intervention. In the third stage, the whole

Figure 2-11 Smart Chaser AI-powered Prediction Tool Workflow
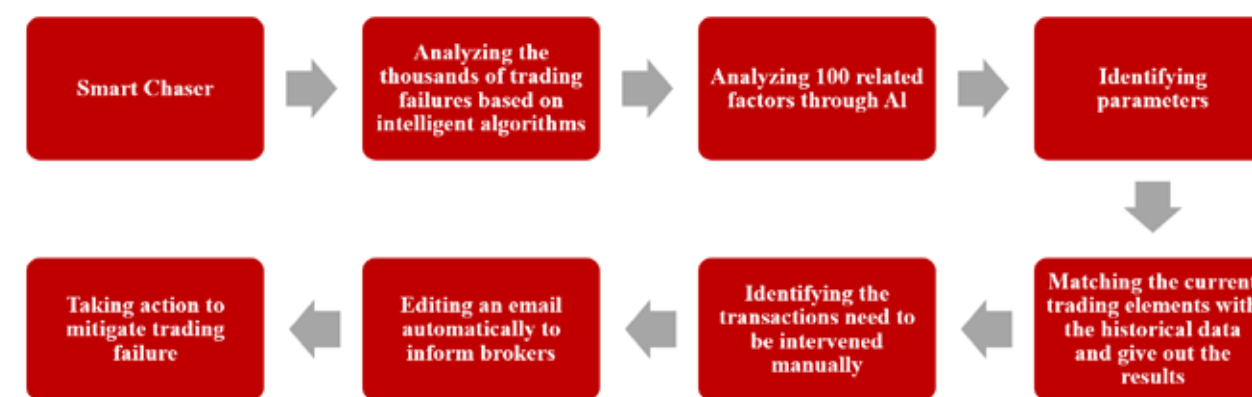
Source: IFF Institute

process of trading will be completed automatically by further combining trade analysis and automation technologies.

4.2.2.3 Outlook for AI Finance development

Looking ahead, AI technology will continue to play an important role in the financial sector in the portfolio optimization, risk assessment and fraud prevention. At the same time, more attention will be paid to issues such as data privacy, security and explainability to ensure that the development of AI technology meets the needs and expectations of the society. In particular, the "algorithmic black box" makes it difficult for financial institutions to explain their decision-making processes due to opaqueness, and thus will dent the trustworthiness from the customers and regulators. So, it's reasonable to make the algorithmic decision-making process more transparent and explainable in the future. Fairer and more comprehensive datasets will also be needed to train the models, such as collecting more sample data and using diversified data sources. The development of AI Finance also faces a challenge of talent shortage. Measures should be taken to cultivate and introduce more talents, and increase their mobility. For example, universities can set up cross-disciplinary majors combining Artificial Intelligence with finance. More Internships and talent policies

could be provided by AI companies and governments to cultivate more technological talents.

In addition, ChatGPT, a brand-new chatbot, was released by OpenAI at the end of 2022. Unlike previous language models, ChatGPT is pre-trained and large-scale, and is capable of generating data such as text, images, and audio. It adopts deep learning methods and has stronger natural language processing capabilities and can be utilized in a wider range of fields. ChatGPT also incorporates the reinforcement learning based on human feedback (RLHF) strategy in the training process to ensure that the output of the AI model in accordance with human common sense, cognition, and values, which greatly enhances the user experience. As the new-generation conversational natural language model, ChatGPT has unique advantages in the fields of intelligent investment consulting, risk assessment, intelligent customer service and information processing. AI like ChatGPT will assist financial institutions providing more efficient, convenient and personalized service to its customers in the future.

4.2.3 Blockchain Finance

4.2.3.1 Current situation of Blockchain Finance

• Blockchain Finance attracts most of investment while China has been left far behind by U.S. in this field.

According to 01Thinktank, the investment in Blockchain worldwide reached up to 1,786 deals or 1,546 projects with worth of 308.815 billion yuan. Due to its natural financial attributes, global Blockchain investment focuses on financial application companies. Specifically, there were 1,174 deals with worth of 234.94 billion yuan of investment in financial applications which accounted for 65.7 percent, 76.08 percent respectively of the total Blockchain related global investment. From a regional point of view, the America, Europe and Asia are the most active in global Blockchain equity investment. The continent of America in 2021 completed 542 deals, one third of total deal numbers with 128.975 billion yuan, 56 percent of the whole and 2.3 times more than that in Europe. The Blockchain equity investment deals in Asia and Europe accounted for 18% and 15% respectively. But

the investment amount in Europe is twice more than that of Asia which also showcases the Blockchain industry in Europe was supported more than in Asia (see Figure 2-12).

