International Monetary Review

April 2022, Vol. 9, No. 2

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Special Column on the NPC and CPPCC Sessions

The Work Report by Li Keqiang in View of IMF Article IV Consultations and Fallout of the Ukraine War

By HERBERT POENISCH[*]

The timing of this year's work report on 5 March warrants some new perspectives. While the gist of the report is very upbeat for the Chinese economy, the publication of the IMF Article IV consultation and the outbreak of the war in the Ukraine with its global outfall add major concerns to how realistic the outlook is under the new developments. This might make achieving stable economic development difficult, if not impossible.

Although Premier Li already warned about headwinds in pursuing stable economic development in his report, they have become stronger than expected by the end of 1Q22. He is talking explicitly about the triple pressures of shrinking demand, disrupted supply and weakening expectations.

The first part of this article will highlight the concerns of Premier Li in achieving stable growth. This will be followed by the concerns of the IMF in the second part and the additional challenges from the global outfall from the war in the third part. The final part will be suggestions how the Chinese authorities could cushion any negative impact.

1. Headwinds to stable growth in Premier Li's report

In addition to the triple pressures he added the underlying currents for shrinking demand, disrupted supplies and weakening expectations. These are the re-emerging Covid-19 cases, most recently in Shanghai and Shenzhen which cast doubt over the Zero Covid-19 policy. Other factors are the sluggish recovery of consumption and investment. Maintaining steady growth in exports is becoming more difficult in view of global factors. The supply (and pricing) of energy resources and raw materials remains inadequate, and imported inflationary pressure is increasing. Many MSME are facing difficulties, and together with self-employed individuals the task of stabilising employment is more formidable. The regulatory crackdown has put scores of highly qualified people out of jobs.

In addition, policy has not adequately addressed the triple pressures. Central fiscal tightening has not helped, and the budgetary imbalances of some local governments   have become more pronounced. Many risks remain in the economic and financial sectors. The government support for innovation is key area. Inspite of President Xi's anti corruption drive, corruption remains a common problem in some sectors.

While economic stability has been declared top priority, ensuring this in the face of downward pressures has become even more challenging. The stability oriented strategy should motivate all stakeholders, which means the important private sector, in addition to central and local

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governments. Promoting efficient market functioning is equally important to a well-functioning government. This will have to be squared with the recent shift to promote the state sector.

Among the major tasks Premier Li mentioned a proactive fiscal policy. While boosting fiscal sustainability has been achieved with reducing the central budget to GDP ratio from 3.2% in 2021 to 2.8% in 2022 there is need to increase the fiscal contribution to growth. This will be achieved by transfer of profits of state-owned financial institutions and state monopoly businesses to the budget. The recent transfer of RMB 1trillion from the PBoC profits to the budget is a case in point. New funds will be channelled to local governments and used mainly to ease the difficulties of enterprises, such as in the real estate sector, stabilise employment, meet living needs, thus increasing consumption and demand.

The second declared task is to keep operations of market entities stable. Giving greater role to market participants entails greater instability. Providing further fiscal support for enterprises will compromise the fiscal sustainability target. Supporting cash flow of enterprises is aimed at mitigating the real estate crisis which could affect close to 30% of GDP. Support from the financial sector to the real economy also addresses the financial squeeze for the enterprises hit by Covid-19 as well as MSME, but not explicitly mentioned cushioning the shock from the insolvency of big property developers. In the same direction, fees charged by industry associations, chambers of commerce and intermediaries will be regulated and overhauled, which is a heavy administrative measure. Enterprises which do not lay off staff will be rewarded.

Next there is a commitment to strengthening market vitality, building a market-based allocation of production factors, focus on creating a market-oriented, law based and internationalised business environment. This does not square with the leading role of the state sector and the disentangling from international links which we have seen recently. At the same time regulatory responsibilities of central and local governments should be strengthened so as to prevent any absence of regulation. The recent regulatory crackdown has shown the resolve of the authorities. How this squares with enhanced market functioning and enterprises not laying off workers has to be seen.

In industrial policy, the development of the private sector in a cordial and clean relationship between government and business at the same time as SOE will be encouraged to better play their role in supporting and driving development with a focus on their primary responsibilities and core businesses.

China will promote scientific and technological innovation by reinforcing China's strategic science and technological capabilities by developing national institutions. At the same time, Premier Li adds the principle position of enterprises in innovation, promoting breakthroughs in core technologies in key fields. High tech enterprises should receive government support, while ensuring regulatory compliance. The target for a Digital China requires digitalisation of industries, building smart cities and digital villages. Will this process be state led or open to private contenders?

Promoting domestic demand is still a major task, which will require boosting personal incomes and improving the income distribution. However, achieving affordable housing has not been mentioned as at present, housing ties up the major part of disposable income. The government's role in providing infrastructure investment has been stressed, while it is uncertain whether financing will come from central or local government sources. Many of these, such as urban pipelines for gas, water and sewage will certainly have to be provided locally, by authorities already facing financial squeeze. New urbanisation initiatives will also have to be shouldered by local government.

The agricultural red line of 120 million hectares was reiterated, together with raising minimum purchasing prices of rice and wheat. These calculations will have to be revised in view of the global grain price hike as well as rising prices of chemical fertilizers. Food security will

take on new priority with local governments in charge. They might need additional finance to perform this job.

Adopting measure to stabilize foreign trade are commendable but challenging in times of global uncertainties. Supply problems as well as logistics constraints will add to this challenge. Foreign direct investment, although booming in 2021 will face headwinds due to geopolitics. Cooperation under the BRI will also come under strain as recipient countries are facing various price shocks which might impact their financial capacity to pay for BRI projects.

Continuing to improve the environment and promote green and low-carbon development might need a new appraisal in view of rising energy costs. It might even have to take a back seat for the time being until global energy markets find their new equilibrium.

On the social programme, providing housing at affordable prices will pose a challenge while sorting out the real estate sector bubble. Promoting the construction of government-subsidised housing is commendable but requires policy measures on the income side as well as the pricing of housing.

2. IMF views on China's economic outlook

The IMF highlights the current slowdown in economic growth (from 7.1% in 2021 to 4.8% in 2022) due to rapid withdrawal of policy support, the lagging recovery of consumption amid new outbreaks of Covid-19, the slowing real estate investment following policy efforts to reduce leverage in the property sector. The fiscal tightening is causing the augmented government deficit (according to IMF definition to include government managed funds and local government finance vehicles) to decline from close to 20% in 2020 to 16% in 2021 and 2022. While the pandemic determined public support, such as tax relief can be reduced now, new developments require fiscal support as well as public investment. Monetary policy tightening has given way to an accommodating policy stance.

Regarding structural reforms, according to the IMF there was little or no progress in key real sector reforms, including in the area of SOE and competitive neutrality between private and stare-owned firms. A wave of regulatory policy has increased policy uncertainty that has added to the financial stress caused by large property developers. This has raised concerns about state intervention using non market measures.

The imposition of the three red lines on developers to limit borrowing and limiting access to bank credit not only slowed real investment and sales, reduced inventories and tampered down house prices, but also exposed existing vulnerabilities among property developers. They are still struggling to honour their debt obligations. Poor disclosure, links to shadow banks have added uncertainty. All this will contribute to subdued private investment in 2022. Domestic credit to the private sector has been declining to 172% of GDP in 2022 and is expected to recede further.

Sudden, new and wide ranging regulatory policy measures have taken the financial markets by surprise, creating policy uncertainty and possibly adding headwinds to growth. This is viewed by market participants as undercutting the role of private enterprise and paving the way toward more state control over the economy. On the whole, China's business dynamism has been on a declining trend since the early 2000s. All available evidence suggests that SOEs still play a key role. They are asked to help with the implementation of China's climate goals, to increase R&D spending for the development of home-grown technologies against the backdrop of increasing decoupling.

Regarding energy, there were power cuts in 2021 caused by coal shortages from curtailed domestic production, restriction on coal imports, surge in global coal prices and the under performance of non fossil fuel energy sources. Local governments have resorted to power rationing and curbing high- energy intensity production, such as steel. The collapse in land sales, an important source of income for local governments could hurt provinces with weak balance sheets.

Local government debt overhangs, support for faltering local SOEs could spread more widely through the corporate sector, tightening financial conditions and creating potential negative feedback loops between corporate, bank and local government balance sheets, posing risks for financial stability. Altogether, reduction in the non-financial sector debt (including government debt) has not happened. On the contrary it increased every year since 2020 to reach 288% of GDP in 2022.

Rebalancing towards consumption regressed in 2020 and 2021, in particular subdued household demand, elevated household savings and the declining contribution of services to GDP growth. The sharp retrenchment of real estate investment weighed heavily on private consumption, through weaker income and employment and wealth effects. Strengthening the social protection system will reduce households' needs to insure against individual risks through precautionary savings and promote rebalancing towards consumption. As current household income is inadequate to sustain demand, household debt is projected to continue increasing to 63.2% of GDP in 2022.

The external environment has become more difficult with decoupling pressures broadening from technology access to financial markets. The current account surplus is expected to narrow further in 2022 to 1.5% of GDP due to normalisation of pandemic related exports and external uncertainties. A more flexible exchange rate can act as a shock absorber against sudden external shocks. As capital account continues to become more open, a more flexible (not stable) exchange rate would allow for less business cycle volatility.

3. Fallout from the war in Ukraine

Prior to the conflict, the global recovery from the pandemic was expected to continue in 2022 and 2023, helped by continued progress with global vaccination efforts, supportive macroeconomic policies in the major economies and favourable financial conditions. Inflation was seen as converging on levels close to policy objectives. Policy settings were expected to normalise with exceptional monetary policy accommodation being progressively removed and emergency fiscal measures taken in response to the pandemic, phased out.

Since the outbreak of the war, economic impacts will flow through three main channels: one, higher prices for commodities like food and energy will push up inflation further, in turn eroding the value of incomes and weighing on demand. In China the latter was marked as one of the downside pressures. Secondly, there might be a disruption to trade and supply chains which still play a major role in China's external strategy. Thirdly, reduced business confidence and higher investor uncertainty will weigh on asset prices, tightening financial conditions and potentially spurring capital outflows from EMDC.

Although Russia and Ukraine do not have a major influence on the global economy, if the war is protracted, global GDP could be reduced by over 1 percentage point in the first year, and push up global consumer price inflation by approximately 2.5 percentage points.

For China, the exports of Russia and Ukraine matter, as they account for about 30% of global exports of wheat, 20% for corn, mineral fertilisers and natural gas, and 11% for oil. Russia is a key supplier of palladium, nickel, inert gases and titanium sponge. The prices of these commodities have increased sharply since the onset of the war. Even if China is not directly affected, the partner countries on the BRI will definitely be squeezed and might run into financial problems.

The long term consequences might be felt on the energy markets, with a return to more carbon use and temporary suspension of ambitious environmental goals.

Finally, the present single global financial system, SWIFT messaging and composition of foreign exchange reserves could be fragmented. While China would welcome a greater international role of the RMB, it is uncertain whether the sudden division between a USD based

system and a RMB system would not add to the uncertainties in global trade. China has supported and is integrated in a well functioning global trading and payment system. Disrupting this cannot be in the interest of creating a stable economic environment.

4. Policy recommendations for China

This is not the time for normalisation of policy measures, as stable economic development is more elusive than ever. Chinese authorities will have to be proactive on all fronts. Starting with fiscal policy, various areas of support to prop up demand and boost supply will have to be taken by central and local governments. Local governments will need financial resources to fulfil their duties. They will also need more income from land use. Monetary policy will have to support growth, but might be facing increased inflationary pressures from global factors. Allowing the RMB exchange rate to appreciate will dampen this impact but adversely affect the outlook for trade. Capital flows might add an unexpected direction.

Pursuing the zero Covid-19 policy will come at an economic cost, not only loss of output but loss of employment and income, in turn dampening demand and consumption.   Will the SOE be able to fill this vacuum or will the authorities need to adopt a more favourable attitude to the private sector. However, private sector investments will only be promoted by long term outlook not short term necessities. The financial sector will have to open the spigots, although they might not feel inclined to do so in view of losses from the burst of the real estate bubble.

On the external side, will a continued decoupling help solve domestic problems? Reverting to an open door policy will subject Chinese interests to more outside pressures, whether in the form of trade tariffs, compliance with Western sanctions on Russia or audit standards for Chinese companies raising funds abroad?

5. Conclusions

Premier Li' work report highlights the uncertainties of the economic outlook for 2022. The three pressures have come to roost, with added global inflationary pressure. In the course of recent developments, ensuring stable economic growth has become more illusive. Instead of laying the foundations for a steady development, Chinese authorities are challenged to react not only to known demand and supply problems but also to an increasingly uncertain environment. They will need to pull all the economic levers to achieve adequate, not ambitious economic growth and to ensure social stability through health in the fight against Covid-19, full employment and greater income and wealth equality within the drive to common prosperity.

Literature used

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A Commentary on the Economic Strategy Discussed at the

2022 NPC and CPPCC Sessions

By IL HOUNG LEE[*]

A brief description of current economic challenges faced by China is presented first to provide a context in which to assess the "policy framework" discussed in the Two Sessions. The focus of this commentary is not on short-term policy measures but on the adequacy of the overall strategy to steer the economy towards a sustainable medium-term growth.

Overview of current challenges: Common global factors

A common global challenge can be summarized as the declining growth trend and high (youth) unemployment. One reason for the declining trend growth can be attributed to weakening "consumption-production-income" cycle. Industrial concentration, increasing high-tech capital intensity of production, and labor skill mismatch, may have led income to be less widely distributed among market participants, thereby weakening the link from income to consumption. Increasing synchronization of consumer demand for global standardized products that are more efficiently produced by multinational companies, including through managing complex modularized global value chain, have outpriced local competitors. As a result, producers catering for local markets, usually self-employed or SMEs who account for a large share of employment but a small share in value added, are losing ground. Only those able to find a niche market through highly localized services or specific technology remain.

Associated social cost such as from widening income and wealth inequality, high (youth) unemployment, and deteriorating climate conditions are rising. Wealth and income inequality worsens due to the widening gap between those with and without financial and/or physical assets, those belonging to the main global production league and those unable to access or remain in the market, and those with skills and experience (educated) and those lacking experience (youth) or with outdated skills (aged). The pandemic has further exacerbated this widening gap. Natural capital, the stock of natural assets such as the eco-system, uncontaminated soil, clean air and water, is being eroded by not internalizing negative externalities, e.g., carbon emissions, into production cost.

Macroeconomic policies, which are instruments to stabilize short-term price and output volatility, have been used extensively along with strengthened social welfare system to contain the rising social cost. However, as structural transformation through market response takes time, the cost of prolonged use of macroeconomic policies is now beginning to outweigh the benefit. Moreover, the widening financing gap of social welfare system is expected to worsen with aging. The upshot of all this is the accumulation of debt, which in turn acts as a further drag on GDP growth. Debt in a broader sense includes public debt,[1] overvalued asset prices (defined as prices above the net present value of return/income of the assets),[2] and excessive leverage relative to

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[1] Even before the pandemic, OECD average general government debt rose from 50% to 85% of GDP during 2007-2019 (to some extent to absorb financial liabilities accumulated prior to the global financial crisis), with Japan, US, and Italy, for example, rising by 60 ppt, 50 ppt, and 44 ppt, respectively (OECD data).

[2] Market capitalization of OECD rose to 147% of GDP (compared with the last peak 110% of GDP before the crash at the GFC), and as for the world total,

GDP (those associated with non-performing assets).[3] Demand for leveraged investment in financial assets and properties continues to rise due to the lack of alternative investment opportunities and the far larger return from valuations gains. Accommodative monetary policy, i.e., a very low or negative interest rate is neutralizing the burden on the economy,[4] keeps ailing firms afloat, and are encouraging leverage. On the fiscal side, large transfer payments are required to maintain social welfare and unemployment low.

Overview of current challenges: China specific factors

China shares many of these features noted above as it is at the center of global value chain. The country's specific challenges arise mainly from the rapid pace of economic growth. The public sector, through the State-owned Enterprises (SOEs), government-led investment, and state-intervention in resource allocation (especially in heavy industries), has been an important driver in transforming a low- to a middle-income country. Despite the successes,[5] signs of strains are emerging as effective state intervention become difficult with increasing sophistication of the economic system.

[Figure 1]

IMF WEO; Polynominal (order 2) trend lines.   IMF WEO; EMA: Emerging Market Asia   Author's estimates: IMF WEO and WB data
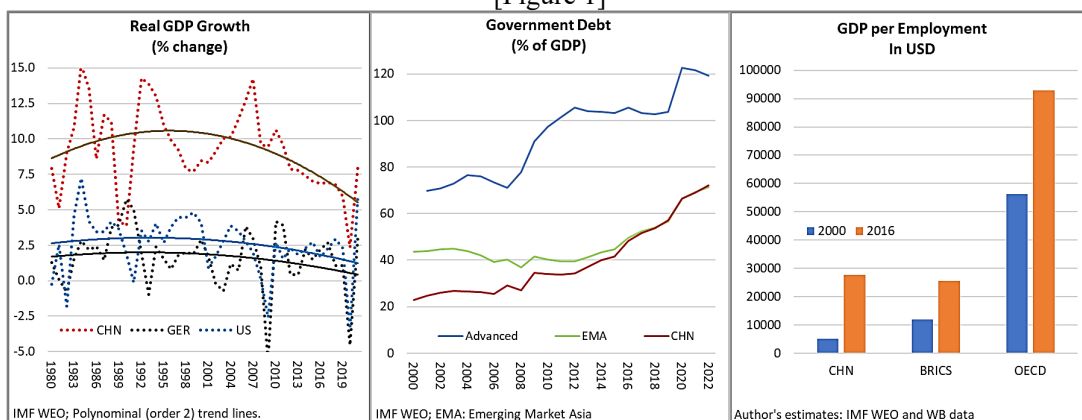
These strains arise from excessive (local) government investment and SOEs, especially since they play an important role in providing employment and countering cyclical downturns. The high investment share of GDP in China is largely attributed to the state which accounts for more than 50% of total investment. This compares with about 15% in both the US and Germany. As such, marginal product of capital (or the inverse of ICOR) is falling while public debt is rising. The situation differs from other countries where strains arise from supporting consumption either directly as social transfers and government expenditure, or indirectly through the financial sector and then absorbing the losses ex-post.

Gradual reduction in investment is necessary to engineer a smooth transition to a consumption-based and sustainable growth. GDP per employment in US dollars has risen from $5,140 to about $27,580 between 2000 and 2016. This is a 5.4-fold increase and compares with the average increase in BRICS of 2.1, and 1.6 among the OECD countries. Consumption-based growth would imply a lower investment share of GDP. This transition cannot take place, however, through faster consumption growth for practical reasons—it has already recorded the

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it rose from 114% of GDP (last peak) to 134% of GDP (World Bank data). Housing prices (2015=100) in OECD rose from 106 (last peak) to 129 in 2020, and for the US, from 119 to 141. Even the Euro Area recorded a significant increase from 119 to 123 during the same period.

[3] See "Redefining Liquidity for Monetary Policy" I.H. Lee, K.H. Kim, and W. Shim, East Asian Economic Review Vol 22 No 3, Sep 2018.

[4] In several countries, interest coverage ratios remained high and debt service ratio low largely due to low interest rates. Inflation, the main objective for monetary policy, is not discussed here.

[5] For example, underpinned by strong public sector led investment, Malaysia maintained rapid economic growth for 23 years (starting in 1974), Indonesia for 27 years (1970), Thailand for 32 years (1965) and Korea for 34 years (1963). China was on its 42nd year (1978) when it faced the pandemic in 2020. During this period, poverty ratio at $1.9 a day (WB data) in China fell from 66.3% in 1990 to 0.5% by 2016.

highest growth of 10% per annum during the last 40 years in US dollar terms[6] than any other country. While it is true that household savings ratio in China is higher than those of its peers,[7] a falling savings rate can better be achieved through lower investment growth. Progress in the currently envisaged reforms could support substituting the impact of lower investment on household income with other sources of growth.

Relating to the desirability of the larger role of the state, there are two aspects to consider before concluding whether it is necessarily associated with suboptimal resource allocation. The first is to weigh the benefit of SOEs contributing more directly to employment creation and acting as a buffer of short-term output volatility as against crowding out the private sector. Anecdotal evidence of SOEs' role as semi-social protection mechanism can perhaps be seen from the surge of SOE defaults since the onset of Covid-19 in 2020.[8] Yet, private sector corporations have not necessarily performed better given the high default rates before the pandemic, especially in the property market. The second is to weigh the benefit of relying on relative price adjustments (i.e., the visible hand) as against administrative intervention of market price adjustments (i.e., invisible hand).[9]

Irrespective of the size of the state, a more pertinent question would thus be whether the state can ensure a stable and a level playing field by quickly adjusting the regulatory framework and keep up with, even stay ahead of, the rapidly evolving technological and financial developments. In this regards, bold steps have been taken to reign in on big tech companies' modus operandi to protect consumer welfare, data and payment system security, and competition.[10]

Yet, the state accounts for almost 60% of total capital stock, as compared with 30% and 20% in the US and Germany, respectively, and entails about a two-fold higher depreciation rate[11] (i.e., China vis-a-vis the average of the US and Germany). This raises the question as to whether the cost of maintaining high public investment is now beginning to outweigh the benefit.

Key strategies of the policy framework of the Two Sessions

The 2020 GDP growth target of 5½ % indicates a realistic and practical policy objective that aims to moderate the recent decline in growth momentum rather than to proactively lift growth to the pre-pandemic level. The job target of 11 million in urban areas suggests further absorption of rural labor (given the lack of jobs and lower productivity) into cities for industry and services. Greater support will be provided for enterprises that expand employment and training. While the overall fiscal policy position does not seem to be expansionary,[12] tax incentives are largely targeted towards small businesses, low-profit enterprises and the self-employed. Export credit insurance for international trade-related SMEs will be expanded. These are consistent with the government efforts to promote SME innovations and startups[13]

The government sees infrastructure investment as a central instrument, including by the local government, to boost provincial economies. The financing of the latter will include, in addition to central government transfers, the use of special-purpose bonds but with an overall cap. Foreign investors are invited to high-end manufacturing and to participate in R&D and in digital services. Medical care and housing for the aged will be expanded partly through attracting private investment. On environment, carbon emission will peak in 2030 and reach neutrality by 2060, i.e., no more depletion of natural capital thereafter.

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[6] This compares with consumption growth of 4.5% in G7, 7.0% and 4.4% EM Europe and EM Latin America, respectively, all in US dollar terms (used for comparability).

[7] China's High Savings: Drivers, Prospects, and Policies; Zhang et al, IMF Working Paper WP/18/277, Dec 2018.

[8] The People's Republic of China, 2021 Article I Consultation, IMF Country Report (p20).

[9] http://www.news.cn/english/20220324/ed4d0ba14c15446bb9360e985a5ec632/c.html

[10] https://techmonitor.ai/policy/big-tech/chinese-tech-regulation-alibaba-ant-group-tencent

[11] Author's own assessment based on "Investment and Capital Stock Dataset, 1960-2013" by Fiscal Affairs Department, IMF.

[12] Author's own assessment based on the People's Republic of China, 2021 Article IV Consultation, IMF Country Report as the baseline.

[13] E.g., China's Working Group for Promotion of SME Development in 2000, the State Council executive meeting chaired by Premier Li Keqiang on July 12 to further enhance the support for innovation and entrepreneurship, and the announcement of support for digitalization in 2020.

Further progress is envisaged in regulatory reforms to strengthen fair market competition and enhance SOE efficiency through the implementation of the three-year action plan. Limiting credit growth (social financing) to nominal economic growth will also help to ensure that the financial market remains engaged with the real sector (i.e., avoid decoupling), limiting leveraged investment leading to financial and physical asset price bubbles (containing growth of debt). It would also be important to keep the real interest rate consistent with the targeted liquidity growth and hence with market fundamentals.

Assessment of the policy framework against the challenges

The policy framework of the Two Sessions provides the necessary package to address the key challenges noted above and to steer the economy in the right direction over the medium term. The package includes finding new sources of growth through innovation in technology (including through FDI), support labor to access the product and service market through promoting startups, supporting self-employment, and SME financing, and establish a sound regulatory framework to promote competition and underpin a level playing field for all participants.

The policy framework should help rebuild a virtuous consumption-production-income cycle. A better targeted government spending will also lead to a broader distribution of income among all market participants such as startups and SMEs, rather than as profit of well-established companies. Government support, including through education, to help labor become more innovative, creative, and better tailored to local taste, would further enable everyone to gain better market access through developing new items that can compete with global products.

If a virtuous cycle can be attained and new sources of household income be generated, China will be able to continue to improve its living standard at its current pace and still create jobs with much less investment. Under such a scenario, GDP growth would also be lower as it no longer relies on inefficient investments and the associated buildup of debt. For example, reducing the share of investment to GDP from 45% to 30% over a period of 10 years through reducing public investment while keeping consumption growth constant at 7 % per annum (constant price and national currency base) would imply an overall GDP growth of 4.5%. Overall investment would need to grow only by 0.3% per annum, i.e., holding it almost constant in level terms, while substituting public investment by private investment. This rebalancing would also be consistent with the aim of attaining employment and personal income growth in line with economic expansion and a reduction in energy-intensive activities.

[Figure 2]

Gross National Savings (In % of GDP) — IMF WEO; Polynominal (order 2) trend lines.

Real Capital Stock % of GDP — Author's estimate based on IMF data (FAD)

Total Financial Claims[1] on Domestic productive capacity (Ratio to GDP) — 1/ (Equity+securities+credit) minus foreign financial assets net of direct investment; author's estimate; IMF WEO, IIP, BIS, and WB data
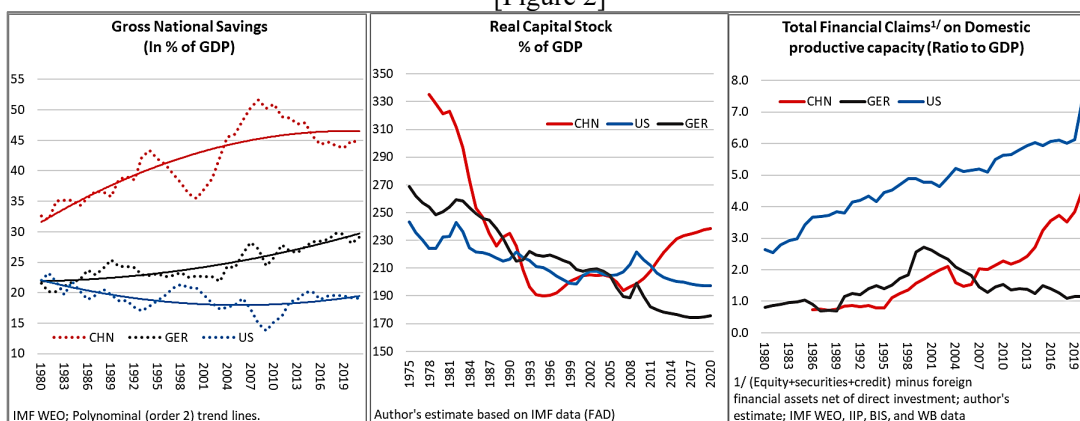
Deadweight loss, i.e., debt stock,[14] will also be curtailed under the rebalancing. China's real capital stock as % of GDP has fallen rapidly through the 1970s-90s and moved in par with those in advanced economies during the 1990s-2000s. This can be explained by the rapid growth in GDP (the denominator) through efficient investment such that the capital stock (the numerator) as a ratio to GDP remained low. However, since the global financial crisis, this ratio has begun to rise again implying a decline in capital efficiency, now reaching the levels recorded in the early 1980s. Moreover, since investment is increasingly financed by leverage, rather than savings, total financial claims on domestic productive capacity as ratio to GDP[15] is rising very fast (i.e., excessive leverage to GDP), well surpassing that of Germany.[16] Moderating public investment and improving private investment efficiency should contain further growth in China's deadweight.[17]

Relating to regulatory environment, in addition to decisive steps taken to ensure orderly private sector activities, similar progress will be needed in the ongoing efforts to assure leveling the playing field between the SOEs/local government and the private sector. A few examples would be full price flexibility, ensuring premiums that reflect proper risk assessment including through no implicit guarantees, and no regulatory bias or forbearance. Costs arising from optimizing social welfare (instead of profit) by SOEs should be transparently recorded as fiscal expenses which will also help strengthen the governance of SOEs.

Ending remarks

The weakening of the consumption-production-income cycle has led to lower growth and social challenges. Most advanced and emerging economies have responded with expansionary macroeconomic policies. However, given the slow pace of transformation, adverse consequences of the prolonged use of macroeconomic policies are taking a toll in terms of rising debt. Unless proactively addressed, market will correct itself through higher inflation or an abrupt adjustment in asset prices and defaults—none of which are desirable.

China is no exception. The consequence of excessive use of public investment has begun to show up in falling capital inefficiency as well as in rising financial claims already well in excess of its productive capacity. The policy framework of the Two Sessions seems to contain the right strategy to steer the economy towards a sustainable medium-term growth. However, a faster adjustment of state investment and SOEs could curtail the buildup of deadweight and ensure a sustainable medium-term growth.

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[14] See footnote 11.

[15] Further adjustment was made to total financial claims relative to that in footnote 3. It is defined as the sum of shares, securities, and loans and then netting out domestic residents' claims of financial assets abroad (using IIP data). Since total financial claims is the amount a country will ultimately need to repay with goods and services, it is used as a proxy for measuring total productive capacity. This measure as a ratio to GDP should remain stable in the long run (e.g., Germany's case).

[16] The ratio in China is still lower than that of the US, but caution is needed for a simple comparison since the US is the global center of the financial market.

[17] China's Path to Consumer-Based Growth: How to Identify and Reduce Excessive Investment, I. H. Lee, M. Syed and L. Xueyan, IMF Working Paper 13/83. Mar 2013

Global Partnerships - Building a Shared Human Community in the Time of Crisis

By JAYA JOSIE [*]

In September 2021 President Xi Jingpin (Xinhua, September 2021) proposed a Global Development Initiative for building a shared human community through global partnerships. At the time (April 2022) of writing this article the world is in a state of crisis, and in China the Covid 19 Pandemic is continuing to wreak havoc in the major cities in the South. During the Covid 19 pandemic in 2020 and 2021 the world came together in a global partnership to combat the effects and devastating impacts of the pandemic. There was a global consensus that the only way to fight the pandemic was through international partnerships in which all countries will work together to promote a global development initiative. International and regional organizations and, developed and developing countries supported the idea of combatting the devastating economic shocks of Covid 19 through a new stage of balanced, coordinated, and inclusive growth. President Xi Jingpin proposed the need:

"...to foster global development partnerships that are more equal and balanced, forge greater synergy among multilateral development cooperation processes, and speed up the implementation of the UN 2030 Agenda for Sustainable Development"

Throughout 2021 China initiated and implemented Covid 19 and developmental initiatives in support of developed, emerging, and developing countries with human resources, humanitarian aid, vaccine programs and infrastructural support through the One Belt and One Road Initiative and the China-Africa FOCAC program.

President Xi underlined the commitment to a people-centred approach in which people's livelihoods and human rights and benefits for all, especially in developing countries, are protected through development. A key element in this proposal is the importance of innovation and the relationship between people and nature. In articulating his development philosophy President Xi emphasised; innovation, coordinated green, open and shared growth for China's economic development and to promote common prosperity in China and the world.

Some key proposals in President Xi's statement include:

1. Support for developing countries in developing green and low-carbon energy, and no new coal-fired power projects abroad.

2. Staying committed to results-oriented actions and building a global community of development with a shared future.

3. Increase input in development, advance cooperation on poverty alleviation, food security, COVID-19 response and vaccines, development financing, climate change and green development, industrialization, digital economy and connectivity, and

4. Accelerate implementation of the UN 2030 Agenda for Sustainable Development, he said.

5. Conservation of nature, clean water and green mountains

6. Protect the environment to ensure future productivity

7. Promote equality in a world where half the global wealth is owned by one percent of the global population

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At the Fifth Session of the 13th National People's Congress of the People's Republic of China on March 5, 2022, Premier of the State Council, Li Keqiang gave a progress report on China's implementation of President Xi's proposals. In his report Premier Li underscored how China has consistently targeted and maintained economic indicators, supported businesses and deepened reforms. The Report also showed how government promoted and stabilized innovation driven development and supply chains through digital and smart technologies. The Report showed progress, among others, in the coordinated development between urban and rural areas, environmental protection, and accelerated improvement in the well-being of the population.

The Report concluded by reporting on developments on the global level where China has advanced diplomacy on all fronts despite the challenge of Covid-19. In this regard China promoted the building of a human community with a shared future, fostered global partnerships, and played an active part in the reform and development of the global governance system and advanced international cooperation on Covid-19 response and worked with all other countries to respond to issues and challenges global in nature. In this regard China has contributed its fair share to promoting world peace and development.

The ambitious vision articulated by President Xi was developed in a year (2021) that the CCP celebrated its one-hundred-year anniversary. It was indeed a momentous occasion and China has much to thank the CCP for its achievements in the past one hundred years. However, 2022 has come with new challenges both globally and in China. Globally, the world is faced with a new threat to world peace and destabilization, putting in jeopardy major developmental advances in Eurasia, Asia, Africa and the internationally. While China and its partners in BRICS, BRI, FOCAC, the Shanghai Cooperation Agreement and ASEAN are promoting development and a shared human community through peaceful cooperation and exchanges there is currently a war raging in Europe that is threatening to destroy all the post Covid-19 gains. This war is likely to have devastating effects on all seven of President Xi's important proposals.

Given the current economic climate, developing countries and groups such as the BRICS, the Eurasian Cooperation Agreement, Shanghai Cooperation Agreement, FOCAC and the BRI need to adopt radical measures to transform society to break out of the current economic hardships characterised by experiences of pandemics regional wars poverty, inequality, unemployment, weak trading networks and limited foreign investment. Moving towards a more innovative digital economy is one way to overcome the current challenges facing the world. A digital economy such as the one currently available in China offers opportunities for emerging and developing economies.

In the 14th Five Year Plan the State Council issued Bulletin No 3 where the plan for The Digital Economy for Development was published. In this plan the digital economy is viewed as a major economic initiative to support both the agricultural and industrial sectors of the economy. The most important element in this plan is the introduction of a modern information network platform that will drive greater fairness and efficiency. The idea is to translate the benefits of the digital economy with changes in production to the way of life and governance in the way resources are allocated in a competitive global environment. China wishes to tap into the enormous progress that has been made in the digital economy in recent years. The development of the digital economy is presented as a strategic choice to benefit from the new global opportunities offered by the rapid development of the digital economy internationally.