In terms of the number of Blockchain equity investment, the United States ranked first with 484 deals, accounting for 89.3 percent of that in the American continent, and 29.1 percent of total global deals. China came as second with 97 deals. As for the amount of investment, the U.S. has got 116.773 billion yuan, followed by the U.K. with 21.118 billion yuan. The amount of China was 11.285 billion yuan, with nearly 10 times less than that of U.S. (see Figure 2-13). However, as the policy environment of the Blockchain industry is improving in China, the Blockchain industry may gain momentum and develop rapidly in the future. According to IDC, the Blockchain market would expand with amount of $4.279 billion in 2026, with a CAGR of 32.3% from 2021 to 2026.
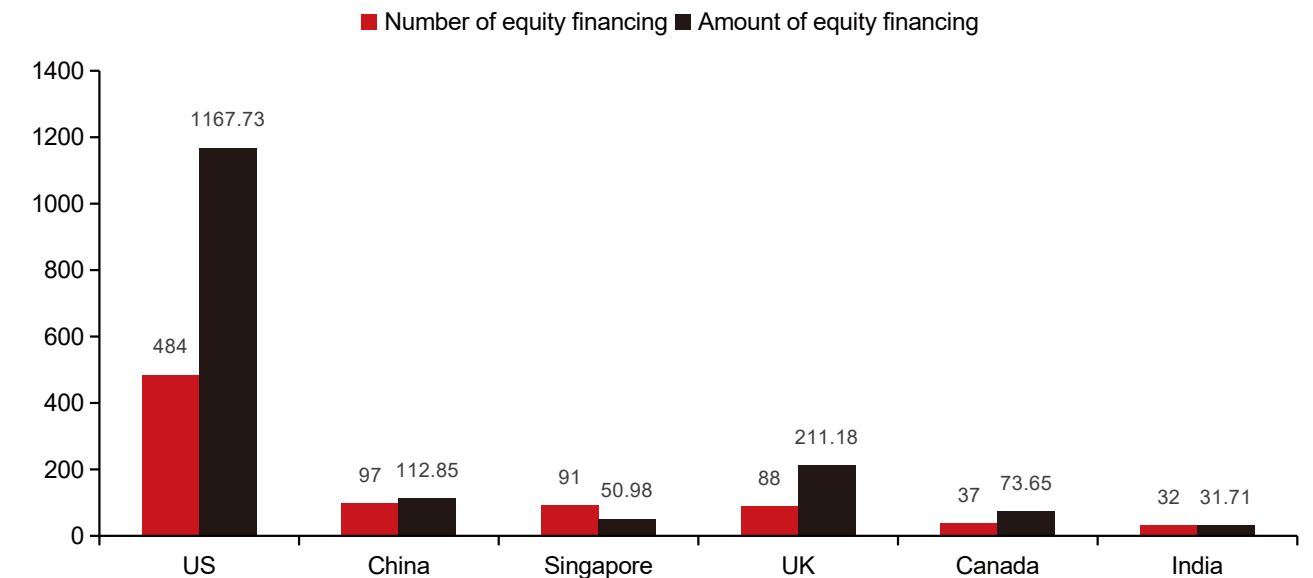
• U.S. Blockchain companies keep ahead globally

According to the list of "Blockchain 50" released by Forbes in 2023, only six companies have kept names on the list for the

Figure 2-12 Worldwide Blockchain Equity Investment in 2021

Figure 2-13 Distribution of Blockchain Equity Investments by Country 2021
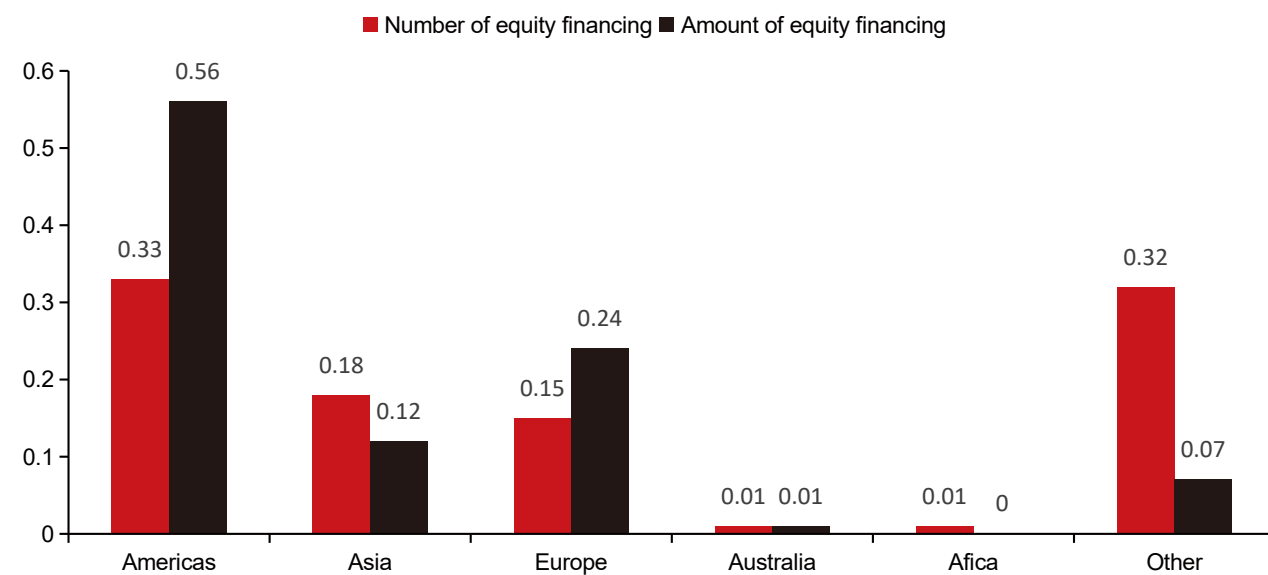
Data source: 01Thinktank, IFF Institute

five consecutive years, and the Depository Trust & Clearing Corporation (DTCC) dropped out of the list for the first time since 2019. Ant Group is the only Chinese company on the list for 5 consecutive years. 34 companies from U.S., accounting for 68 percent of total 50, are selected while 7 and 4 companies from China and EU respectively. In addition to its sound innovation ecosystem, relaxed legal environment and excellent technical talents, the rich financial resources contribute to the development of Blockchain industry in the U.S.. Blockchain technology has great potential in the financial field. The United States, as the world's largest financial market, attracts a large number of financial institutions and investors to participate in the development and investment of Blockchain projects.

4.2.3.2 Blockchain Finance application scenarios and cases

Blockchain technology has taken effect widely in different financial practices. This report has studied the four typical application

scenarios including supply chain finance, cross-border payment, digital currency and DeFi [15].

Digital supply chain finance refers to using Blockchain and other technologies to empower supply chain financial companies to realize online business operation, information interaction, trust transmission and risk warning. Blockchain technology is also utilized to enhance the security, settlement speed and capital utilization rate of the cross-border payment by establishing trustworthy and direct interaction, and bypassing transit banks through peer-to-peer payment networks, which reduces transit fees as well. Digital currency is one of the important products with Blockchain technology in financial field. It initially emerged in the form of private digital currency with different form, circulation and payment models comparing with the traditional currencies. And its design varies, it generates different intrinsic values. With the advent of private digital currencies, many central banks tried to unveil their sovereign digital currencies, with purposes of reducing the cost of issuing currencies,