In the 14th Five Year Plan China intends to embark upon deepening applications, standardize digital development and promote inclusive sharing. The main aim is to deal with new challenges by seizing opportunities for development of the digital economy and promote economic development. In 2020 it was reported that the digital economy accounted for 7.8% of GDP. China has also become the global leader in 4G and 5G technology. China also increased the number of mobile broadband, fibre, and active IP users. For 2022 and beyond China is

promoting innovation and a regulatory framework for governance of the digital economy. Today most people in China conduct payment transactions using mobile and online banking. With respect to innovation China is already leading the field in the financial sector with the promotion of the digital Yuan and the introduction of the Central Bank Digital Currency (CBDC). The digital Yuan is already making a huge impact domestically in China. The use of the digital Yuan and CBDC is likely to have a very positive impact in the agricultural areas in China and promote trade and commerce between the industrial and agricultural sectors ensuring minimum disruption to value chains in the economy.

In 2021 the 14th Five Year Plan for developing the digital economy produced a working report where it proposed the development of the industrial internet, build more common technology research and development platforms, and improve the innovative and specialization levels of small and medium enterprises. In 2022 China also began to promote the production of its own hardware and software abilities to break from dependency on foreign imports. Finally in 2021 China's regulatory authorities acted against the unbridled abuse of the internet and introduced regulations to promote the safe and well governed use of the internet and digital platforms.

In the current climate of war, pandemics, global financial instability and disruptions to global value chains, threats to food security and inflation developing and emerging economies should seriously consider emulating China's use of the digital economy. Taken on a global level, the example of China's use of digital currencies and online payments will have a significant impact internationally. This will likely be significant in regions where financial instability, disruptions to global value chains, food insecurity poverty, unemployment and inequality are important considerations. If China uses its membership of the BRICS, FOCAC, the Belt and Road Initiative (BRI) and the Shanghai Cooperation Organization (SCO) to promote the digital economy and especially the use of CBDC and other innovative ideas this will have a great impact in promoting common prosperity and help to create jobs and reduce poverty and inequality in many of these regions. For example the use of a CBDC for trade in the African Free Trade Area, the BRI, the BRICS, Eurasia, and the SCO will make trade and commerce easier and more efficient for small and medium entrepreneurs and farmers to trade across countries without being dependent on intermediate payment systems. The use of Blockchain and digital currencies managed and governed by   Central Banks will provide a well-managed and secure system of trade and commerce across the developing world. This is the most efficient way of spreading common prosperity in the developing world. China's experience in reducing poverty over the past 30 years can become an excellent model especially for developing countries.

To by-pass possible threats from intermediaries and other challenges faced by developing and emerging economies regional groupings representing developing and emerging economies should seriously consider moving towards a digital civilization. In such a civilization developing and emerging economies can become self-sufficient, independent of foreign intermediaries for trade and investment and promote the development of the most vulnerable and marginalized in their societies. Using the digital economy and central bank digital currencies will free developing and emerging economies from dependency on financial intermediaries. Such self-sufficiency will create conditions for employment, reduction of poverty, inequality and food insecurity.

An important question is whether South-South development integration could be 'an instrument' of trade and industrial policy in the regional groupings. Furthermore, in Sub-Saharan Africa, developing and emerging economies, the Global Financial Crisis (GFC), the current war in Europe and the COVID-19 Pandemic has had massive negative impacts on economic growth and development with devastating consequences for households and private and public sectors resulting in high levels of unemployment, rising poverty, food insecurity inequality and social

unrest. Given this imperative, joint research needs to be undertaken for developing Central Bank Digital Currencies (CBDC) in developing and emerging economies.

Given the current critical international juncture and difficult economic climate, the developing and emerging economies need to adopt radical measures to transform society to break out of the current economic hardships characterised by experiences of pandemics, war, poverty, inequality, unemployment, weak trading networks and limited foreign investment. Digital platforms and CBDCs offer a radical departure from traditional economic and monetary policy, bringing new ideas to reimagine the economic structure globally. International research has shown that a CBDC is a virtual or digital format of a nationally issued fiat currency. Such a transactional payment system is supported and regulated by the country's monetary authority and should be in compliance with its monetary policies. A CBDC will simplify monetary and fiscal policies and reduce the barriers faced by the financially excluded portions of society. A digital currency such as the CBDC will provide a universal means of payment appropriate to a digital civilization. Globally, a move towards CBDC's will demonstrate a most fundamental shift in the evolution of monetary policy, trade and intranational finance.

Policy Priority Shifting to Pro-growth Again

By XIA LE [*]

The annual "two-sessions", namely the National People's Congress (NPC) and the Chinese People's Political Consultative Conference (CPPCC), are always on the top of in China's political agenda. This year's event especially attracted a lot of market attention not only due to enormous uncertainties associated with domestic economy but also due to the unprecedented volatility of external environment caused by the gloomy inflation outlook and escalating geopolitical conflicts. The observers are keen to learn how the Chinese central government will set the tone for their work of this year.

In the week-long session starting on March 5th, thousands of delegates from around the country reviewed the Government Work Report by Premier Li Keqiang which covered almost all the important topics with respect to the country's social and economic developments, ranging from the national anti-pandemic endeavors to the reforms of the national judicial system. To the majority of market observes, what interests them most is a number of 2022 key indicator forecasts announced at the event, including this year's growth rate, inflation, money supply growth, fiscal budget deficit etc. Except for the fiscal budget deficit, these official forecasts only reflect official projections rather than binding targets, reflecting the authorities' willingness to allow the market mechanism to play a fundamental role in economic development. However, people still expect these official forecasts to reveal the authorities' overall policy stance.

An ambitious growth target amid escalating uncertainties of the Pandemic

At the "two-sessions", this year's GDP growth target is set at "around 5.5%", which is a little bit higher than the average growth rate of 5.2% during the period of 2020 and 2021. It is also higher than the IMF's latest growth forecast of 4.8% and the current market consensus projection of 5.2%. Regarding the target, Premier Li Keqiang particularly emphasized that it requires adequate policy support and the efforts of the entire society. In the meantime, the authorities aim to create 11 million of new urban jobs this year and maintain the surveyed urban unemployment rate below 5.5%.

The official growth target of 5.5% is still in line with the current level of China's potential GDP, which, according to our estimate, falls in a range of 5-6%. In theory, this seemingly attainable target should not meet with such a large extent of pessimism in the market. However, many observers are not sanguine about it at all, worrying that the new wave of the Covid-19 variant, namely Omicron, will break through China's defense and tip the world's second largest economy into a severe downturn. More importantly, the situation of Hong Kong added people's concerns. Over the past couple of years, Hong Kong had been implementing a similar "zero Covid" strategy to battle the Covid-19 before the much contagious Omicron variant swept the city at the beginning of this year.

In our opinion, it is still too early to tell whether the Omicron can sweep through Shanghai as it did to Hong Kong. The grave situation in Shanghai has prompted the central government to intervene with unprecedented efforts. A strict lockdown is to be implemented in a bid to bring the situation under control as soon as possible. In coordination with the lockdown, China's authorities also mobilize enormous amounts of medical resources from outside Shanghai to support the city.

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We don't believe that China's authorities will switch to the mode of "co-existence with virus" any time soon. Shanghai has now become a watershed in China's war against the Covid-19, just like Wuhan at the beginning of 2020. Our bottom line is that the lockdown in Shanghai will last at least until June. The authorities will stick to its "Zero Covid" strategy while they might fine-tune some measures to minimize the social and economic costs. With the time going on, the general public and policymakers will gain a deeper understanding of the Omicron variant. At some time point, the authorities might find that the hygienic risk of the Omicron variant, in terms of its death toll and threat to the healthcare system, is too small to justify the costly "Zero Covid" strategy. By that time, the authorities will make the big decision to switch to the mode of "co-existence with virus". But it won't happen earlier than June.

All in all, we find that the difficulties in attaining this 5.5% official target have been on the rise. However, thanks to the strong mobilization capacity of China's government, we believe that the Omicron virus is unable to break through China's Wall to cause a nationwide flare-up. That being said, the real growth outturn of this year is likely to fall in a range of 4-5%.

The property sector likely to be a significant drag of growth

The headwinds to China's growth abound. We tend to believe that the largest headwind to growth is still the real estate sector, which experienced a severe policy clamp-down in the past two years and are showing clear signals of slowdown now. In this respect, not only the housing prices tumbled in many cities, but also the activities relating to real estate sector begin to decelerate significantly.

In China the property sector's large contribution to economic growth, the real estate and construction sectors account for around 14.5% of the total GDP in 2020. This ratio seems a bit lower than people's impression but quite comparable with the ratio in the US (16%), Japan (16.9%) and Germany (15.7%). Taking into account its strong linkages to its upstream and downstream sectors, such as construction, architecture raw materials, housing decorations, housing appliance, furniture, etc., these real-estate-related industries are estimated to account for around 25% of the country's total GDP.

The up-and-down in the real estate sector also has significant impacts on local governments, the banking sector as well as the country's households. In particular, around 84% of local governments' total revenues are related to local property market and land sales. Therefore, the slowdown in the real estate sector will unavoidably lead to the decline in local governments' revenues and consequentially limit the authorities' fiscal capacity. Indeed, local governments have long played an important role in the economy, not only in form of maintaining the public spending on various social wellbeing programs but also through infrastructure investment.

In China's giant banking sector, mortgage loans to households and developer loans jointly accounted for around 29% to banks' total outstanding loans. Not to mention that many other loans also use property or land as collaterals. The negative shock to the real estate sector will directly increase the volume of Non-Performance Loans (NPL) in the banking sector. It will consequentially weigh on the balance sheet of banks and dampen their capability of extending credit to the real economy.

China's households also have a great exposure to the real estate sector. The latest household survey from Southwest University of Economics and Finance (CFHS Survey) points out that in Beijing and Shanghai, the share of housing to household's total assets even reached 85%. By contrast, this ratio is only 36% in the United States. Such a great exposure could imply an enormous magnitude of wealth effect for Chinese households in reaction to the movement of house prices. That being said, the consumption of households could plummet remarkably if the property prices have a significant correction in a short time.

Given the importance of the real estate sector to the economy, the "two-sessions" indicated to fine-tune the sector-wide policies and regulations so as to ensure a soft-landing in the sector. Although the authorities will continue its principle of curbing speculations in housing market and improving the housing affordability in the society, they are willing to adjust the pace of policy implementation so as to ensure a soft-landing in the real estate sector. In a couple of weeks after the conclusion of the "two-sessions", the fiscal authorities announced a postponement of the property tax this year. It reflects that the authorities are well aware of the potential risks associated with the property market, which is a welcome step and helps to engineer a soft-landing in the property market.

Monetary policy has more room for the authorities to maneuver

At this year's "two sessions", the market expected to see more monetary and fiscal policy initiatives in support of growth. The government work report announced that the annual growth of M2 and total social financing are set to be in line with this year's nominal GDP growth rate, which we estimate will be around 8.5%. In addition, the authorities emphasized the monetary policy will be prudent, albeit tilted to the easing side, in concerns of the US Fed's interest rate hike and domestic vulnerabilities such as debt overhang. The authorities show their strong preference for targeted credit expansion, in particular to SMEs, Covid-19 affected sectors as well as the agricultural sector.

In our opinion, the authorities might overrate the constraints on the monetary policy at this junction. It is true that China's monetary policy was constrained by a number of factors, chief among which were the concern of housing bubble and the stability of exchange rate. That's why the authorities preferred to use targeted monetary policy tools to rev up the economy rather than deploy universal interest rate or required reserve ratio (RRR) cuts.

However, the fast change of external environment has substantially relaxed those constraints imposed on monetary loosening. For example, after the authorities' persistent policy tightening over the past couple of years, the housing market are slowing down at a fast pace. As we discussed in early part, the policy priority for the real estate sector has shifted to engineering a sector-wide soft-landing from curtailing market bubbles previously. Therefore, the deployment of traditional monetary easing tools, such as interest rate cuts, will help to stabilize the real estate sector and boost domestic demand at the same time.

Moreover, we believe that people's concerns over the China-US interest rate differential might be exaggerated as well. Some people worry that the interest rate cuts in China will further narrow its gap with the interest rate in the United States given that the US Fed is on its way to hike policy rates. Then it will exert greater pressure on the RMB exchange rate and even introduced another round of fast currency depreciation comparable to the episode in 2015.

However, this argument fails to recognize the current backdrop of the Fed rate hike. In the United States, the inflation rate has elevated to a record high level over the past 40 years. Meanwhile, China's inflation continues to be tame thanks to both low food prices and measured monetary policy. That being said, the interest rate differential between China and the USA is narrowing only in the nominal term while widening in the real term. Under such a circumstance, the RMB exchange rate should have a natural tendency to appreciate instead of depreciate. Of course, the fast interest hikes could generate unpleasant noises in global financial markets and aggravate capital outflows in the short time. But it should not have a long-lasting impact on the RMB exchange rate if all the in-place measures under the capital account are implemented effectively. Put differently, the potential interest rate cuts in China should not become a woe for its currency.

In sum, China's monetary policy room is still ample for the authorities to deploy more easing measures. Neither housing bubbles nor US-China interest rate differential constitutes a binding constraint for the monetary authorities to further lower social financing cost through policy rate

or RRR cuts. We anticipate 1-2 times of LPR and RRR cuts this year. They are better to be front-loaded before the US interest hikes are in full swing.

Table 1. COMPARISON OF 2020 AND 2021 TARGETS SET BY GOVERNMENT WORK REPORT

	2021 target	2021 actual	2022 target
GDP	6%	8.1%	5.5%
CPI	3%	0.9%	3%
M2	In line with nominal GDP growth	8.7%	In line with nominal GDP growth
Total social financing	In line with nominal GDP growth	10.3%	In line with nominal GDP growth
Fiscal Deficit	-3.2%	-3.7%	-2.8%
Special Covid-19 Government Bond	No issuance	No issuance	No issuance
Local Government Bond	RMB 3.65 trillion	RMB 3.65 trillion	RMB 3.65 trillion
Survey unemployment rate	5.5%	5.1%	5.5%
Urban employment	11 million	12.69 million	11 million

Source: BBVA Research and 2022 Government Work Report

Resilient China*

By ANDREW SHENG AND XIAO GENG*

Rather than doing what is required to bolster public trust, many political leaders, particularly in the West, have sought to unite their populations by framing and highlighting external threats, especially China and Russia. This has left China with little choice but to redouble its efforts to build resilience at home.

Instability is the new worldwide normal. From Russia's invasion of Ukraine and tensions in the Taiwan Strait to the COVID-19 pandemic and climate change, the challenges the world faces are as varied as they are volatile. But, despite their transnational nature, building resilience to them must happen, first and foremost, within the confines of nation-states.

Russia's war on Ukraine represents a historic turning point. In this week's On Point, Project Syndicate commentators – including Cambridge's Helen Thompson, Harvard's Kenneth Rogoff, and the American Enterprise Institute's Kori Schake – offer exclusive analyses and predictions of what the war will mean for the global balance of power, national and regional economies, energy markets, the global financial and monetary system, nuclear proliferation, and other critical issues.

To be sure, effective multilateral cooperation has an important role to play. But intensifying geopolitical rivalries limit its potential. Moreover, even if countries did work together, their ability to address destabilizing global and regional trends and imbalances would depend substantially on the work that each country is doing to strengthen financial, economic, and social resilience at home.

But there are plenty of barriers to effective national-level action. With public trust in government sagging in much of the world, few political leaders have the political mandate or legitimacy they need to make the difficult choices that the situation requires. Widespread mistrust of media does not help matters.

Rather than address these trust deficits in an honest and sustained way, many political leaders and journalists, particularly in the West, have sought to unite their populations by framing and highlighting external threats, especially China and Russia. This is a dangerous distraction that arguably will leave the West less secure.

If countries remain on a war footing, they will dedicate insufficient attention and resources to domestic imperatives like meeting net-zero targets, bolstering demand, delivering quality health care, ensuring adequate social protections, and reducing economic inequality. Without progress in these areas, discontent will only grow, undermining domestic, regional, and global stability further.

China, for one, recognizes that attempting to address domestic challenges while fighting a "war of words" in the media and managing a cold war with the United States is a zero-sum game. With this in mind, in 2020 it introduced its "dual-circulation strategy," focused on increasing China's self-reliance and thus its ability to withstand external pressures and disruptions.

As China has begun to implement this strategy, it has also maintained a strict zero-COVID policy. This enabled it, most importantly, to keep total deaths low: had China's COVID-19 mortality rate matched that of the US, some four million Chinese would be dead. Instead, China recorded just a few thousand deaths from COVID-19.

Beyond saving lives, China's zero-COVID policy enabled the country to avoid the economic drag of protracted national lockdowns, thereby facilitating a rapid recovery of production and consumption. This gave the government the confidence to implement structural-adjustment policies aimed at improving the quality of growth and advancing the goal of "common prosperity."

For example, policymakers acted decisively to reduce risks in the real-estate sector and rein in internet-platform giants. While these reforms carried short-term costs – GDP growth slowed to 4% in the fourth quarter of 2021 – full-year growth reached 8.1% (compared to 5.7% in the US), and China's current-account surplus stood at $315.7 billion (1.8% of GDP).