Figure 2-14 Application Scenarios of Blockchain Finance
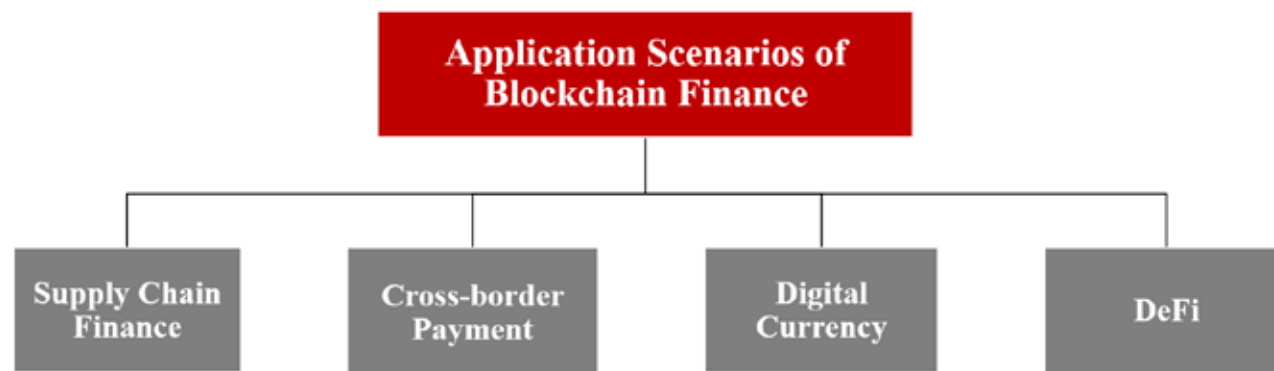
Source: IFF Institute

enhancing convenience and safety, improving the efficiency of payment and clearing and settlement, and elevating the control of currency supply and circulation. The term decentralized finance (DeFi) refers to an open financial infrastructure that is built on the basis combining cryptocurrencies such as Bitcoin and Ethereum with Blockchain and intelligent contract. DeFi provides financial services and products such as decentralized lending, algorithmic stablecoins, decentralized exchanges (DEXes), and decentralized derivatives.

- Case 1: Typical Blockchain application of China's Ant Group

AntChain, the focus of Ant Group's blockchain research, has won more than 2,000 patents and applied to over 50 scenarios. AntChain ranks the No.1 globally in the number of patents referring to the privacy-preserving computing, and has served more than 200 large businesses and tens of millions of merchants. Two cases from Antchain have been chosen by "the 2022 Blockchain Typical Application Cases" published by China's Ministry of Industry and Information Technology.

One of them is the "trusted public data flow anti telecom fraud platform based on blockchain" is a typical application of blockchain in financial risk prevention. AntChain assisted the Anti-Fraud Joint Office of Zhejiang Province to create the first "anti-fraud alliance chain" in China, which empower the full chain ecological governance by linking data and risk control capabilities of multiple parties. According to the Zhejiang Provincial Blockchain Technology Application Association, the anti-fraud alliance chain delt with 2.4 million pieces of warning messages, defended capital accounts for 1,380 times, blocked the capital transition about 13.4 million yuan involving fraud and marked ten millions of sensitive or illegal messages in cooperation with the police, the central bank and telecommunication providers.

In addition, AntChain has also launched the Ant Double-Chain Pass to incorporate accounts receivable into the blockchain supply chain finance model to realize the confirmation and circulation of assets and financing.Through the Ant Double-Chain platform, the enterprises of upstream and downstream on the supply chain, financial institutions and banks are able to communicate, share information and process businesses. The model has successfully operated in Chengdu and fulfill the integration of the supply chain and finance chain as well as risk control.

- Case 2: U.S. Nasdaq Linq uses blockchain to reshape its private market

Nasdaq Linq, a platform for private security transaction, was officially launched in November, 2015. The platform was developed in collaboration with blockchain startup Chain, and represented the first-ever financial service platform based on blockchain technology in the world. The process of the traditional security issuance and transaction for those unlisted companies was labor-intensive, manual and paper-based involving paper stock certificates, option grants and convertible notes that requires attorneys manually checking spreadsheets, which can cause a lot of human errors and make it difficult to have an audit trail. Issuers can digitally represent a record of ownership using Nasdaq Linq, which significantly reduces the settlement time.

Chain notes that this use of blockchain could reduce trade clearing and settlement time from the current standard of three days to about 10 minutes, and could lower the risk exposure by up to 99 percent and effectively saving the costs and mitigating systemic risk. Moreover, the platform also gets rid of the paper stock certificates, while both issuers and investors have the ability to complete and execute subscription documents online, alleviating administrative burden. Linq share

issuers log in to find a cap-table management dashboard complete with valuation, the price of shares issued in each investment round and the percentage of available stock options. So, issuers and investors can better track and manage securities information. The blockchain technology replaces the conventional record method with paper-and-pen and spreadsheets, and significantly upgrades the efficiency of the transaction and management.

- Case 3: U.S. Ripple cross-border payment settlement solution

Founded in 2012, Ripple has achieved global success as a provider of Blockchain-based financial solution. The XRP Ledger, flagship of Ripple, is an open-source payment network based on distributed ledger technology. Its key objective is to provide financial institutions with a real-time, reliable and low-cost cross-border payment solution. The On-Demand Liquidity (ODL), one of core products of the company, uses XRP as a bridge currency for cross-border payments. With ODL, financial institutions are able to complete cross-border transaction in

seconds, significantly reducing the cost and time of remittances.

According to Ripple, the financial agencies have saved billions of dollars with ODL system. Ripple therefore has won partnership with well-known financial institutions across the world such as the Bank of America, Standard Bank and MUFG Bank. According to Ripple's latest report, RippleNet, a global payment solution driven by XRP, has processed nearly 20 million transactions worth of nearly $30 billion. These cases fully showcase the potential of Blockchain technology in cross-border payments. Ripple also faces some challenges such as lawsuit filed by the U.S. Securities and Exchange Commission (SEC). At the same time, Ripple is still growing rapidly by developing and providing innovative Blockchain solutions to financial institutions around the world.

4.2.3.3 Outlook for Blockchain Finance development

With the advantages of transparency, tamper-proof timestamps, and consensus rules, Blockchain technology could be applied broadly and will reshape the credit

mechanism in the financial field. However, due to the defects on the technology and regulation, illegal tax evasion and fraud remain frequent and cause customers' asset losses and bring adverse impact on the credibility and popularity of the encrypted assets. The prices of encrypted assets crashed in 2022 which also displays the risks of cryptocurrencies and the importance of protection for the investors.

Related laws and regulations on encrypted assets are enacted by the European Union, the United States, Hong Kong SAR of China, and other regions in 2023 and the chaos of the market thus vanished to some extent. However, it is still a dilemma for regulatory authorities around the world to balance innovation and risk management. In addition, Blockchain-based cryptocurrencies face technical risks such as forgery and double-spending. Quantum-currency is expected to address the above problems but more time and research still need before the quantum money finally takes effect as the technology is still in its early stage.

4.3 Risk and regulation

4.3.1 Risks of Big Data, AI and Blockchain Finance

New technologies as well as new forms and models of business have brought new vitality and vigor to the traditional financial market, but a number of problems and risks were accumulated in the process of its emergence and development. Many illegal behaviors are swinging on the fringe of traditional regulation, difficult to be timely detected and effectively controlled. This results in the aggregation and proliferation of financial risks, thus affecting the safety and soundness of the financial system. The development of Big Data, Artificial Intelligence and Blockchain Finance all revolve around data collection, storage and analysis, which are essentially new financial patterns driven by "data + technology", and the related risks are steadily on the increase with the growth of the data value as well as the evolution and development of information technology. This report will explore the potential risks of digital finance from the perspectives of data and technology.

4.3.1.1 Data risk

Data is the core element of digital finance. As a data-intensive industry, the financial market possesses a huge amount of data, which not only generates great value but also lays itself wide open to cyber attacks. The formation of data starts from digital encoding, that is, 0 and 1. With the continuous advancement of communication and chip technologies, as well as the increasing popularity of the Internet infrastructure, massive amounts of information can be transmitted to all corners of the world at extremely fast speeds. Information, once on the Internet, can be shared over and over again by countless people, which means that the use of data by a single user does not exclude the use of data

by other users. This non-competitive attribute of nature is very likely to make it beyond the effective regulation of the traditional legal framework, burying hidden risks.

From the dimension of data rights protection, the unclear delimitation of data rights, coupled with the low cost of network data replication and the invisibility of data secondary utilization and transmission, problems such as excessive data collection and illegal data transaction by practitioners often occur in the field of digital finance, and traditional protection methods have failed to work. From the dimension of data use, if the credit information obtained during the information collection process is inaccurate or is copied or tampered with during the data transaction, it will lead to a large deviation in the subsequent analysis of the information, which not only reduces the value of the credit information, but also may impair the industry's decision-making, thus generating huge financial risks.

4.3.1.2 Technical risk

- Emerging information technology and systemic financial risk

While the extensive use of information technology improves the operating efficiency of financial institutions, it also makes the complexity, contagiousness, invisibility and suddenness of systemic financial risks more prominent, with endogenous risks accumulating within the system. From the perspective of its characteristics, digital finance is the product of the integration of finance and S&T, in which high and new technology may bring new risks, while the original financial risks still exist. The superposition of technical risks and financial risks may further amplify the risks.

At the same time, as the role of the Internet accelerates the speed of risk transmission and presents significant characteristics across industries and regions, it makes it

easier to induce systemic financial risks. For example, when facilitating more effective value delivery and resource allocation in the financial industry, Blockchain technology also provides an ideal approach for financial risks to spread, thus leading to a higher transmission rate and more serious cross-transmission of risks. In addition, the decentralized nature of Blockchain gives rise to a financial market without financial intermediaries and government credit endorsement. Systemic risks then ascend against the current immature technology and regulation mechanisms.

• Cybersecurity risks of Blockchain technology

Security is the primary issue facing the development of Blockchain Finance. According to the 2022 White Paper on Blockchain Security published by the SAFEIS Security Institute, Blockchain security incidents involved more than USD 75.3 billion in 2022.

First of all, there is a 51% attack on a Blockchain, i.e., under the Proof of Work (PoW) consensus mechanism, owning 51% of the nodes or computing power within the network gives the controlling parties the power to tamper with and falsify the Blockchain data. Although the benefits of a successful attack are far less than the cost of controlling 51% of the network's computing power, this does not mean that the threat is completely gone. If an attacker somehow controls more than half of the Blockchain network's computing power and uses that advantage to rewrite transaction history, the so-called "double-spending problem" can occur. The second is the vulnerabilities in smart contracts. Both the smart contract system represented by Ethereum Virtual Machine (EVM) and the smart contract system represented by EOS WASM virtual machine have been exposed to different types of smart contract vulnerabilities in one way or another. These vulnerabilities have not only caused heavy losses to project owners

and users but also raised questions about Blockchain security among users. Smart contract vulnerabilities themselves are rarely caused by the underlying Blockchain virtual machine, and most of them are problems with the code written by the smart contract developers. In 2016, the decentralized financial platform Badger DAO was hacked, and the attackers stole more than USD 60 million worth of cryptocurrency by exploiting a vulnerability in the smart contracts that manage the DAO. In short, the asymmetric encryption mechanism used in Blockchain will be severely challenged by the rapid advancement of related disciplines such as mathematics, cryptography, and computing technology.

• The risk of "rule of code" with Artificial Intelligence

In the traditional "rule of man" model, decision-making and management are mainly done by human decision-makers and managers, while in the "rule of code" model, Artificial Intelligence technology plays a more important role, by analyzing and processing a large amount of data, generating models and algorithms, automating decision-making and management tasks, and significantly improving the forecasting, decision-making and risk management capabilities of financial institutions. However, in the process of transforming the "rule of man" into the "rule of code", new risks may also arise.

The first risk is the "algorithm black-box". The opacity of algorithms exacerbates the information asymmetry in AI Finance, and some may conceal biases and impure motives behind the algorithms, creating new issues of unfairness. For example, Amazon's recruitment algorithm was accused of gender discrimination in 2019, favoring male candidates. In addition, algorithmic black-boxes can exacerbate financial discrimination and hinder the development of inclusive finance. The refinement of data labeling achieved by AI algorithms may result in more targeted label-based discrimination,

departing from the fairness attributes of inclusive finance, and in the most extreme cases, these black-box algorithms exacerbate financial discrimination by categorizing, sorting, and labeling human beings in the name of "optimizing resource allocation". The second one is the risk of algorithm convergence. The pre-input algorithmic programs used by AI make them similar in general, which can lead to near-consistent analyses and decisions by different financial firms based on similar data. Therefore, it in turn reinforces the impact of the same market signals and leads to deviations from market norms. The third risk is the abuse and malicious use of AI. With the development of AI technology, the use of this technology for financial fraud is also increasing. Fraud gangs take advantage of deepfake techniques to create fake videos or voices for fraudulent activities such as false authentication, false transactions and false money transfers.