Further highlighting China's commitment to addressing imbalances, the country's macro leverage ratio (a measure of the economy's overall indebtedness) has declined for five consecutive quarters. In 2021, the ratio fell by 7.7 percentage points, to 272.5%. For comparison, as of June 2021, the macro leverage ratio stood at 286.2% in the US, 416.5% in Japan, and 284.3% in the eurozone.

Fiscal and monetary prudence also helped to ensure that the renminbi's value rose just 2.7% against the US dollar in 2021, compared to 6.7% in 2020. Moreover, consumer prices climbed only 0.9% in 2021, compared to 7% in the US.

Producer prices did rise sharply in 2021, with annual growth peaking at 13.5% in October, owing to commodity-market volatility and supply-chain disruptions. But the government's stabilization policies are already working to counteract this trend, reflected in the subsequent slowdown in producer price inflation, which stood at 9.1% in January.

And China is just getting started. In the quest for common prosperity, the government will continue to use a combination of market incentives and fiscal transfers both to expand the economic pie sustainably and to ensure that gains are allocated more fairly. Voluntary charitable contributions will also make a difference here.

A second priority is to achieve a more balanced and disciplined use of capital, with the help of both incentives (such as to bolster productivity growth) and regulations (to protect against speculative practices or monopoly prices). As part of this effort, China is encouraging the use of long-term equity capital, instead of debt.

China's government is also working to secure adequate supplies of strategic natural resources, energy, commodities, industrial materials, and agricultural products, to shield itself against a hostile geopolitical environment. Furthermore, it is improving its systems for predicting, managing, and mitigating major financial or non-financial risks, including low-probability, high-impact Black Swan events and slow-moving Grey Rhino risks like climate change and biodiversity loss. And it remains committed to reaching a carbon-emissions peak before 2030 and achieving carbon neutrality by 2060.

It is an ambitious agenda, and success is not guaranteed. China's own track record shows that, in devising and implementing bold policies, missteps are inevitable. But China also has a long history of learning from its mistakes and adapting to changing conditions. In any case, at a time of profound uncertainty and open hostility, China has little choice but to prepare for the worst. Fortunately for the rest of the world, whatever progress China makes in addressing internal imbalances will only bolster global stability.

With More External Woes, Smart Macro Moves Key to Sound 2022[*]

By E Zhihuan[*]

Since the COVID-19 outbreak, development gaps between nations due to different levels of anti-COVID measures have exacerbated divergences in the global economy, generating even more risks facing the Chinese economy this year. In view of the external environment, there are three major challenges in this situation China now is confronting.

First, before the Russia-Ukraine conflict, the International Monetary Fund lowered its 2022 global economic growth forecast to 4.4 percent, down from 5.9 percent in 2021, and that for the United States to 4 percent from 5.6 percent. For the eurozone, the number was lowered to 3.9 percent from 5.2 percent last year. Yet now, with the adverse impact of the conflict, it may be revised down further. With Europe being one of China's major trading partners, and the US a key export market, all of the exterior uncertainties are potential woes that could hinder China's export momentum this year, making assessment of the geopolitical impact on foreign trade a must for Chinese regulators.

Second, the Chinese economy is currently facing downward pressure and is in a different cycle from the US economy, and the gap between the two giants may be larger. Even if the US economic growth rate has been revised down to 4.4 percent, it is still higher than the average of the past decade and well above the US trending growth rate.

In addition, the US Federal Reserve announced earlier this month a 25-basis-point interest rate hike, which may trigger adjustments in international capital flows, as well as changes in supply and demand in global financial markets.

However, as the 25 bps increase is relatively small and interest rates are still at a historically low level, the impact the US move may cause on global financial markets is expected to be limited. Meanwhile, the move was well predicted by the market as the Fed had been delivering related information. For China, what is worth noting is that the Fed's move is not a one-time action, but the beginning of a series of actions－a turning point in policy orientation.

For a long time, the Fed's monetary policy has been determined based upon the needs of the US itself, without consideration of spillover effects. At present, the US is facing severe inflationary pressure, and the inflation level will exceed the target range in the next two years, which is exactly the basis for the rate hike move. The market is also worried about a worsened situation due to inflation and economic stagnation.

Judging from the labor market, the unemployment rate in the US is expected to reach 3.5 percent by the end of this year－close to full employment－which may form a wretched cycle of higher wages and larger inflationary pressure.

What is happening in terms of both the current inflation and the employment situation is urging the US to take faster steps to abandon its easing policy. The interest rate hike by the Fed has led to dynamic changes in the interest rate gap between China and the US, which will have a certain impact on the renminbi exchange rate. As China's macroeconomic policy options are always made against the backdrop of global macro policy adjustments, it is a work that must be done effectively, with attention given to the impact of US monetary policy adjustments.

Third, how the Russia-Ukraine conflict evolves remains uncertain, which in fact had caused a direct impact on the turbulence in commodity markets and global financial market sentiment. In the past few years, Russia has successively reduced its holdings of US bonds in its foreign exchange reserves, and has achieved a certain degree of de-dollarization in the currency in which imported goods are denominated. Exported goods, however, are still mainly denominated in US dollars.

So, it's fair to say Russia is not fighting an unprepared war, and had prepared in terms of its economy and financial bearing. While direct effects brought by the Russia-Ukraine conflict are being witnessed in many sectors, various secondary disasters are also being seen one after another, among which are the financial and economic sanctions imposed on Russia by Western countries led by the US. But the sanctions are very different from those in the past. The latest sanctions have restricted the use of forex reserves held by Russia and excluded some Russian banks from the SWIFT system, which has dented relevant countries' confidence in the US dollar. On the bright side, it may be a new reform opportunity for the international currency system to promote de-dollarization and reserve diversification.

In the short term, the above three external factors pose more challenges to China's economy than opportunities, and should be dealt with in a proper and cautious manner. The two sessions this year set a target of 5.5 percent GDP growth, which is the upper limit of general market expectations, reflecting the government's priority in employment and resolve to provide a certain number of job opportunities for more than 10 million new college graduates. The target is also a hard nut that must be cracked to meet the requirements of the overall goals of the 14th Five-Year Plan (2021-25).

From the perspective of both internal pressure and the external environment faced by China's economic growth, the target can by no means be reached only through modest measures, but greater efforts are needed to achieve that goal. With the continuous slower growth seen in the third and fourth quarters, and a growth rate of 4 percent in the fourth quarter, the uptrend of the first quarter is under relatively heavy pressure, and it will be difficult to fundamentally reverse the trend of economic deceleration in growth. For the whole year, to achieve the 5.5 percent target requires the coordination and support from macro elements.

To this end, as has been highlighted in many meetings and forums, implementing long-term structural reforms has been well acknowledged to be key to achieving high-quality economic development in China. However, the implementation of relevant measures needs to reduce and control possible side effects and avoid unintended shocks to the financial sector. Therefore, structural reform policies should refine the process and strengthen process management and risk control.

First, the government should strengthen the management of relevant policy expectations. When functional departments introduce structural policies, including those targeting market-oriented reforms and production factors, they should conduct adequate deductions accordingly, fully consider the impact of industry-specific measures on the financial market and consider potential perspectives of the domestic market and the international market in terms of policy interpretation. Proper and understandable vocabulary should be used to ensure sufficient communication with market players.

Second, cooperation between relevant functional departments should be further strengthened. For instance, there is still ample room for further cooperation between online platform standardization and financial management departments.

Third, the continuous impact of the Russia-Ukraine conflict may lead to the concentrated release of global systemic risks, which will have a greater impact on financial markets. Plans should be formulated in advance for abnormal market fluctuations while strengthening risk

management in the process of implementing structural policies so as to enhance policy implementation and make ensuing policies play their proper role.

Global Economy

Continued Concatenation*

By ZHAO CHANGWEN*

Great changes in the global economic landscape, the COVID-19 pandemic, technological revolution and green transformation are having a profound impact on the division of labor in the global industrial and supply chains that will affect the global economy for a long time to come.

The world's economic landscape has been undergoing seismic changes for some time. The share of emerging and developing economies in the global economy is increasing rapidly. Measured by purchasing power parity, emerging and developing economies accounted for nearly 60 percent in 2019. The influence of non-economic factors on the global industrial division and supply chain system is increasing, as is obvious in some strategic, public and national security-related industries. The global industrial chain is also becoming decentralized and multi-centralized. In the past, North America, Europe and the Asia-Pacific were considered the centers of the global economy. Now, multi-polarization has led to a balance between the developed and emerging economies. In addition, in line with changes in the economic landscape, the importance of companies from different countries in the global industrial and supply chains is also changing, with the influence of industry leaders in emerging and developing economies increasing.

The world has been battered by the COVID-19 pandemic since 2020.Its impact on the industrial and supply chains is mainly reflected in three aspects. First, the requirements of large economies for independent, secure, controllable or resilient industrial and supply chains have increased. Second, industrial differentiation has further deepened, and the distinction between strategic industrial sectors and market-oriented industrial sectors has been reinforced. Third, social governance and anti-pandemic governance capacity have become basic capabilities that determine the status and attractiveness of different countries and regions in the division of labor in the global industrial and supply chains.

At the same time, digital technology is having a profound impact on the division of labor in the industrial and supply chains. Digital technology has become highly integrated with production and life, enhancing the tradability of services and the stability of industrial and supply chains. The penetration of digital technology into the service industry is gradually deepening, and digital trade and services have become the new engine for the growth of the service trade. In 2020, despite the impact of the COVID-19 pandemic, global digital trade exports grew by 3.8 percent, accounting for 62.8 percent of the trade in services and contributing 98.3 percent to the growth of service exports. Also, digital penetration has

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deepened and internet platforms have emerged that can quickly restore the stability of the industrial chain through intelligent means. However, digital technology will also affect the comparative advantages of developed and developing countries in the division of labor. Because of the rapid growth of the digital economy, the importance of labor will be relatively reduced, so developed countries can regain competitiveness, and developing countries' comparative advantage of low-cost labor will be weakened.

The green transformation will also change the cost structure of the division of labor significantly, and the proportion of environmental cost in the total cost will be greatly increased. In the past, cost determined competitiveness. In the new development context of peaking carbon emissions and achieving carbon neutrality, the proportion of environmental cost will greatly increase in the future. In addition, the transformation will promote the global industrial chain to be green, low-carbon and recyclable.

But although the global industrial and supply chains are undergoing some major changes, the transformation of the world economic development pattern will remain the same in three aspects.

First, although environmental costs are increasing and new factors of production such as big data are becoming more influential, low cost will always be the fundamental determinant of competitiveness. Second, the general trend of deepening division of labor in the global industrial chain will not change. COVID-19 and the changes in the economic landscape will bring changes to the global division of labor at regional and sub-regional levels, but vertical and horizontal international division of labor in the value chain will remain unchanged. Finally, although digital technology will to some extent make it difficult for developing countries to exploit the competitive advantage of low-cost labor, they will have the opportunity to catch up and even surpass developed countries as long as they pay attention to the construction of new digital infrastructure and investment in human capital. In 2019, the digital economy in developing countries grew by 7.9 percent, far outpacing that of developed countries (4.5 percent).

Innovation ability is the key. An environment conducive to innovation will encourage production elements to pour into the real economy and help foster innovation, facilitate the transformation of small innovative businesses into big ones, and encourage the constant emergence of innovative enterprises. For an innovative economy, there must be a spirit of excellence and optimism believing that there will be more and better new technologies in the future.

Force of Circumstance[*]

By ZHANG MING[*]

The Russia-Ukraine conflict has been a black swan event for most investors. So far, it has brought huge shocks to the global financial market. Generally speaking, the outbreak of unexpected events such as wars usually boosts risk aversion among investors in financial markets, leading to higher prices of safe-haven assets (such as gold, dollar and US Treasuries) and lower prices of risky assets (such as stocks and bulk commodities). However, considering that both Russia and Ukraine are important global commodity exporters (such as Russia's energy and Ukraine's agricultural products), the outcome of the Russia-Ukraine conflict will significantly impact the supply of key commodities in the world, leading to soaring prices of bulk commodities.

The London Bullion Market Association Gold Price was up from $1,795 per ounce to $1,945 from Jan 31 to March 4, approaching the $2,000 per ounce mark, an increase of 8.4 percent. During the same period, the dollar index rose from 96.54 to 98.65, an appreciation of 2.2 percent; the 10-year US Treasury yield dropped slightly from 1.79 percent to 1.74 percent. However, it is worth noting that driven by expectations of the Fed raising interest rates and shrinking its balance sheet, the yield on the 10-year US Treasury bond rose to 2.05 percent on Feb 15. If compared with this high point, the indicator is down 31 base points as of March 4.

The US Dow Jones Industrial Average fell from 35131.86 to 33614.8 from Jan 31 to March 4, down 4.3 percent; the US Nasdaq Composite Index fell from 14239.88 to 13313.44, down 6.5 percent. Compared with the US stock market, the drop in the Russian stock market was much sharper. From Feb 22 to 25, Russia's dollar-denominated Russian Trading System index fell 23.6 percent, and the ruble-denominated Moscow Interbank Currency Exchange Russia index also fell 20 percent. In addition, the drop in the Russian stock index was also accompanied by a depreciation of the ruble. From Jan 31 to March 4, the exchange rate of the ruble against the dollar and the euro depreciated by 36 percent and 34.5 percent respectively.

The price of Brent crude oil futures rose from $89.26 per barrel to $118.11 from Jan 1 to March 4, an increase of 32.3 percent. Some institutions have predicted the crude oil price rising to $200 per barrel within this year. During the same period, the US Commodity Research Bureau Futures Price Index, metals index, food index, lipids and oils index rose 6.9 percent, 6.4 percent, 12.7 percent and 9.6 percent respectively. In the first week of March, global commodity prices rose in an even more astonishing manner. The S&P commodity index is up 37 percent for the year.

As mentioned earlier, the biggest shock of the Russia-Ukraine conflict on the global financial market is that it may once again lead to a new round of global commodity price hikes. Of course, whether the price hikes are sustained depends on the evolution of the conflict. If the conflict ends in the short term, the rise in commodity prices may be a short-term disturbance. Once the conflict evolves into a medium-term confrontation, the rise in bulk commodity prices may become a new trending event.

The scenario that the Russia-Ukraine conflict is prolonged to the medium term would exacerbate the global economic slowdown, because intensified global geopolitical conflicts weaken the confidence of micro players and dampen international trade and investment. The growth rates of consumption, investment and imports and exports may all decline accordingly.

Second, the continuous spike in bulk commodity prices will heighten the pressure on imported inflation for major importers of commodities, forcing the global economy to face severe stagflation again. Third, rising commodity prices will continue to drive US inflation higher, forcing the Federal Reserve to accelerate monetary tightening. The spillover effect of the Fed's tightening of monetary policy will accelerate the decline in global economic growth and the turmoil in the global financial markets.

For the Chinese economy, an intensified Russia-Ukraine conflict will also bring fresh external pressures. On the one hand, China is the world's largest importer of bulk commodities. The new round of commodity price hikes will lead to a deterioration in trading conditions, rising import costs and shrinking trade surpluses. It may not only result in a quicker rise in the producer price index, which gauges factory-gate prices, but also reduce the contribution from the industrial sector and imports and exports sectors to economic growth. On the other hand, if a new round of inflation is passed from the upstream to the middle and downstream of the industrial chains, it may push the consumer price index, a key gauge of inflation, up too quickly, which will reduce the room for the People's Bank of China to ease its monetary policy. In addition, with the recent adjustment of the global capital market, the Chinese stock market is also facing the pressure of large-scale investment outflows.

The Chinese government can respond to the negative influence caused by the Russia-Ukraine conflict through the following measures. First, it is important to actively seek alternative suppliers of bulk commodities. Ukraine has recently suspended its exports of agricultural products. Relevant Chinese enterprises should actively seek alternative third-party exporters. Second, let the market play a larger role in determining the exchange rate of the renminbi, fluctuations in renminbi's exchange rate can effectively alleviate the negative shocks from outside. Third, the nation can maintain the stability of the capital market through large domestic institutional investors, including the National Council for Social Security Fund, to avoid a continuous drop in the capital market as a result of investor panic. Fourth, over the medium to long-term, the Chinese government should actively promote a domestic energy revolution and green transition to reduce the dependence of the Chinese economy on traditional energy imports.

Why the Dollar Won't Be as Strong as Many Think[*]

By MARK SOBEL[*]

As a junior US Embassy officer in Bonn, Germany, I watched a senior official recount the market's dollar outlook. Ambassador Arthur Burns listened attentively, slowly drew on his pipe for emphasis and snapped: 'Anybody who thinks he knows where the dollar is headed is a fool. Next.'

Given huge uncertainties about Covid-19, inflation, geopolitics and monetary policy, one must now even more humbly enter the realm of dollar outlook foolhardiness.

Many analysts project significant dollar strength in 2022 on the back of a hawkish Federal Reserve stance relative to other major central banks, especially the European Central Bank and the Bank of Japan. These relative stances should indeed underpin the dollar, especially as Fed hikes support the short end of the curve, for which exchange rates are sensitive.

But the narrative of a significantly strengthening dollar could well prove overdone, much like predictions for a sharp fall in 2021 were overplayed.

Analysts should specify what they mean by the 'dollar'. The DXY index, which heavily influences market commentaries, is overwhelmingly a composite of the euro and euro bloc. But even if the dollar strengthens versus the euro, major currencies account for less than half of the dollar's overall trade-weighted index, and the euro area and Japan for a quarter.