4.3.2 Global regulatory policies for digital finance

4.3.2.1 Policy review (2022 Report)

Confronting the regulatory challenges posed by digital finance, international financial regulatory organizations and national financial regulators have responded positively by studying from different perspectives the evolution of digital finance, its risk links and its impact on the financial system and regulation, and have explored various ways to improve the regulation of digital finance on this basis.

At the international organizations level, the IMF released The Bali FinTech Agenda, which, while encouraging countries to actively embrace FinTech, also provides a basic framework for countries to formulate relevant regulatory policies; the Basel Committee on Banking Supervision (BCBS), through the establishment of a working group on FinTech, focuses on the impact of FinTech on the

banking industry's market position, business model and systemic risk, as well as the challenges of FinTech to banking regulation; and the Financial Stability Board (FSB) focuses on the potential impact of FinTech on financial stability by setting up a working group of the Financial Innovation Network (FIN), which is mainly in charge of FinTech-related research.

At the country level, China, the United States and the EU have continued to explore effective data circulation mechanisms, gradually pushing harder in the areas of data security, information protection and the prevention of data monopolization. Overall, Europe has demonstrated the EU's ambition to become a global leader in digital regulation by adopting comprehensive and harmonized regulatory policies, with relevant legislation emerging more forward-looking and stringent globally. The U.S., instead of formulating an all-encompassing unified data protection regulation like the EU, has adopted a divisional decentralized legislative model, where relevant laws and regulations are formulated separately at the federal level based on the condition of specific industries. In China, through a combination of top-down and bottom-up legislative principles, relevant policies, ranging from lenient to progressively tighter, were enacted in a more flexible form, which has been an important factor in China's "curved-road overtaking" strategy in the field of digital finance. Most of the relevant policies have been detailed in the 2022 Report (see Table 3-1).

Table 3-1 Regulatory Policies in Digital Finance of China, the US and the EU

Purpose of Legislation	Region	Relevant Laws and Regulations
Network and data security	China	Cybersecurity Law (2017)
		Data Security Law (2021)
	US	Clarifying Lawful Overseas Use of Data (CLOUD) Act (2018)
		National Security and Personal Data Protection Act of 2019
		National Cybersecurity Strategy (2023)
	EU	Cybersecurity Act (2023)
		Network and Information Security (NIS) Directive (2022)
		Directive on the Resilience of Critical Entities (2022)
Personal information protection	China	Personal Information Protection Law (2021)
	US	American Data Privacy and Protection Act (Draft) (2022)
		California Privacy Rights Act / Virginia Consumer Data Protection Act (2023)
	EU	Digital Single Market Strategy (2015)
		General Data Protection Regulation (2018)
		Data Governance Act (2020)
Data anti-monopoly	US	American Innovation and Choice Online Act (2022)
		Open App Markets Act (2022)
	EU	Digital Markets Act (2020)
		Digital Services Act (2020)

Source: Public information, IFF Institute

Figure 3-1 Total Global Cryptocurrency Market Capitalization since 2022
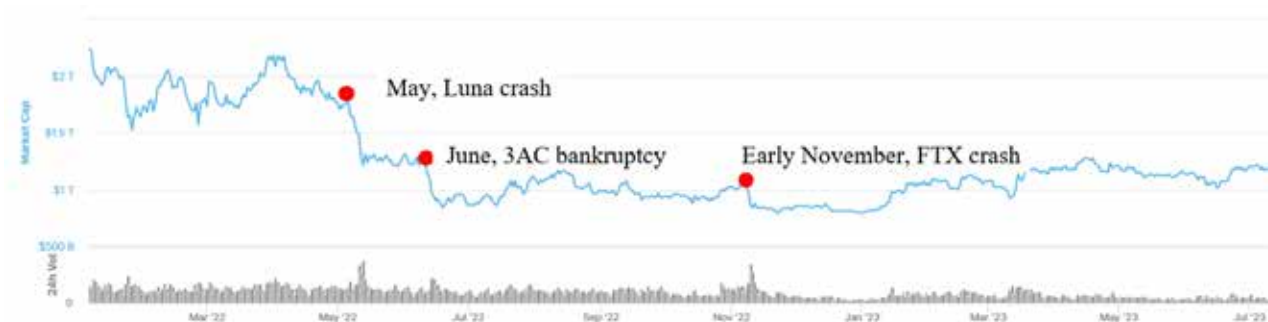
Data source: CoinMarketCap, IFF Institute

4.3.2.2 Focus of digital financial regulation in 2023: crypto-assets

In 2023, the regulation of crypto-assets appears to be the dominant trend. In May 2022, the Luna crash reduced the total global market capitalization of crypto-assets by more than 30% from USD 1.8 trillion to USD 1.2 trillion. Immediately following in June, the bankruptcy of Three Arrows Capital led to a further drop in market capitalization to less than USD 0.8 trillion, another drop of more than 30%. Although there was a brief rally in the bear market before FTX's bankruptcy in early November, with the total market value recovering to USD1 trillion, Binance CEO Changpeng Zhao's selling of FTT once again pushed the market value down to a low of USD 0.8 trillion. Then, when rumors of Genesis' bankruptcy were released in late November, there was a slight panic in the market, resulting in a drop of about 5%. In January 2023, Genesis, the world's largest cryptocurrency lender, declared bankruptcy, causing huge losses to a wide range of investors. The four crashes, involving project owners, exchanges, and investment institutions, covered almost all the major tracks in the crypto industry. As of the end of 2022, the total market capitalization of cryptocurrencies was about USD 830 billion, down 64% from the beginning of the year. It is urgent to develop appropriate and feasible regulatory responses.

The collapse of crypto-asset prices in 2022 has revealed the risks of cryptocurrencies while highlighting the importance of investor protection. Currently, there are differences in the regulatory stance on crypto-assets (including stablecoins) in major countries and regions around the world, and the corresponding regulatory frameworks and legislation are at different stages of development.

• European Union

The Markets in Crypto-Assets (MiCA) was adopted by the European Council on May 16, 2023, making the EU the first major jurisdiction in the world with a crypto licensing regime. MiCA defines crypto-assets as a "digital representation of a value or of a right that is able to be transferred and stored electronically using distributed ledger technology or similar technology." This broad definition emphasizes two key elements of crypto-assets: (1) a digital representation of value or legal status with no intrinsic value; (2) the underlying technology is a distributed ledger (e.g. Blockchain). Meanwhile, crypto-assets are also categorized into three types based on their specific purpose: (1) asset-referenced tokens; (2) e-money tokens; (3) other crypto-assets not covered by existing EU laws, such as utility tokens. According to MiCA, companies issuing and trading crypto-assets, tokenized assets and stablecoins in the 27 countries of the EU are required to be licensed and stablecoins issuers are required to hold corresponding reserve assets. The introduction of MiCA is of great significance in achieving harmonized regulation across Europe, curbing money laundering in Europe, and protecting the euro.

• The United States

The U.S. has not yet formed a unified regulatory framework for cryptocurrencies, showing a trend of "multi-regulatory", and is jointly supervised by the federal and state levels. Where digital currencies and related activities are similar to traditional financial products and services, state and federal financial industry regulators have adopted existing frameworks and regulations. As a result, regulators may consider digital assets as securities, commodities, or currencies, as appropriate. However, this also led directly to different positions on cryptocurrency regulation by different regulators, and this fragmented regulation has slowed the development of the crypto market. For example, on April 3, 2019, the U.S. Securities and Exchange Commission (SEC) issued a guide entitled "Framework for 'Investment Contract' Analysis of Digital Assets", which is designed to assist issuers

or other entities engaged in the digital asset business in analyzing whether their digital assets are "investment contracts" and should be included in the definition of "securities," and thus subject to the SEC's regulations and compliance obligations. On June 6, 2023, the SEC sued digital cryptocurrency exchange Coinbase in Federal Court of New York. The indictment alleged that since 2016, Coinbase has been letting Howey Test-compliant crypto-assets be used for trading, despite verbalizing its willingness to comply with applicable laws. On the other hand, there were reports that executives of crypto companies such as Coinbase and Ripple have made it clear that they may shift their businesses to other countries if the SEC continues to enforce such harsh regulations on the crypto industry. Therefore, how to act to manage risk without stifling innovation is a pressing issue for U.S. policymakers to consider.

In 2023, U.S. crypto legislation sees significant progress as the regulatory framework becomes clearer. In April, the U.S. Congress released two milestone discussion drafts of the stablecoin bill, known as the "2023 U.S. first draft" and the "2023 U.S. second draft", which are currently under consideration. Among them, the main contents of the first draft include: (1) a detailed definition of stablecoins used for payments; (2) the object of licenses is the issuer of stablecoin, and non-bank issuers must be licensed; (3) differentiated treatment of different types of algorithmic stablecoins; (4) asset segregation requires more focuses on protecting customers' rights and interests from creditors' claims; (5) issuers must disclose the composition of their reserves on their websites monthly, and the certificator must be the issuer's CEO. The U.S. Congress has indicated that a third version of the draft bill will be introduced within two months and believes it is highly likely to receive bipartisan support and be formally adopted.

On July 26, the House of Representatives approved two bills, the Financial Innovation and Technology for the 21st Century Act and the Blockchain Regulatory Certainty Act, the former of which seeks to create a comprehensive regulatory framework for digital assets, granting the Commodity Futures Trading Commission (CFTC) jurisdiction over digital commodities, clarifying the jurisdiction rights of the U.S. Securities and Exchange Commission (SEC), and establishing a process for the sale of digital assets, which were originally considered securities, as commodities; the latter clarifies the legal status of virtual currencies and formally defines them as "any form of intangible personal property that can be exclusively owned and transferred from person to person without relying on an intermediary", i.e., "digital assets", setting out clear guiding principles for the regulation of such assets. This not only provides consistency in the regulation of virtual currencies within the U.S. and eliminates the previously confusing regulatory environment, but also has the potential to positively impact the definition and regulation of virtual currencies globally.

• Chinese Mainland

In recent years, China has taken a tough line on cryptocurrencies and successively introduced a number of related policies. The most important one is the Announcement on Preventing Token Issuance Financing Risks issued and implemented in September 2017, formally categorizing ICO as an illegal public financing scheme and banning all ICO financing trading platforms. As one of the first countries in the world to take restrictive measures, the Chinese government's announcement of a ban on the operation of cryptocurrency exchanges has attracted widespread international attention.

In 2021, China continued to strengthen its regulation of cryptocurrencies, with the People's Bank of China, the Ministry of Public Security and more than a dozen other departments issuing two consecutive documents, namely the Notice on Further Preventing and Handling the Risks of Speculation in Virtual Currency Transactions and the Notice on the Rectifying of Virtual Currency Mining Activities, to comprehensively crack down on virtual-currency-related illegal financial activities and virtual currency mining activities. The former points out that virtual currencies do not have the same legal status as fiat money and cannot be circulated in the market, and that virtual-currency-related business activities are illegal. It is also considered an illegal financial activity for overseas virtual currency exchanges to provide services for domestic residents via the Internet. Virtual currency investment and trading activities are subject to legal risks, and those suspected of disrupting financial order and jeopardizing financial security shall be investigated and dealt with by the relevant authorities and departments in accordance with the law. The latter made it clear to strengthen the regulation of the whole upstream and downstream industry chain of virtual currency "mining" activities, strictly prohibit new virtual currency "mining" projects through measures such as strengthening credit supervision of data centers, accelerate the orderly withdrawal of existing projects, and promote the optimization of the industrial structure and help to achieve the goals of carbon peaking and carbon neutrality as scheduled.

As technology advances and digital finance continues to develop, cryptocurrencies will become a trend, while better management and regulation are in need to achieve greater benefits, and risk control should not be overlooked while realizing value transfer and wealth growth. By strengthening the regulation of cryptocurrency trading platforms, strictly controlling ICO financing activities, and enhancing the monitoring and tracking of cryptocurrency transactions, the Chinese government aims to maintain financial order and protect the rights and interests of investors.