The market has already started to price in relative monetary policy stances and US financial conditions remain highly accommodative regardless. Rising US yields tend to pull up European yields, limiting spread widening.

The US will run a large 2022 current account deficit around 3.5% of gross domestic product, similar to 2021.

The effective 'dollar' is already top heavy. It peaked in the mid-1980s, rose sharply in the early 2000s when the euro came into being, and is now above the early 2000 levels (see Figure 1).

Figure 1. Real narrow effective exchange rate for US

Source: Federal Reserve Bank of St Louis, Bank for International Settlements

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Forecasts show US growth slowing over 2022. The failure so far to pass the 'Build Back Better' bill is causing markdowns in the US outlook. US fiscal policy will be consolidative. The dollar is generally well bid in strong risk-off and risk-on periods, but demand is more muted in between. Absent geopolitical shocks or a large underestimation of inflation pressure and the Fed's response – which are distinct possibilities – markets may find themselves in that intermediate state.

The Canadian dollar and Mexican peso merit special attention, constituting roughly a quarter of the US trade-weighted index. The Canadian dollar is some 13% of the entire Fed trade-weighted basket, while only around 10% of the DXY. It may firm slightly against the US dollar over the year, underpinned by a more aggressive Bank of Canada stance relative to the Fed; lower (higher) oil prices could moderate (increase) Canadian dollar buoyancy.

The peso should remain broadly steady – the Banco de México has so far adopted a hawkish tone, remittances have been strong, the current account is roughly in balance and the fiscal stance has been relatively restrictive. But structural problems are not being addressed, impeding the investment climate and inflows.

Chinese authorities in 2022 will likely seek to curb upward renminbi pressures against the dollar, though it will be a struggle. The authorities are easing policy amid slowing growth, especially given developments in the real estate market, and sending clear signals that further renminbi appreciation against the dollar, such as raising reserve requirements on foreign currency deposits or weaker fixings, is unwanted.

But the balance of payments points to robust renminbi demand. The pandemic has helped boost China's current account surplus towards 1.5% to 2% of GDP, particularly given the demise of outbound tourism. The renminbi remains buttressed by increased direct and portfolio investment opportunities in China's financial market, relatively favourable yields and lacklustre portfolio demand for other emerging market currencies.

The Chinese central bank seeks stability in the trade-weighted renminbi, but it also wishes to avoid sharp renminbi moves – especially upward – against the dollar. These objectives can clash when the dollar is firm against EM currencies and/or the balance of payments is unco-operative. In seeking to limit renminbi appreciation, particularly against the dollar, questions will intensify about whether the People's Bank of China is using Chinese banks to engage in stealth intervention or doing so itself.

The EM complex is too differentiated to analyse in one fell swoop. Turkey, Argentina, Sri Lanka and Pakistan, for example, face idiosyncratic problems. Latin America's situation cannot be compared with Eastern Europe or non-China East Asia. That said, concerns about a repeat of the 2013 taper tantrum are overdone, especially as key EMs float, have built up reserves and face reduced external vulnerabilities. Overall, the dollar should remain resilient against the non-China EM complex, with many EM central banks adopting a hawkish stance, while slowing global growth could weaken commodity prices.

Putting it all together, the dollar should keep a firm tone, but predictions of sharp strengthening are not likely to be fulfilled.

IMF Must Regain Lost Territory*

By KEVIN GALLAGHER AND RACHEL THRASHER*

Often depicted as a rigid institution averse to change, the International Monetary Fund deserves credit for embracing climate change concerns, showing signs of abandoning austerity and calling out the G20 for its weak debt relief efforts during the Covid-19 pandemic.

However, the most profound change came in 2012 when the IMF partially reversed its longstanding view on capital account liberalisation. Ten years later in March, the IMF board will meet to revisit this view, providing a crucial opportunity to take another step forward.

One key aspect that needs to be addressed is the increasing inconsistency between the IMF's advice on capital flow volatility and the sprawling web of international trade and investment treaties, which increasingly – and counterproductively – obstructs the use of the capital account regulations. Indeed, new research from the Boston University Global Development Policy Center published in the Journal of International Economic Law reveals that trade and investment treaties increasingly curtail the ability of governments to regulate capital flows.

For decades, the IMF conditioned the liberalisation of capital flows as part of IMF financing programmes and, in the 1990s, went so far as attempting to change its articles of agreement to outlaw regulating capital flows. When premature capital account liberalisation led to massive financial crises in east Asia, the IMF began to rethink its view.

As economists studied the issue more intensely, a consensus emerged that capital account liberalisation was associated with financial crises in emerging market and developing countries, that regulating capital flows could make global financial markets more efficient rather than less and that regulations on capital flows were effective. The IMF found that those countries that deployed regulations on capital flows were hit less hard during the 2008 financial crisis than those without them.

While hotly contested among shareholders, the IMF devised a new 'institutional view' in 2012, stating that capital flow liberalisation carries risks, and there 'is no presumption that full liberalisation is an appropriate goal.' The IMF said that capital controls, which they rebranded as 'capital flow management measures', 'can be useful for supporting macroeconomic policy adjustment and safeguarding financial system stability.'

The new institutional view was far from perfect. Countries need to have permanent legislation to be able to rapidly deploy CFMs to mitigate 'surges' and 'sudden stops' of capital flows. Yet the IMF saw CFMs as a temporary last resort after all other instruments had been attempted. Nevertheless, the new view was a step in the right direction. The IMF's Independent Evaluation Office recently praised its implementation, though forthcoming research shows implementation was uneven across countries.

Add to this the growing tension between international trade and investment treaties and the ability of countries to deploy CFMs. As tariffs on goods and services have dwindled, trade treaties increasingly cover investment and financial services, requiring that capital be allowed to flow freely and without delay across the jurisdictions of treaty signatories.

Our new research finds that regional and bilateral trade and investment treaties – especially those originated by the US and Europe – go deeper than the World Trade Organization and are fast becoming the norm in the world economy. Not only do these treaties mandate that all forms

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of capital flow freely across borders, but they also lack balance of payments exceptions and have more limited prudential exceptions. Furthermore, rather than having nation states and monetary authorities settling disputes over these provisions, these treaties provide access to 'investor-state dispute settlement' fora that allow private firms to directly file claims against governments.

The IMF is mandated to promote international financial stability and monetary co-operation, and it now recognises that regulating capital flows is essential to maintaining financial stability. The trade regime is charged with helping countries use trade as a means of raising living standards, but this has also crept into the IMF's mandate.

In the coming weeks, the IMF is scheduled to not only review the institutional view on capital flows but also the Fund's role in trade policy. The IMF must move to regain its territory over these matters. Member states need pathways to refrain from taking on new commitments in treaties incompatible with the ability to deploy CFMs. The Fund should help design new rules for future treaties that grant members the proper policy space for CFMs that prevent and mitigate financial stability.

There are, however, over 2,000 trade and investment treaties already in the system, many of which require the deregulation of capital markets. In these cases, the IMF should devise trajectories to help member states adopt 'interpretations' of existing treaty language that could clarify or change existing language in current treaties, amend existing treaties to reconcile current incompatibilities, or withdraw from them altogether if they are major threats to stability. The trade and investment regime should not govern global financial stability.

The Road Ahead - Lifting Barriers for Cross-Border Payments*

By KLAAS KNOT*

Thank you Doctor Kasekende for reminding us of the importance of Professor Ndulu's work. He had a vision I can very much relate to – especially in my capacity as chair of the Financial Stability Board.

Professor Ndulu's vision was to establish a cross-border payments system in this region. And this aligns very well with the FSB's vision. We have made it a priority to enhance cross-border payments – in our case at a global level.

So it is a great pleasure to talk to you today about our ambitious workplan.

I remember the time when I studied abroad. This was pre-euro. In Italy. And it was quite a hassle for my parents to send me any money.

Today, my children are still in high school. But in the future, they may study abroad too. If that happens in the eurozone, I will experience hardly any hassle sending them money.

Unfortunately, there are still many payment corridors all over the world which face incredibly high costs and considerable delays. A recent report by the World Bank provides an example from East Africa where, in 2021, the fee for sending 200 dollars in remittances from Tanzania to neighboring Uganda was 23 percent for a Ugandan migrant.1 I cannot begin to imagine giving up nearly a quarter of my income every month just to send that money home to my family.

But barriers like these are the reality for many people. And it is not just the cost of cross-border payments. These types of payments are often also slow and not transparent – and then there's the fact that they are not fully accessible for all.

The FSB stance is that the payments barriers should be reduced – for both individuals and companies.

The more we trade and invest with one another, the more need for cross-border payments – it is as simple as that. As goods and capital markets continue to internationalize, cross-border payments, more than ever, sit at the heart of global economic activity.

Just over a year ago trading officially commenced under the African Continental Free Trade Area. One factor that could greatly enhance the economic benefits of free trade in Africa is cheaper and faster cross-border payment services within the continent and beyond.

A lot of what we do daily involves crossing borders. From sending an email to someone abroad, to meeting with you virtually right now. It is time that our money also flows more easily across borders.

There are four key barriers to cross-border payments – the cost, the speed, the transparency and the inclusion. To address these four barriers, the FSB has developed a Roadmap to enhance cross-border payments. We have done this together with our partners, most notably the Committee on Payments and Market Infrastructures. And this Roadmap has been endorsed by G20 Leaders, giving it strong political backing from the largest financial centres.

This Roadmap covers the whole payments market – both wholesale and retail payments. And it includes a particular focus on remittances, recognising that they are a critical source of

financing for people in developing countries and that they play an important role in economic growth.

The Roadmap seeks to deliver the necessary improvements through five focus areas, with cooperation between all stakeholders – public or private, national or international – being essential.

Let me briefly walk you through the focus areas.

First – part of the success of this Roadmap will depend on public-private cooperation.

We will need central banks to improve their core payment systems, allowing the private sector to follow suit. And at the same time, we will need the private sector to play a big role in the needed improvements when developing new payment systems and arrangements, or when enhancing existing services.

We will also need the combined efforts of many different types of experts – from payment service providers and system operators, to supervisors, regulators, and central banks. But also from experts outside of the financial sector – like data authorities contributing to streamlining data provision and data sharing.

Second – to improve cross-border payments, we need coordination of regulatory, supervisory and oversight frameworks.

Cross-border payments obviously involve at least two jurisdictions, and often more, when correspondent banking networks are involved. This often creates frictions – with, as a result, the four challenges I just mentioned. To address these frictions, we will need actions on both an international and a national level. This should lead to a better alignment of regulatory, supervisory and oversight frameworks across jurisdictions. Where appropriate, this should be done on a "same business, same risk, same rules" basis.

High-quality customer due diligence is, of course, essential. But it is relatively costly for cross-border transactions. So the FSB wants to improve confidence between financial institutions and between jurisdictions. We want to do this by:

- promoting more consistent application of AML/CFT standards;
- facilitating cross-border data flows and information sharing;
- fostering improved digital identity frameworks as well as customer due diligence infrastructures; and,
- in specific cases, by identifying low-risk "safe payment corridors".

Our third focus area is that we need to better align existing payment infrastructures and arrangements. The reason for this being that technical differences increase costs and slow transactions. So this third focus area of the FSB Roadmap would seek several things – for example,

- to strengthen links between payment systems and reduce settlement risk, through measures such as facilitating payment-versus-payment,
- to improve access by banks, non-banks and payment infrastructures to systems,
- to extend and align operating hours between systems,
- to pursue better interlinking of payment systems for cross-border payments,
- and to explore reciprocal liquidity arrangements.

Fourth – to reduce costs and improve the scope for straight-through data processing, we need better data.

To achieve this, we need to adopt common data formats, including rules for conversion and mapping from legacy formats, as well as protocols for information exchange.

More specifically, the FSB Roadmap aims to harmonize technical standards common message formats and standards for data exchange. We are also examining the scope for a unique global identifier that links to the account information in payment transactions.

These improvements would also be important building blocks to enable the development of efficient new payment infrastructures.

Our fifth and final focus area is that we need to examine the potential role of new types of payment infrastructures and arrangements, like central bank digital currencies and well-regulated "global stablecoins".

So far, these innovations have not been implemented broadly – some are still in their design phase and others remain theoretical. But they could, potentially, bypass barriers that are hard to address by merely adjusting existing processes.

So with this focus area, the Roadmap is examining in particular to what extent such innovations could contribute to improved cross-border payments – all of this, of course, without compromising on minimum supervisory and regulatory standards to control risks or endangering monetary and financial stability.

The importance of this work has recently been emphasised by the rapid evolution and growing popularity of crypto-assets. This has prompted us to accelerate work to strengthen the regulation and supervision of crypto-asset markets. But there is a cautionary tale here. The demand for crypto-assets in part reflects public dissatisfaction with current payment services, and if we do not improve the performance of the regulated market then there may be increasing demand for the less-regulated crypto-asset market to fill the gap. Enabling easier remittance payments, while maintaining their safety and security, will be a key part of this.

These are, in a nutshell, the five focus areas of the FSB Roadmap.

In some ways, however, the work we have done so far has been the easy part. The hard part lies ahead, as we start to translate our goals into actions. To guide our actions, we have developed a set of quantitative targets. Each target relates directly to one of the four challenges we want to tackle.

For example, related to the high cost of cross-border payments, our target is to lower the global average cost of cross-border retail payments to one percent of the amount transferred, with no cross-country corridor above three percent.

We have also reaffirmed the UN Sustainable Development Goal targets for costs of sending remittances.

In terms of speed, we have set the goal that, for 75 percent of payments, recipients receive their funds within one hour of payment initiation, and the remainder within one business day.

In terms of transparency, we want people making cross-border payments to have access to a minimum list of information about their payment – such as on charges and the ability to track the status of their payment.

And regarding inclusion, all should have access to at least one option for sending and receiving electronic payments, and – if possible – multiple options.

We are aiming to achieve most of our targets by the end of 2027. This may seem like a long timeframe, but it is, in fact, quite ambitious when you consider the time needed to upgrade underlying infrastructure. Critically, the targets have been set in order to lead to – and motivate – actions that are focused on achieving visible improvements for those making and receiving payments.

So after the groundwork of the past two years, we have started, this year, to develop specific proposals for material improvements to existing payments systems and arrangements, as well as the development of new systems.

Without these improvements, our targets will not be achieved. And cross-border payments will remain costly, slow, and untransparent, and continue to exclude many of the most vulnerable.

To wrap up:

Enhancing cross-border payments is a shared global goal. Commitment, coordination and accountability will be critical to its success. The FSB Roadmap gives us the opportunity to make a real difference to individuals, businesses and financial institutions across the globe. Cheaper, faster, more transparent and more inclusive cross-border payments have widespread benefits for

companies conducting cross-border business, for tourists visiting other countries or for migrants sending money home to their families.

One of the regions that could benefit the most from achieving the global targets is Sub-Saharan Africa, where the challenges of costs, speed and inclusion are greatest.

So as we move forward with the Roadmap, we will seek input from emerging markets and developing economies beyond the twenty-four countries in our membership. We will bring in these perspectives via our six Regional Consultative Groups, including our Group for Sub-Saharan Africa. This group is co-chaired by Governor Addison of Ghana and Governor Kganyago of South Africa, who is also co-chairing the FSB's coordination group for the Roadmap as a whole.

What you are trying to achieve, building on professor Ndulu's legacy, deserves nothing but admiration. And I hope the FSB Roadmap offers inspiration and encouragement in the tasks you have taken upon yourselves.

Maybe one day, one of my children will go and study in Africa. And if they stand in a book store, ready to buy something they need for class, and they text me for some extra funds, I hope I will be able to do that with a simple click on a button. And with me, many others.

Central Banking

Challenges for Central Banks[*]

By AGUSTÍN CARSTENS[*]

Thank you, Tim and Axel, for another opportunity to participate in an IIF Board meeting.

In the context of the pandemic, the actions of central banks, together with fiscal support and supervisory flexibility, have ushered the global economy into a strong, fast recovery. This was no mean feat. Decisions had to be taken under much uncertainty and they involved difficult trade-offs. What comes next will be a treacherous path to navigate, and a lot depends on how central banks respond. In addition to an exacting macroeconomic environment, digitalisation is changing the structure of the financial and monetary system and demanding central banks' attention. So, I would like to devote my remarks to highlighting the main challenges that central banks will face in the next few years.

How we got here

When Covid-19 hit two years ago, we found ourselves in uncharted waters. The pandemic was a truly exogenous shock: a recession ensued from the drastic public health measures that were required.

Information about the virus and its impact on the economy became available only as time passed, and it was and continues to be imperfect. Acting under this uncertainty, the policy responses were fast and bold, taking some calculated risks. Policymakers recognised that, after the economy had been deliberately put into a coma, it would need all the life support it could get in order to avoid bankruptcies, worker displacement and scarring.

They were under no illusions: such measures would come at the cost of higher public debt, to say nothing of potential financial distortions and allocative inefficiency. But their thinking was, and in my view rightly so, that any inaction on their part would have led to far worse outcomes.

So, central banks deployed their full arsenal of tools. They tailored their response to the nature of stress experienced in each country and the structure of their financial systems. They promptly eased their policy stance, acting decisively to prevent market dysfunction. This was complemented with supervisory flexibility, to support banks' ability and willingness to lend. The fiscal policy response too was swift and forceful.

A unique and rapid rebound has followed the recession. A much-feared wave of defaults and bankruptcies did not materialise. The unprecedented degree of support for corporates implied a massive decline in bankruptcies in spite of the recession. And, not least thanks to the strong policy response, private demand bounced back faster than in previous global recessions, in particular with strong demand for goods.