• Hong Kong, China

Currently, digital finance is the growth point of global finance as well as the high ground of global financial competition. However, Hong Kong, China is lagging behind in FinTech development, as the latest report released by the Global Financial Centers Index (GFCI) shows that Hong Kong's FinTech development is ranked 14th in the world, lagging behind Shanghai (7), Shenzhen (12), and Beijing (13) in Chinese Mainland, while its ranking in the international financial centers index has dropped to the fourth place. Therefore, there is an urgent need for Hong Kong to develop digital finance if it is to maintain its status as an international financial center.

In this regard, on October 31, 2022, the Hong Kong SAR Government officially released the Policy Declaration on the Development of Virtual Assets in Hong Kong, which is an important initiative of the Hong Kong Government to set out comprehensive planning and layout of the development of virtual assets, demonstrating the HKSAR Government's vision to promote the development of Hong Kong into an international virtual assets center, as well as its commitment and determination to explore financial innovations together with the global assets industry. On May 23, 2023, the Securities & Futures Commission of Hong Kong (SFC) released the Consultation Conclusions on the Proposed Regulatory Requirements for Virtual Asset Trading Platform Operators Licensed by the Securities and Futures Commission (hereinafter referred to as "Consultation Conclusions"). Considering that a large number of cryptocurrency investors suffered huge losses last year as a result of repeated crashes due to the lack of standardization in the regulation of virtual trading platforms, the SFC has made a point of clarifying in the "Consultation Conclusions" about the qualification of the virtual asset platforms, their financial soundness, and insurance/compensatory arrangements for the risks related to the custody of clients' virtual assets. Immediately on May 31st, HKVAC, a virtual asset rating agency in Hong Kong, was

officially announced. The platform is designed to reflect the reliability of trading platforms and promotes transparency in the virtual asset trading market by providing credit ratings for virtual platform exchanges and virtual products. On June 1, the Guidelines for Virtual Asset Trading Platform Operators and the Anti-Money Laundering Guidelines issued by the SFC were formally implemented. The SFC began accepting license applications from virtual asset trading platform operators and allowed retail investors to access licensed virtual asset trading platforms. However, virtual asset trading platforms need to comply with regulations and put in place a series of proper investor safeguards covering the establishment of business relationships with clients, governance, disclosure, and token due diligence review and incorporation.

Looking ahead, Hong Kong's virtual asset trading industry will gradually move towards standardization, which is expected to attract more traditional financial institutions and institutional investors to enter the virtual asset market and strengthen Hong Kong's competitiveness in the global FinTech sector. On the other hand, virtual assets are crucial to the development of the digital economy.

However, the current stringent measures in this area in the Chinese Mainland seem to run counter to this. Hong Kong, as a testing ground for early and pilot implementation, is expected to accumulate more experience for the future introduction of virtual assets into the Chinese Mainland as well as for the development of China's digital economy, especially in terms of the construction of virtual asset centers.

• Singapore

As an important financial and trade center in the Asia-Pacific region, Singapore is renowned worldwide for its comprehensive legal and regulatory system. According to investment platform Funderbeam, Singapore has become the third-largest ICO financing market in the world. Singapore paid early attention to the development trend of digital currency trading and introduced relevant policies on digital currency regulation. Legally, Singapore provides a neutral system for transactions and investment activities involving digital currencies. On the one hand, the Singaporean government is actively exploring the benign impact of Blockchain technology innovation on society, and

promoting the landing of digital currencies and digital payments; on the other hand, a prudent regulatory approach has been taken to digital currency-related activities, with a series of important legislation in digital currency-related areas, including Securities and Futures Act, Payment Services Act, A Guide to Digital Token Offerings, and the Consultation Paper on a New Omnibus Act for the Financial Sector (draft for public comment), covering the full range of regulations on ICOs, taxation, anti-money-laundering/counter-terrorism, and the purchase/transaction of virtual assets.

On June 21, 2023, the Monetary Authority of Singapore (MAS) released a white paper proposing general guidelines to regulate the use of digital currencies. It stipulates the conditions for the use of digital currencies such as central bank digital currencies, tokenized bank deposits, and stablecoins on distributed ledgers. Meanwhile, MAS announced on July 3, 2023, that in order to protect the rights of cryptocurrency investors, it is about to introduce a series of new measures that will require cryptocurrency exchanges to segregate the custody of customer and company funds by the end of the year and keep customer assets in separate trust accounts, as well as prohibit the provision of cryptocurrency lending and pledging services to retail investors in order to provide stronger safeguards.

4.4 Summary

The report consists of the following main sections:

First, this report analyzed the current development of global digital finance from the perspective of patents. From 2017 to 2022, the overall applications of digital financial patents worldwide have grown tremendously, increasing by 10 percent annually. However, the proportion of granted patents is relatively low, showing a bubble in digital financial patent applications, and the

quality of patents needs to be improved. For example, patents applied from China topped the global application list, but the share of Chinese patents among the total granted was only 16.6% and did not reach the global average (21%). In addition, companies such as Internet technology companies and financial institutions have led the development of digital finance globally, with a 78% share of patent applications. In the development of the three tracks, banking technology, insurance technology, and asset management technology, is still dominated by major global economies such as China, the United States, the EU, Japan, and South Korea. However, thanks to the extensive financial demand, technological progress and growth potential, Asian countries, such as India and the Philippines, have achieved rapid development in banking technology and insurance technology. In terms of asset management technology, given the long-existing dominant position of the U.S. securities industry, early transition and high investment by U.S. asset management organizations in recent years, the U.S. has maintained an absolute leading role in the field.