But the faster recovery has come with some surprises: it has unleashed inflation, which in most advanced economies had been all but absent for nearly a decade. Deciphering the drivers of

that inflation has been challenging. The pandemic shifted demand away from services towards goods. Adjustments in supply have been difficult. Supply constraints and bottlenecks, which became prominent in 2021, are likely to stay through at least mid-2022.

In some economies, signs of labour shortages have also appeared, attributable to an increase in reservation wages, falling participation rates and skill mismatches. Covid-hit workers in the logistics chain and clogged delivery pipelines.

Overall though, the bottlenecks seem to relate more to the suddenness of the demand recovery, which came up against inelastic short-run supply, amplified by bullwhip effects.

What is next?

Central banks need to assess how robust the recovery is and urgently address inflation – while managing the effects of Omicron and any yet-to-emerge Covid variants.

The shape of the recovery

There is no guarantee that the strong private demand will continue.

Household income has held up, but with fiscal support coming to an end and accumulated savings being drawn down, consumption could take a hit.

With businesses in many countries already heavily indebted before the pandemic – and leverage having increased further, corporate investment may be low.

The evolution of inflation

Thus, a key question is how persistent inflation pressures will prove to be. Although it is still unclear when bottlenecks will eventually clear, taking the pressure off prices, especially if the bullwhip effect goes into reverse. The key to where global inflation is headed is rather in wage setting.

So far, inflation expectations appear to be anchored. They have increased much more for the near term than the medium term, including in emerging market economies. But we do not know if they will remain so. The risk of un-anchoring increases with inflation itself.

Wage pressures could be a game-changer. So far, aggregate wage growth has been moderate, notwithstanding large rises in certain sectors, such as leisure and hospitality and transportation, notably in the United States. But, again, we do not know how much slack there is and how it will evolve.

Central banks face a difficult balancing act

A recovery together with rising inflation is an unpleasant combination. While not a new phenomenon, it poses a difficult balancing act for central banks. The challenges are even greater if wage pressures break through before inflation starts to moderate.

In addition, there are trade-offs stemming from public and private debt levels that are very high, and central bank balance sheets have rarely been as large as now.

Fiscal and monetary policies reinforced each other during the Covid-19 crisis, but their interactions could now give rise to tensions. Some countries have already applied the fiscal brakes. Large advanced economies also expect significant fiscal consolidation in 2022 and 2023.

Years of accommodative policy have generated froth in many financial markets. Some advanced economies are especially vulnerable, with some risky asset prices continuing to soar during the pandemic.

At the start of the pandemic, central bankers made difficult decisions in the face of both known unknowns and unknown unknowns. Since then, central bankers have learned and adapted. They need to continue to react forcefully, yet flexibly.

Staying ahead of the inflation curve and clearly signalling a path towards normalisation will be essential. This will also help ease the intertemporal trade-off by mitigating the build-up of financial vulnerabilities fuelled by easy financial conditions in housing markets, the corporate sector and among non-bank financial intermediaries.

A brave new digital world

As if the monetary policy juggling act were not enough, central banks face the additional challenge of a rapidly changing financial landscape due to digital innovation. The very meaning and future of "money" is at stake.

Stablecoins issued by big techs could compete with national currencies and each other. A big tech stablecoin may be an attractive proposition at first sight but it raises fundamental questions about trust in the monetary system since it would entail handing over the keys to a few dominant and profit-driven private entities that are accountable only to their shareholders. For the most part, stablecoins have grown by importing their value from collateral in the form of central bank money or other regulated financial instruments, without stablecoins themselves having the requisite oversight.

Big tech financial services activities thus need to be properly regulated, to safeguard financial stability and address any competitive distortions relative to banks. Private stablecoins need also to be adequately regulated to address the risks they pose, such as runs, payment system dislocations and concentration of market power.

Another risk is so-called decentralised finance (DeFi), which envisions the replacement of institutions with distributed ledger technology (DLT) with the aim of reclaiming data from big techs and "cutting out the middlemen" such as big banks.

To date, the DeFi space is primarily used for speculative activities; it is a parallel financial system with little to no oversight, and it facilitates illegal activities. At a structural level, it depends on rents to maintain trust in an anonymous system. Insiders win while efficiency gains for average users have so far failed to materialise.

In addition, DeFi is subject to the same vulnerabilities – high leverage and liquidity mismatches – as traditional financial services are. It also has connections to the formal financial system. Stablecoins in DeFi may not be sound money. In the absence of proper regulation, they may lack full backing or test the definition of a safe asset. Thus, DeFi too threatens the soundness of the financial and monetary systems.

A better approach to shaping the future of money would be to ensure a market structure that fosters competition and innovation with the aim of creating an open and global monetary system. Central banks should continue to stand at the core of this system, building on the trust already placed in them. Central bank credibility should be reserved for public goods, not borrowed by DeFi and stablecoins that serve other interests. The issuance of well-designed central bank digital currencies (CBDCs) can play a key role.

Importantly, central banks can work with the private sector and with each other to ensure interoperability domestically and across borders. The private sector could interact with clients and build a host of financial services on top of such a system. The BIS Innovation Hub is working to make this vision a reality.

Concluding remarks

Let me conclude with one more thought. The pandemic should encourage a sense of humility about what is possible. In times like this, as Meg Wheatley puts it, "we don't need more command and control; we need better means to engage everyone's intelligence in solving challenges and crises as they arise." From a central banker's perspective, this puts effective communication and engagement with the markets and the broader public at an even greater premium.

Looking through Higher Energy Prices? Monetary Policy and the Green Transition*

By ISABEL SCHNABEL*

In 2021 the global economy was shaken by a major energy crisis. Prices for oil, gas and electricity surged as our economies reopened after the shutdowns imposed in response to the coronavirus (COVID-19) outbreak.

Though last year's events were extraordinary on many levels, spikes in energy prices are a common phenomenon. Since the 1970s, sharp movements in energy prices have been a recurring source of economic dislocations and volatility.

And yet, the roots of today's shock are likely to go deeper. While in the past energy prices often fell as quickly as they rose, the need to step up the fight against climate change may imply that fossil fuel prices will now not only have to stay elevated, but even have to keep rising if we are to meet the goals of the Paris climate agreement.

In my remarks today, I will discuss the challenges that such prospects pose to both fiscal and monetary policymakers in an environment in which the supply of cheaper and greener sources of energy will only gradually be able to meet rapidly rising demand.

I will argue that governments will need to push the energy transition forward, while at the same time protecting the most vulnerable members of society from energy poverty.

Central banks, in turn, will have to assess whether the green transition poses risks to price stability and to which extent deviations from their inflation target due to a rise in the contribution from energy to headline inflation are tolerable and consistent with their price stability mandates.

I will explain that there are instances in which central banks will need to break with the prevailing consensus that monetary policy should look through rising energy prices so as to secure price stability over the medium term.

Fast rise in carbon prices helps accelerate the green transition

The world economy will have to undergo a far-reaching transformation to be able to live up to the Paris agreement to limit the increase in the global average temperature to 1.5° Celsius above pre-industrial levels.

At the heart of these efforts is the need to radically cut greenhouse gas emissions.[1] According to the United Nations, global emissions would need to drop by 7.6% each year between 2020 and 2030 to reach the Paris target. By way of comparison, in 2020, when global economic activity came to a virtual standstill, emissions fell by only 5.8%.

There is broad agreement that meeting these ambitious targets requires putting a global price on carbon, and it requires doing so swiftly. At present, only 21.5% of global emissions are covered by carbon pricing instruments and only 4% are covered by a price of more than USD 40.

According to a recent survey, most climate economists think the price of carbon should be above USD 75 to reach net zero emissions by 2050. The median response of USD 100 is

consistent with what Nicholas Stern and Joseph Stiglitz recently estimated to be the carbon price in 2030 necessary to achieve the goals of the Paris Agreement.

In the EU, prices under the Emissions Trading System (ETS) have recently started to rapidly approach these levels, in part reflecting expectations that the EU is committed to delivering on the clean energy transition.

In early December, ETS prices reached a new record high of nearly €90 per tonne of carbon, almost three times as high as at the beginning of 2021, and a multiple of their level a few years ago.

The measurable rise of carbon prices will help accelerate the green transition. If persistent, it strongly disincentivises new investments in fossil fuel energy carriers.

Two parallel developments are reinforcing the effects of a higher carbon price.

One is the European Commission's Fit for 55 package – an ambitious set of reform proposals, which was presented in July last year.

It includes a recommendation to significantly strengthen the ETS and widen its scope, which currently covers only around 40% of the EU's greenhouse gas emissions. The Fit for 55 package also proposes a review of the EU Energy Taxation Directive, with the aim of raising the minimum tax rate for inefficient and polluting fuels, and lowering those for efficient and clean fuels.

The second development is the ongoing transformation in financial markets.

Sustainable investment is no longer a "nice to have" policy but has become an essential ingredient in most investor portfolios. Many institutional investors have started to materially reduce their exposures to fossil fuel energy producers and have redirected capital to more environmentally acceptable low-carbon alternatives.

ECB analysis shows that financial markets are increasingly serving as a corrective device.

It finds that market prices have started to reflect the premium demanded by investors for exposures to climate-related risks. There is a positive relationship between the greenhouse gas emissions resulting from a firm's operations and credit risk estimates, as measured by credit ratings and market-implied distance to default.

The magnitude of the effect is economically relevant. On average, it is comparable to that of traditional determinants of credit ratings, such as leverage. The analysis also finds that disclosing emissions and emission reduction targets helps lower credit risk premia.

Since financial markets are global, these developments seem to have started to produce tangible climate-related effects even in countries that do not yet have a national carbon price, such as the United States.

Last year's strong economic expansion, for example, was characterised by an atypically slow response of US shale oil production to rising oil prices, as such investments may no longer prove profitable to investors over the medium term − at least not to the same extent as they have done in the past, or as returns may become even more volatile (Slide 4).

In other words, even in the absence of a global carbon price, which remains essential, there are growing signs that the green transition is accelerating around the globe.

Transition phase may bring protracted period of higher energy inflation

While such relative price changes are desirable and intended, they may weigh on the economy if firms and households cannot substitute more expensive carbon-intensive energy with greener and cheaper alternatives.

Higher carbon prices work in part by stimulating investments and innovation in low-carbon technologies. But these investments will take time. At present, renewable energy has not yet proven sufficiently scalable to meet rapidly rising demand.

In the EU, renewable energies currently account for only around 20% of energy consumption. The Fit for 55 package proposes increasing this share in the EU to 40% by 2030.

The combination of insufficient production capacity of renewable energies in the short run, subdued investments in fossil fuels and rising carbon prices means that we risk facing a possibly protracted transition period during which the energy bill will be rising.

Gas prices are a case in point.

Last year's adverse weather conditions, which constrained the production of renewable energy, have led to significant demand and supply imbalances in the gas market as global growth accelerated, pushing gas prices to new record highs.

The green transition may reinforce these imbalances in the future. In many countries, especially in Asia but also in the euro area, gas − being half as polluting as coal − is seen as a stopgap solution in the secular shift to a greener energy system.

In the EU, rising gas prices have a direct and immediate impact on wholesale electricity prices, which are linked to the short-run marginal costs of gas-fired power plants.

In November, wholesale electricity prices in the euro area reached €196 per megawatt hour, nearly four times as much as the average in the two years preceding the outbreak of the pandemic.

As a result, energy price inflation in the euro area, as measured by the energy sub-index of the harmonised index of consumer prices (HICP), reached a historical high in November last year, with electricity and gas jointly accounting for more than a third of the total increase, also a new historical high (Slide 6).

Energy, in turn, has been the prime factor behind the sharp rise in overall consumer price inflation in the euro area, with the HICP standing at 5.0% in December 2021 according to Eurostat's flash estimate, which was the highest level recorded since the euro was introduced in 1999 (Slide 7). Between April and December 2021, energy contributed, on average, more than 50% to HICP inflation.

Governments need to advance the green transition and protect the most vulnerable

These developments pose significant challenges to policymakers – both governments and central banks.

On the fiscal side, many governments have responded to rising energy prices by imposing tax cuts, price caps or rebates to shield the most vulnerable households from the sharp rise in gas, fuel and electricity prices.

Because energy expenditures are typically highly inelastic and constitute a particularly large share of income for less well-off households, carbon taxes tend to be regressive. Already in 2020, 8% of the population in the European Union (EU), or around 36 million people, said that they were unable to keep their home adequately warm.

Energy poverty is a serious threat to the cohesion of our society and to the support for climate-related policies. Compensation measures are therefore important.

But such measures need to be designed in a way that does not reduce the incentives to lower carbon emissions.

It would be a serious mistake if governments, faced with rising energy prices, would backtrack from their commitment to reduce emissions. Governments should also not slow down the pace of the transition or delay the phasing out of fossil fuel subsidies.

Two recent proposals by the European Commission go in the right direction.

One is the introduction of the Social Climate Fund, which aims to address the social impact of higher energy prices resulting from the proposed broadening of the scope of the ETS towards the building and transport sectors, both of which will affect households in particular.

The other is the proposed system for EU countries to jointly procure strategic reserves of gas that can be released in the event of supply shortages. At present, capacity utilisation of gas

storage facilities in Europe is just under two-thirds, almost 20% below seasonal norms. Energy buffers will help limit the volatility of gas prices.

Green transition poses upside risks to medium-term inflation

For central banks, the challenges are equally profound.

In the past, central banks have typically looked through energy shocks, for good reasons.

Most of the time, such shocks have been short-lived, meaning that a policy response would have amplified the negative effect of rising energy prices on aggregate demand and output and, given the long lags in policy transmission, exerted downward pressure on inflation at a time when the shock is likely to have already faded.

Temporary supply-side shocks therefore typically warrant a deviation from the target in the short run, provided price stability is restored over the medium term and inflation expectations remain anchored.

This insight also motivates our policy response today. In our baseline scenario, the current energy shock is expected to fade over the projection horizon.

The Eurosystem staff projections are based on gas and oil futures prices, which suggest that energy prices should decline measurably this year, thereby significantly contributing to the projected decline in HICP headline inflation over the medium term (Slides 5 and 8).

Such technical assumptions, however, are surrounded by significant uncertainty. In the past, futures prices have often significantly under- or overpredicted energy price inflation. These risks are arguably even larger today.

To see this, it is enough to look at the profile of the projected inflation path: the decline of headline inflation to levels below 2% at the end of the projection horizon hinges on the assumption, derived from futures curves, that in 2023 and 2024 energy is not expected to contribute to headline inflation.

History suggests that such a profile would be unusual. Since 1999, energy has contributed, on average, 0.3 percentage points to annual headline inflation. Sensitivity analysis conducted by Eurosystem staff suggests that it is enough for oil prices to remain at November 2021 levels for HICP inflation in 2024 to reach our target (Slide 8).

The scale of the energy transition, and the political determination behind it, implies that these estimates could be conservative.

Potentially protracted supply and demand imbalances related to "transition fuels", such as gas, as well as the fact that carbon prices are likely to rise further, and to extend to more economic sectors, mean that the contribution of energy and electricity prices to consumer price inflation could be above – rather than below – its historical norm in the medium term.

The energy transition therefore poses measurable upside risks to our baseline projection of inflation over the medium term.

At our Governing Council meeting in December, such risks were one factor in deciding on a step-by-step reduction in the pace of asset purchases over the coming quarters.

The pace of the adjustment, with net purchases under our asset purchase programme (APP) falling back to €20 billion by October, is consistent with what Alan Greenspan previously called a "risk-management approach" to monetary policy.

It prescribes that central banks should not only consider the most likely future path of the economy, but the entire distribution of risks around that path with a view to keeping sufficient optionality to address all inflation contingencies.

Rising energy prices may require a departure from a "looking through" policy

The question, then, is: if energy inflation were to prove more persistent than currently anticipated under our baseline scenario, at what point could we no longer afford to look through such a shock?

I see two scenarios where monetary policy would need to change course.

A deanchoring of inflation expectations

The first would occur if we were to detect signs that inflation expectations have become deanchored. Consumer price expectations are particularly susceptible to changes in the prices of goods that we purchase frequently. Energy, and petrol in particular, are part of this basket of goods.

Over the past year, consumer price expectations for the next 12 months have increased sharply (Slide 9). In October, when energy accounted for more than half of the rise in measured inflation, they reached the highest level since the euro was introduced in 1999 and have remained close to record highs since then.

The experience of the 1970s, when rising energy prices triggered a harmful price-wage spiral, emphatically demonstrated that allowing inflation expectations to drift away from the target makes it significantly costlier to bring inflation back to target, both in terms of lost output and higher unemployment.

So far, however, there are no signs of broader second-round effects. Wage growth and demands by unions remain comparatively moderate. But in an environment of large excess savings and protracted supply disruptions, the energy transition may lead to inflation remaining higher for longer, thereby potentially raising the risks of inflation expectations destabilising.

In this case, monetary policy would need to respond to, rather than look through, higher inflation to preserve price stability over the medium term.

Not all energy shocks are alike

The other scenario in which policy would require adjustment is if the nature of the shock were to change.

More than a decade ago, the seminal paper by Lutz Kilian established that not all oil price shocks are alike. Their effects on the economy critically depend on the underlying source of the shock.

Rising oil prices due to stronger aggregate demand, for example, are associated with an increase in real economic activity, calling for a different monetary policy response than if oil prices were to rise in response to supply disruptions in the oil market.

A carbon tax may share some of the characteristics of an adverse oil supply shock. Higher energy prices could weigh on economic activity and thereby put downward pressure on consumer price inflation in the medium term. In this case, monetary policy should "look through" temporary deviations of inflation from its target.

But a carbon tax differs from an adverse oil supply shock in two fundamental ways.

One is that the transformation of our economies through large-scale public and private investment programmes and the subsequent adoption of more efficient and greener technologies is expected to boost, rather than weigh on, economic growth and thereby support wages and aggregate demand.

The second aspect is that, for an energy-importing economy such as the euro area, oil supply shocks are negative terms-of-trade shocks, raising inflation and transferring wealth abroad. But a carbon tax is ultimately a domestic levy that shifts financial resources from the private to the public sector.

In the EU, for example, the coming years are expected to see significant increases in ETS revenues. ECB calculations, based on European Commission data, suggest that they will rise from €14 billion in 2019 to up to €86 billion annually in the period 2026-30.

The proposed carbon border adjustment tax, which will put a carbon price on selected imports, as well as higher minimum tax rates on fossil fuels and other national tax initiatives, will further raise revenues.

Eurosystem economists show, based on the example of Spain, that what governments would do with such revenues will shape the response of the economy to the energy transition.

For example, lump-sum transfers to households and electricity bill subsidies, as currently implemented by many governments, can largely cushion the negative short-term effects of rising energy prices on consumption and GDP.

Alternatively, if revenues are used to cut other distorting taxes, such as social security contributions, thereby reducing the labour tax wedge, a carbon tax may in fact boost economic activity, even in the short term. And since new activity will likely arise in greener sectors, part of the increase in GDP will be permanent, potentially raising inflation both over the short and medium term.

These findings are not just hypothetical. An emerging strand of empirical evidence finds no robust negative effects of carbon taxes on GDP growth and employment. If anything, the evidence is consistent with a modest positive impact.

As such, if the future path of energy prices threatens to push headline inflation above our target in the medium term, and if growth and demand prospects remain consistent with firm underlying price pressures, monetary policy needs to act to defend price stability.

Conclusion

Carbon prices in the EU and elsewhere increased sharply last year, reinforcing efforts to reduce carbon emissions as fast as possible and accelerating investments in green technologies.

As the shift in the energy mix towards cheaper and less carbon-intensive fuels will take time, a rising carbon price, higher tax rates across a range of fossil fuels, and relatively inelastic energy demand may lead to continuous upward pressure on consumer prices in the transition period.

These developments pose challenges to both fiscal and monetary policy.

Governments will have to protect the most vulnerable parts of society from higher energy prices in a way that does not delay the green transition. Monetary policy, for its part, cannot afford to look through energy price increases if they pose a risk to medium-term price stability.

This could be the case if prospects of persistently rising energy prices contribute to a deanchoring of inflation expectations, or if underlying price pressures threaten to lift inflation above our 2% target as rising carbon prices and the associated shifts in economic activity boost rather than suppress growth, employment and aggregate demand over the medium term.

Financial Regulation

Basel III and Global Cooperation: Where Do We Go from Here?[*]

By CAROLYN ROGERS[*]

Introduction

Good afternoon, and thank you for inviting me to speak at this virtual debate of the Kangaroo Group's Working Group on Financial Services on the finalisation of the Basel III framework.

When I received your invitation, the name of your group caught my attention: I must admit to needing to do a bit of research to find out what possible interest a group interested in kangaroos would have in bank regulation. But I was pleased to discover that your organisation has a lot in common with the Basel Committee. Both of our organisations are founded on the value of cooperation in achieving better policy outcomes, and your goal of ensuring the full implementation of various EU-specific initiatives aligns closely with the Committee's expectation of full, timely and consistent implementation of its global standards.

So I am of course very happy to be here today and to have the opportunity to speak with a like-minded group.

The timing of today's debate is also opportune. As we all know, the European Commission is due to release its proposal on transposing the final Basel III reforms into EU law. That makes this a pivotal time – both for preserving and strengthening financial stability and for the role of multilateralism.

I intend to use my remarks today to remind us of the important connection between these two topics – multilateralism and financial stability. I will also take the opportunity to respond as directly as possible to some of the arguments circulating against the full implementation of Basel III in the EU.

Global cooperation and financial stability

The past decade has been a difficult one for multilateralism. Geopolitical, economic and societal shifts have, at times, created scepticism or even mistrust in cross-border cooperation. The role of some international organisations was called into question and the commitment to existing agreements was tested. The Covid-19 pandemic was, at once, a further strain on global cooperation, and a stark reminder of its necessity.

The world is a more interconnected and interdependent place now. Protecting the health and financial stability of our countries necessarily requires us to think of these values as global public goods, and therefore to think past our own borders.

This principle – that financial stability is a global public good – is what underpins the standards set by the Basel Committee. An open, global financial system – a choice the world has

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already made – requires global standards for safety and soundness. Without them, the potential underinvestment of any one jurisdiction in financial stability can result in spill over effects for other jurisdictions. Global regulatory cooperation is therefore an imperative as long as we value a global financial system and global financial stability.

Fortunately, despite a challenging time for global cooperation, the past decade has been one of the most productive for the Basel Committee. The Great Financial Crisis (GFC) of 2007– 09 and its aftermath led to a global resolve for change. Central banks and supervisory authorities came together quickly and agreed on a comprehensive strategy to address the shortcomings in the banking system.1 In September 2010 the Group of Governors and Heads of Supervision – the Basel Committee's governing body – announced higher global minimum capital standards for internationally active banks2 and later that year, the Committee agreed to the design of the capital and liquidity reform package, now referred to as "Basel III".3

From 2011 to 2016, despite a slight waning of the global resolve for change as memories of the financial crises started to fade, the Committee's member jurisdictions continued to cooperate closely. With improved minimum standards now in place, the focus shifted to ensuring the measurement of those standards was also robust and consistent across all global banks.

The Committee completed the last plank of the Basel III reforms in 2017, with the publication of new standards for credit risk, credit valuation adjustment risk and operational risk.4 The final reforms also incorporate a leverage ratio and an output floor, two complementary measures that improve the consistency and comparability of the overall regime by reducing opportunities for arbitrage.

More recently, the Committee demonstrated its capacity for agility, flexibility and cooperation when it acted quickly and decisively at the onset of the pandemic and agreed on a set of policy measures to help banks remain resilient and continue to lend to households and businesses through a period of unprecedented economic uncertainty.5

Time and again, the Committee has shown its ability to work collectively in a timely manner to strengthen the resilience of the global banking system. And while it is relatively easy to summarise this great track record in a speech, I assure you the work is much harder. The decisions reached by the Committee come after thorough research and analysis, extensive consultation and hours upon hours of discussion and debate.

Before I was the Secretary General for the Committee, I was a member of the Committee, representing the financial regulator in Canada. It was my job to ensure the Committee's deliberations were informed by an understanding of the Canadian banking system, including those things that I saw as unique about our banks or our economy. Like all my fellow Committee members, I took this job seriously.

And because all Committee members take this job seriously, a consensus is not always quick or easy to reach. As I have learned over the last two years, this makes the job of the Secretary General a challenging one. But this is ultimately the strength of the Basel Committee: the ability of a group to overcome individual differences in the interest of solutions that benefit the global public good.

Given the audience of this debate, I should note the important role that Europe plays in the Committee's ongoing cooperation. Approximately one third of the Committee's membership hails from Europe. The European Central Bank, the Single Supervisory Mechanism, the European Banking Authority and the European Commission are all important and active contributors to the work of the Committee. Since its inception, the Committee has had 11 Chairs, with nine of them hailing from Europe. In my own personal experience with the Committee, I have come to appreciate our European members as some of the toughest negotiators, but also the fiercest advocates for multilateralism. Our European members worked very hard to achieve a global consensus on Basel III.

It is also worth noting the tremendous progress made within Europe in the past decade when it comes to collaborating on financial stability issues. The introduction of the Single Supervisory Mechanism, the Single Resolution Board and Single Rulebook – all important components of the Banking Union – are significant accomplishments. They also share common objectives with the Basel standards: more transparent, unified and safer oversight of banks, preventing problems in one market from spilling over and creating distress in other markets, and ensuring that banks can weather tough times without taxpayer support. And, as is the case with Basel III, there are important, outstanding elements of the Banking Union that need to be implemented for the full benefits to be realised. Nevertheless, it is important to acknowledge the progress to date.

Global cooperation and Basel III

As challenging as reaching a final consensus on Basel III at the Committee table was, it was not the last step. The last step requires translation of the Committee's hard work into its ultimate objective of enhancing global financial stability, and that step is only achieved when each of our member jurisdictions implements the agreed standards domestically. The path to implementation varies across jurisdictions, and as with many things in life, the last mile is often the hardest. But it is also the most important and most consequential - both to achieving global financial stability and to preserving multilateralism.

I have previously referred to the implementation of global standards as being a lot like a two-legged football game.6After the first "away" game in Basel, a second "home" game takes place, where banks and trade associations lobby vigorously to reopen elements of the global framework. Regrettably, this second leg, aided by "home field advantage" has resulted in cases where the standards implemented at the national level are not fully compliant with the Basel framework, including here in Europe.7

So, where are we at when it comes to the implementing the outstanding Basel III standards? On the one hand, I take great comfort when I hear my European Basel Committee colleagues consistently reiterate their commitment to implementing these standards in a full, timely and consistent manner, in line with the repeated pledge by G20 Leaders. I am also reassured by the repeated calls by key EU policymakers for Europe to demonstrate its commitment to multilateralism and international cooperation by implementing Basel III as it was agreed.

On the other hand, I am concerned that some stakeholders continue to lobby against a consistent and timely implementation of Basel III. Their arguments aren't new, but in some cases have been they have been repurposed for the latest context or set of circumstances. I will use the balance of my remarks today to address, as directly as possible, the most common arguments.

First is the assertion that the broadly positive state of the banking system thus far during the pandemic proves that no additional measures are needed to strengthen its resilience. True, the global banking system has remained resilient to date. Bank lending to households and businesses grew last year by 9% in advanced economies and 15% in emerging market economies. We have not seen a repeat of banks' crisis-exacerbating behaviour to date, unlike during the GFC.

But let us be very clear about what has been behind this stability thus far: the banking system has benefited tremendously from the unprecedented scale and scope of public support measures, spanning fiscal, monetary and regulatory actions. Whether it is government guarantees for bank lending, job furlough schemes, wide-ranging liquidity support or various forms of regulatory and supervisory forbearance, these support measures have done much of the heavy lifting thus far and shielded banks from shocks and losses.

What is more, the pandemic is not a typical financial crisis fuelled by a credit boom, excessive leverage and lapses in risk management. So, in many ways, the last 20 months have not fully tested the resilience of the banking system, and it has certainly not tested the banking system's resilience in the absence of large-scale public support.

Indeed, we know that there remain some fault lines – most notably with the way in which banks measure their capital requirements using internal models. These fault lines remain as important today as they were pre-pandemic, including in Europe, and they are exactly gaps that the final Basel III reforms target. Let me give just one example. The Committee's first report on the variability of banks' modelled capital numbers – which highlighted a worrying degree of variation and inconsistency – was in 2013.8 Eight years later, and despite repeated claims by some stakeholders that banks had "fixed" this problem, the latest report by the European Banking Authority on banks' modelled capital requirements points to a "significant" level of capital dispersion "that needs to be monitored".9Implementing Basel III in full – and in particular the output floor - will go a long way toward addressing these persistent concerns. Far from being a reason to dilute or delay Basel III, the experience of global banks through the pandemic is another reminder of why we need global standards for resilience.

Second, some banks argue that certain parts of Basel III should not be implemented as agreed by the Basel Committee because they will be "disproportionately" impacted by them, relative to their peers. This argument is often supported by the suggestion that the final set of Basel III reforms included a commitment not to increase overall capital requirements.

In my view, a bank, or any stakeholder that argues that a global standard needs to be domestically adjusted to reduce the impact on outlier banks has lost sight of the purpose and value of global standards.

The primary objective of the outstanding Basel III reforms is to enhance the comparability of reported capital levels across all banks, by constraining the discretion they have to measure that capital using their own models. Put differently, these reforms level the global playing field and preserve trust and credibility in the capital levels published by banks. A level playing field reinforces trust and credibility and both are critical for financial stability, particularly in times of stress.

And we have always said that these measures will not significantly increase overall capital requirements at the global level. We have met this objective. Under very conservative assumptions, these measures are estimated to increase global banks' Tier 1 capital requirements by less than 2% if implemented immediately.10 This is equivalent to about 5% of annual dividend payments made by internationally active banks during the period 2015–2019, hardly a constraint, and a small price to pay for the benefits of added stability.11

Of course, there will be "outlier" banks that face higher requirements. Changes designed to increase the consistency of capital measurement – to level the playing field – will necessarily impact banks differentially. Banks that have benefited from aggressive modelling of their capital in the past, or that have been subject to rules that were not in line with prior Basel standards, will be impacted more. To be clear: this is an intended outcome.

But even in those instances where banks will see increased capital requirements, the actual impact is likely to be much lower than is asserted, not least because of the sufficiently long transitional arrangements. With a 2023 start date, the final elements of Basel III, including the output floor, will only be fully implemented by 2028 – a full 20 years after the GFC. Surely this is enough time.

Third, some have argued that now is not the time to implement Basel III because we are in a middle of a global pandemic and banks must support the economy. This is a version of the very tired argument that banks can either increase their resilience or support the economy – as though these two things were mutually exclusive objectives. Of course, they are not. In fact, they are mutually reinforcing objectives.

There is a long and growing list of rigorous, empirical studies that all come to the same conclusion: it is healthy, well-capitalised banks that lend to households and businesses, both in good times and bad.12 The last year only added to this experience. We saw jurisdictions with

better capitalised banks experience a less severe impact on their expected GDP growth, and better capitalised banks increased their lending more during the pandemic, relative to their peers. The global economy faces a tough recovery ahead. All the more reason why we need strong, resilient and well-capitalised banks.

Fourth, some stakeholders have pointed to "national specificities", or unique features to a banking system or jurisdiction that demand a deviation from global standards. For example, I often hear about the dominant role of bank lending relative to other sources of financing in Europe, the distinct structure of housing markets in other markets or certain banks that are just too small to be held to a global standard.

These arguments belie the purpose of the Basel III standards. The Basel framework is designed and calibrated to create a global level playing field for internationally active banks. They are a common baseline that reflects, as much as possible, structural differences across jurisdictions.

The arguments also ignore the fact that the reforms are designed through an extensive and transparent process of consensus building that includes a wide range of empirical analysis and extensive public consultation.

In the case of Basel III, the Committee issued no fewer than 10 consultation papers as part of these reforms, with an accompanying consultation period that spanned the equivalent of almost three years. The finalised standards took on board many of the comments received from stakeholders and reflect the differences in views among our members. They are a compromise by their very nature.

Global cooperation and the future of the Basel Committee

In conclusion, multilateralism lies at the heart of the work of the Basel Committee. Looking ahead, there is no shortage of cross-border financial stability issues that will require global cooperation. Over the coming years, the Committee will tackle a range of challenges impacting the global banking system, including the impact of prolonged low interest rates, digitisation of finance, cyber threats and climate change, to name just a few. As we pursue our work, the Committee will maintain its transparent and consultative approach.

Most importantly, the Committee will rely on its members to continue to work collaboratively and constructively toward enhancing financial stability. Implementing Basel III in a full, timely and consistent manner is an important and powerful demonstration of this commitment to global cooperation.

The Digital Disruption: The Role of Regulation*

By Fernando Restoy*

Introduction

Thank you very much for the invitation to participate in this event.

Presentations before mine have already covered much ground on the implications of the ongoing technological disruption, including its impact on financial inclusion and resilience.

Overall, the already vast literature on the topic and, certainly, the presentations at this conference stress the complex combination of risk and opportunities that digital technologies bring to the financial sector. Indeed, it is remarkable how digitisation is helping to enlarge the opportunity set of consumers and investors, increase efficiency and competition in the provision of financial services, and, importantly, make those services available to larger segments of the population. The significant acceleration of the financial inclusion indicators in the last few years in countries like India and China – where digital payments have skyrocketed – is just one illustration of the power technology has to make the financial system more able to serve the public interest.

Yet the disruption created by new technologies, the new products and the new providers of financial services – particularly big tech companies – also poses relevant risks for the achievement of key social objectives such as market integrity, consumer protection and financial stability. Those are precisely the objectives that justify public intervention when markets fail to deliver them on their own.

The establishment of rules and constraints on market activity, such as that performed by new tech players in the market of financial services, is the most relevant policy tool to address negative market externalities. That regulatory action should be subject to the principle of good regulation under which public intervention should be minimised to what is essential to preserve social objectives. Yet regulation occasionally needs to face relevant trade-offs, as public actions aiming at containing risks for adequate market functioning may limit private tech firms' ability to deliver services that could otherwise be socially valuable, for instance as a result of their positive impact on financial inclusion.

In that context, it is important to bear in mind that regulation is not the only form of policy intervention that can help correct market failures. At times, the direct provision of services by government-owned companies may contribute to socially desirable options. In the area of digital payments, for instance, experience in countries like India3 shows how public infrastructures may help society to embrace the benefits of technology and facilitate financial inclusion while avoiding some of the risks posed by excessive reliance on large private providers. In particular, putting in place public infrastructures such as India's Unified Payments Interface (UPI) seems to substitute, at least to some extent, for a more forceful policy intervention to address big tech risks related to anti-competitive practices, walled garden ecosystems and hoarding user data.