Second, the report discussed the differences and connections between Big Data, AI and Blockchain Finance (BAB) and clarified the internal logic of digital financial empowerment from the perspective of "technology + finance". Big Data Finance focuses on discovering valuable information from massive data to support the decision-making process of financial institutions. In other words, it goes for results. AI Finance focuses on creating the intelligence through data processing, i.e., in response to the needs of different business scenarios. It involves technologies such as machine learning, deep learning, and natural language processing to form a kind of intelligent financial solution through learning and self-adaptation, gradually replacing human decision-making and task execution. The application of AI Finance has a game-changing advantage in improving the efficiency, precision and level of smartness of financial services. Blockchain

Finance focuses on decentralization and increasing transparency. Blockchain may help to create the latest business model of finance from 0 to 1, which will form a trust mechanism between completely untrusting nodes, thus reconstructing the financial trust system and solving the information-related problem fundamentally. Although BAB has different focuses, these technologies are all important directions for digital finance development. They are mutually integrated and reinforcing. For example, Blockchain technology can provide a more secure and reliable way of data storage and sharing for Big Data Finance, thus improving the efficiency and quality of Big Data Finance. In addition, from the point of the digital financial empowerment pathway, since digital technology has not fundamentally changed the essential characteristics of the financial industry, digital finance still plays its role based on price discovery, resource allocation and risk management.

Third, the report systematically summarized and considered global BAB development from development status, application scenarios, case studies, and future outlook. Due to the continuous growth of investment and financing, policy support and innovation breakthroughs, the global BAB market increased rapidly, with gradually enriching application scenarios and many successful application cases in regions such as China, the U.S., and the EU. However, the development of digital finance is still in the primary stage, and there are a series of problems waiting ahead. In terms of Big Data Finance, to realize penetrable and accessible regulation of financial data, the most pressing issue, at present, is to deal with the proprietary rights of data. Although all countries are strengthening the protection, development and utilization of data security, and China, the U.S. and the EU are constantly exploring effective circulation mechanisms and more efforts on data trading and circulation and preventing data monopolization. There is currently no legislation on data ownership, which is also an issue called for in this report.

As for AI Finance, the emergence of the new generation of conversational natural language generation models, such as ChatGPT, will further promote the digital transformation of financial institutions, improve customer experience and optimize business operations. However, at the same time, market players need to pay more attention to important issues such as data privacy, security and interpretability to ensure that the application of AI meets the expectations of society and the requirements of laws and regulations. Blockchain Finance is very promising thanks to its natural attribute of finance. However, security is an urgent issue that needs a solution. In 2022, frequent security incidents in the cryptocurrency market have brought huge losses to a wide range of investors, and how to take action to manage risk without stifling innovation is an issue that policymakers in all countries should consider with a high priority.

Fourth, the report also explored the main risks currently in digital finance and reviewed the latest regulatory policies of major countries. Tackling information asymmetry between financial institutions and the outside world has always been an issue of the financial industry. Driven by digital technology, the amount of data (e.g., Internet, IoT, etc.), algorithms (e.g., Big Data analysis, AI, etc.) and computing power (e.g., cloud computing, 5G, etc.) have made revolutionary advances, which is of great and far-reaching significance to alleviate information asymmetry. In addition, people once regarded the Blockchain technology as a breakthrough in reconstructing the trust mechanism and took it as a fundamental solution to the information-related problems. But the application is still in the exploration and development stage.

From another perspective, digital technology has not fundamentally changed the essential characteristics of the finance. Traditional risks, such as credit risk, liquidity risk, maturity and currency mismatch risk, etc., would remain in the industry and may evolve into new

challenges. The application of cutting-edge technologies represented by Big Data and Blockchain in financial service scenarios is highly segmented and intersecting in their businesses, which will blur the boundaries of different financial institutions, and at the same time, the emerging new business forms in the financial industry and new trading behaviors are hard to be effectively regulated under the existing legal framework; On the other hand, the role of the Internet has accelerated the transmission of risks, showing significant cross-industry and cross-regional characteristics. Therefore, while the extensive use of information technology improves the operating efficiency of financial institutions, it also makes the complexity, contagiousness, invisibility and suddenness of systemic financial risks more prominent, with endogenous risks accumulating within the system. The massive use of advanced technology in finance also requires systematic transition and improvement of the management approach and capability of regulatory personnel accordingly.

In this regard, international financial regulatory organizations and national financial regulators have responded positively

by studying the evolution of digital finance, risk links and impact on the financial system and regulation from various angles and exploring to improve the regulation of FinTech on this basis. In recent years, China, the U.S. and the EU have continued to explore effective data circulation mechanisms, gradually pushing harder for data security and information protection and preventing data monopolization.

However, the existing regulatory policies focus on technology and data compliance, and systematic and effective regulatory policies on digital finance have yet to be formed, especially for Big Data, AI and Blockchain Finance. As a result of the dramatic volatility of the crypto market in 2022, there has been a breakthrough in the regulation of Blockchain Finance. Since the beginning of this year, the EU, the U.S., Hong Kong and other countries and regions have introduced effective regulatory policies for crypto-assets, eliminating the previous chaotic regulatory environment to a certain extent, which will promote the healthy and orderly development of Blockchain Finance. With the further development of digital finance, the financial regulators of

all countries are called upon to introduce more regulatory measures in the field of "digital technology + finance" as soon as possible. In addition, many existing regulatory policies are formulated based on traditional regulatory frameworks and regulations, which place digital finance-related activities similar to regular financial products and services under the same regulatory principles, such as licensing and capitalization requirements. However, the formulation of existing financial regulations is mainly subject to the traditional financial formats, whose types of entities, areas of operation and business boundaries have not changed significantly for a long time. Therefore, in the face of the innovation and development of digital finance, traditional regulatory mechanisms become less effective. Therefore, exploring and improving the regulatory framework of digital finance and building a reasonable digital financial regulatory system is the key to promoting the healthy development of digital finance, which requires regulatory authorities to adjust the regulatory concept, methods and intensity of operation.

To conclude, the rise of digital finance has brought the global financial systems more closely intertwined, and its development involves value, security, ideology and many other aspects. Promoting healthy and orderly development of digital finance requires stronger cooperation on a global scale.

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The International Finance Forum (IFF) is an independent, non-profit, non-governmental international organisation founded in October 2003, and established by financial leaders from more than 20 countries and regions, including China, the United States, the European Union, emerging countries and leaders of international organisations such as the United Nations, the World Bank and the International Monetary Fund (IMF). The IFF is a long-standing, high-level platform for dialogue and communication and multilateral cooperation and has been upgraded to F20 (Finance 20) status.

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