The introduction of central bank digital currencies (CBDCs) is another example of how well designed public facilities can help optimise the net benefits of digital payment platforms for society as a whole.

Sound policy strategies aiming at facilitating an orderly adoption of new technologies in the financial sector should therefore incorporate a good combination of regulation and the provision

of public infrastructure. While other presentations have focused on the latter, let me share with you a few reflections on how the regulatory framework needs to be adapted to preserve a key social goal: financial stability. For more concreteness I'll focus my remarks on how risks posed by big techs could be addressed by adequate rules constraining their practices and modus operandi.

Big techs and financial stability

One of the most important recent developments in the financial industry is the rapidly expanding participation of large technological companies (big techs) in the market for different financial services. Big techs originally specialised in non-financial areas such as e-commerce or the provision of different types of technological services through the internet. However, starting with payment services, several big techs soon became active in the business of wealth management, lending or insurance. In some cases, they also perform regular banking services through licensed subsidiaries or through joint ventures with commercial banks.

As is now well documented, the expansion of big techs leverages on their unique business models based on technological and, especially, data superiority, which allows them to benefit from network externalities.

Big tech services have brought efficiency to the financial industry. Moreover, by offering innovative products they have eroded the historical dominant position of commercial banks in in some market segments – notably payments, for which a banking licence is not required. Furthermore, in some jurisdictions they have been able to make payment facilities and external funding available to firms and individuals who did not previously have access to banking services. Yet the financial activity of big techs does pose some risks for the preservation of financial stability which may not always be fully captured by the current regulatory framework.

Those risks stem from at least four different sources.

First, from the direct provision to the public of a suite of sensitive financial services such as payments, credit, wealth management and, sometimes, deposit-taking. Unsound performance of those activities could contribute to potentially systemic stress due to excessive indebtedness, operational discontinuities and liquidity mismatches and also to facilitate illegal activities. The parallel performance of several of those financial activities alongside the provision of other non-financial services within the same group could exacerbate operational risks and complicate their supervision by the competent authorities.

Second, from the frequent provision of relevant technological services to regulated financial institutions (such as cloud computing services) that lead to large third-party dependencies and important operational vulnerabilities. Recent outages in the technological services provided by big techs illustrate the potential significance of those risks.

Third, by the issuance of new means of payments – such as so-called stablecoins. Given the complementarity of those new payment instruments with other services offered by big tech platforms to a large number of users, they have the potential to replace fiat currency as a predominant settlement instrument, thereby challenging the integrity of the payment system, consumer protection and, possibly, monetary sovereignty.

And, finally, from the potential to generate significant concentration dynamics in the provision of key financial services. Network externalities that characterise big tech business models can easily lead to a continued increase in their size and business diversification, at the cost of damaging competition in a quickly increasing number of related market segments. Notice that concentration threatens not only market contestability but also financial stability as it amplifies the dependence of financial system participants on the services provided by a few large players.

The current regulatory approaches

The challenges posed by big techs are now being addressed – with different approaches and intensity – in several jurisdictions.

So far, authorities are following a piecemeal approach aiming at inserting specific rules in the current regulatory framework in order to contain some of the risks I mentioned before.

In particular, the provision of financial services (payments, wealth management, credit underwriting) other than banking or insurance are regulated through an activity-based approach. Big tech subsidiaries that perform specific regulated activities are subject to the corresponding sectoral requirements that typically address consumer protection, AML/CFT and sometimes operational resilience.

In some jurisdictions, authorities are now considering the introduction of a specific regulatory and supervisory framework for large providers of technological services to regulated institutions. That regime will affect, in particular, those subsidiaries of big techs that provide services to a large number of financial institutions, such as cloud computing.

However, many of the risks that big techs' activity generates for the adequate functioning of financial markets stem from the combination of both financial and non-financial activities that they perform. Their ample array of services is typically anchored on shared systems across subsidiaries and an extensive use of all available data from clients obtained throughout all the activities performed by the group. Risks posed by such interdependencies can hardly be fully addressed by pure activity based regulation.

This is certainly the case of the prevention of excessive market concentration. In the EU, the European Commission has put forward a proposal for a Digital Markets Act (DMA) which establishes a series of specific requirements which must be satisfied by big tech platforms ("gatekeepers" in the DMA terminology), aimed at preventing (and not only prosecuting ex post) anti-competitive practices that could lead to the abuse of market dominance. Special rules on data use, data protection and data-sharing obligations with end users and business users are a key component of the proposed DMA. A similar entity-based approach is already being enforced in China following the rules established by the market regulator (SAMAR), and is the one considered in different legislative initiatives which are currently under discussion in the US Congress.

Moreover, we have recently seen some initiatives for the development of specific regulation of entities performing services related to stablecoins. In particular, a report by the US president's commission composed of the Treasury and main regulatory agencies has proposed a bold legislative reform that would require issuers of stablecoins to become insured depositary institutions and establish concrete rules and a supervisory regime for entities providing associated payment services (like custodial wallet providers). Moreover, the report proposes limiting the affiliation of those entities with commercial companies. If those proposals are finally endorsed by the US Congress, the scope for big techs to promote and sponsor stablecoins would be seriously constrained.

In sum, current developments aim at revising the current activity-based regulation and add a few specific entity-based rules (particularly in the area of competition) to deal with some of the risks posed by big techs. So far, however, there is no ambitious attempt to consider a more comprehensive approach that could consistently address the risks posed in different policy domains by the combination of activities that big techs perform as implied by their unique business model.

Can we do it better?

At present, there are no internationally established regulatory categories or standards aiming at addressing the risks posed by the combination of different types of financial and non-financial activities within the same group.

The closest reference is probably that of financial conglomerates. Following the publication of the report by the Joint Forum in 2012, jurisdictions established rules and supervisory practices to strengthen the prudential regime of entities which are active in more than one regulated financial sector (ie banking, insurance and securities markets).

One specific type of conglomerate rules are licensing frameworks for financial holding companies (FHCs). FHCs are typically large non-financial companies that hold controlling stakes in two or more financial firms that offer regulated financial services across sectoral boundaries and exceed minimum size thresholds. The FHC and the financial institutions it controls make up a financial holding group. The non-financial activities performed by this group are limited to maximum thresholds.

In China, the People's Bank of China requires companies that control two or more different types of financial companies, including big techs such as Ant and Tencent, to apply for an FHC licence.

The Chinese FHC regulatory regime establishes requirements for the parent FHC in terms of minimum profitability, financial capacity and owners' fit and proper conditions. It also promotes sufficiently simple corporate structures and imposes specific governance procedures including the centralised management of all relevant financial risks across the group. The regime entails the fulfilment of consolidated capital requirements at the group level and includes constraints on related party transactions and cross-subsidiary interactions.

A key objective of the FHC regime is to guard against systemic risk by protecting the safety and soundness of the financial holding group from risks arising from the non-financial activities performed by other parts of the wider group to which it belongs. It also helps address contagion of risks across financial subsidiaries and minimises the potential for regulatory arbitrage across the different types of sectoral rules that apply to the regulated subsidiaries. Importantly, that regime facilitates consistent supervision of all financial risks, including those related to solvency, operational resilience and market conduct.

Certainly, the FHC regime goes a long way towards satisfying the quest for a comprehensive entity-based regime for big techs which are active in the market for financial services. That regime may, however, fall short of addressing all relevant risks.

As we have discussed before, challenges posed by big techs for the preservation of financial stability, or more generally, adequate market functioning are associated with the combined provision of different types of financial and non-financial services as part of their unique business model. That entails using common technological and data infrastructure for the provision of different services. Notice, in that regard, that, particularly in western countries, the non-financial business lines of big techs are substantially larger than those related to regulated activities. Therefore, the grouping of all subsidiaries offering financial services under the same holding company may not be enough on its own to control operational risks or various forms of data and market abuse.

Furthermore, payment services are not explicitly included in the definition of FHCs in existing regulatory frameworks. Given the crucial role that payment services play within big tech ecosystems and, in particular, as an enabler for the provision of complementary financial services, a greater focus on payments could be added to the current FHC regime to enable it to achieve its objectives more fully when applied to large technological companies.

The FHC regime therefore seems a useful reference for a policy reflection on how best to regulate big techs with the aim of preserving financial stability and other relevant social goals.

Yet that reflection should consider how the FHC regime could be adapted to cope with the unique business model of big techs and the key role played by their payment infrastructures.

Concluding remarks

To conclude, the disruption that technology is creating in the market for financial services is probably unprecedented. The new developments are dramatically changing the very nature of the services offered, the diversity of the users and providers, and the way the latter perform their activities and distribute the products they offer.

In that context, the public policy response to such a far-reaching technological disruption has to be commensurate with the magnitude of that disruption. That entails both direct public intervention to provide the required infrastructure to fully grasp the benefits associated with innovation as well as an overhaul of the current regulatory framework. The current regulatory setup, consisting of a series of diverse activity-based requirements accompanied by specific rules for traditional financial institutions, is simply not fit for purpose.

In particular, the potential implications of the activities performed by big techs in the market for financial services require the establishment of a consistent set of entity-based rules spanning different but related policy domains. For that purpose, we may need brand new regulatory categories and supervisory procedures to address the challenges posed by their unique business models, including effective mechanisms for coordination among financial, competition and data authorities.

The good news is of course that some relevant policy actions are already taking place in several jurisdictions. What we need now is sufficient ambition, policy impulse and international cooperation to make those efforts more comprehensive and consistent at the global level.

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Non-Bank Financial Institutions Pose Significant Systemic

Risk[*]

By TAYLOR PEARCE[*]

Despite being hit by the largest exogenous shock in its history in March 2020, the global financial system appears to have weathered the Covid-19 storm. It seems that the regulatory framework introduced after the 2008 financial crisis has passed its first major test. Yet, despite banks' resilience, non-bank financial institutions – including insurers, pension funds and sovereign funds – were not subject to the same post-crisis regulatory overhaul.

As a result, the most acute threats to financial stability stem not from the banking system, but the less regulated and often more highly leveraged NBFIs.

During a live broadcast with OMFIF, Randal Quarles, former vice-chairman for supervision at the Board of Governors of the Federal Reserve System, spoke about his time at the Fed and as chair of the Financial Stability Board. In his first public appearance since the expiration of his term on the board, he reflected on financial stability considerations for both monetary policy-makers and regulators as they move into the post-pandemic era.

The discussion began with an overview of his efforts to recalibrate Dodd-Frank legislation, for which he drew heavy criticism (in 2019 Senator Elizabeth Warren accused Quarles of intentionally weakening supervision for large banks by 'cutting holes in the safety net'). He maintained that the reforms introduced under his tenure, which included higher effective required capital rates and stress testing, brought more transparency, efficiency and certainty into the system.

He also alluded to the risk posed by NBFIs, articulating that it would be difficult for the Fed to address this regulatory gap. 'Our current system is limited, and really is most effective with regard to banks,' Quarles pointed out, 'as the central bank's principal responsibility only has strongest levers on the banking system.'

In the US, non-bank financial intermediation is regulated in part by the Securities and Exchange Commission, the Commodity Futures Trading Commission and the Financial Stability Oversight Council. Yet, Quarles lamented that this patchwork system is less than 'intellectually pleasing' and remains a 'historical kaleidoscope' unlikely to change due to bureaucratic and political hurdles.

The gap in regulation has borne consequences for financial institutions' performance, evidenced by the banking sector's superior growth against NBFIs in 2020 for the first time in over a decade. In the aftermath of the pandemic, 'the banking system performed quite well, but the non-banking financial system did not,' Quarles stated.

This regulatory mismatch can be seen at the international level as well. The December 2021 Bank of International Settlements Quarterly Review found that, at the outbreak of the pandemic, 'NBFIs retreated en masse, liquidity evaporated and markets froze amid deleveraging and feedback loops.' Moreover, the report stated that March 2020 was not the first episode of global market turmoil in which the NBFI sector 'amplified stress through structural vulnerabilities, notably liquidity mismatches and hidden leverage.'

The push to close this gap in macroprudential policy comes against the backdrop of financial overheating as a result of pandemic emergency measures, namely prolonged fiscal stimulus and accommodative monetary policy, which has provided a buffer against systemic risk. But while the repeated shocks of the pandemic certainly challenged financial stability, the real test will come when central banks and governments wind down their support measures.

Since 2020, the FSB has re-evaluated the stability of the non-bank financial sector. In the international organisation's 2021 Global Monitoring Report on Non-Bank Financial Intermediation, it noted that the pandemic's impact on financial markets 'highlighted vulnerability in the NBFI sector related to liquidity mismatches, leverage and interconnectedness.' The FSB is due to revise NBFI regulation in November, with the objective to strengthen the sector's resilience.

Regulation must be designed with care. Absence of more specific guidance at the international level could lead to significant differences in the NBFI regimes across jurisdictions, embedding vulnerability into the global financial system. The need to implement robust, cross-jurisdictional regulation, stress testing and monitoring on NBFIs has never been more pressing.

Governments and central banks have done their part to prevent a pandemic-induced financial collapse. Regulators are now tasked with the challenge of maintaining post-pandemic resiliency.

Digital Economy

The Future of Money: Gearing up for Central Bank Digital Currency[*]

By KRISTALINA GEORGIEVA[*]

Let me start by thanking the Atlantic Council for providing a fitting venue to discuss central banks' forays into Digital Currencies.

Since its founding in 1961, the Council has made important contributions to strategic, political, and economic policy debates. Those debates have served us well, helping us to test the boundaries of our thinking and be better prepared for what lies ahead.

So, today, we aim to test our thinking again. We have moved beyond conceptual discussions of CBDCs and we are now in the phase of experimentation. Central banks are rolling up their sleeves and familiarizing themselves with the bits and bytes of digital money.

These are still early days for CBDCs and we don't quite know how far and how fast they will go. What we know is that central banks are building capacity to harness new technologies—to be ready for what may lie ahead.

If CBDCs are designed prudently, they can potentially offer more resilience, more safety, greater availability, and lower costs than private forms of digital money. That is clearly the case when compared to unbacked crypto assets that are inherently volatile. And even the better managed and regulated stablecoins may not be quite a match against a stable and well designed central bank digital currency.

We know that the move towards CBDCs is gaining momentum, driven by the ingenuity of Central Banks.

All told, around 100 countries are exploring CBDCs at one level or another. Some researching, some testing, and a few already distributing CBDC to the public.

In the Bahamas, the Sand Dollar—the local CBDC—has been in circulation for more than a year.

Sweden's Riksbank has developed a proof of concept and is exploring the technology and policy implications of CBDC.

In China, the digital renminbi [called e-CNY,] continues to progress with more than a hundred million individual users and billions of yuan in transactions.

And, just last month, the Federal Reserve issued a report that noted that "a CBDC could fundamentally change the structure of the U.S. financial system."

As you might expect, the IMF is deeply involved in this issue, including through providing technical assistance to many members. An important role for the Fund is to promote exchange of experience and support the interoperability of CBDCs.

As part of the service to our members, today we are publishing a paper that shines a spotlight on the experiences of six Central Banks at the frontier—including China and Sweden—to be covered in the panel discussion following my remarks.

We take away three common lessons from these Central Banks from which others may benefit.

Lesson number one: no one size fits all.

There is no universal case for CBDCs because each economy is different.

In some cases, a CBDC may be an important path to financial inclusion—for instance, where geography is an obstacle to physical banking.

In others, a CBDC could provide an essential backup in the event that other payment instruments fail. One such case was when the Eastern Caribbean Central Bank extended its CBDC pilot to areas struck by a volcanic eruption last year.

So, central banks should tailor plans to their specific circumstances and needs.

Lesson number 2, financial stability and privacy considerations are paramount to the design of CBDCs.

Central banks are committed to minimizing the impact of CBDCs on financial intermediation and credit provision. This is very important for the wheels of the economy to run smoothly. The countries we studied offer CBDCs that are not interest-bearing—which makes a CBDC useful, but not as attractive as a vehicle for savings as traditional bank deposits.

We also saw in all three active CBDC projects—in the Bahamas, China, and the Eastern Caribbean Currency Union—that they placed limits on holdings of CBDCs, again, to prevent sudden outflows of bank deposits into CBDC.

Limits on holdings of CBDCs also helps meet people's desire for privacy while guarding against illicit financial flows. Smaller holdings are allowed without the need for full identification if the risks of money laundering and terrorist financing are low—this could be a boon for financial inclusion. At the same time, larger transactions and holdings require more stringent checks, as you would expect if you deposit a bag of cash at the bank.

In many countries, privacy concerns are a potential deal breaker when it comes to CBDC legislation and adoption. So, it's vital that policymakers get the mix right.

And that brings me to lesson number three: balance.

Introducing a CBDC is about finding the delicate balance between developments on the design front and on the policy front.

Getting the design right calls for time and resources, and continuous learning from experience—including shared experiences across countries. In many cases, this will require close partnerships with private firms to successfully distribute CBDCs, build e-wallets, add features, and push the bounds of technology.

But the policy aspects are also paramount, including developing new legal frameworks, new regulations, and new case law.

On both fronts, a CBDC also requires prudent planning to satisfy policy targets like financial inclusion, and avoid undesirable spillovers such as sudden capital outflows that could undermine financial stability.

Taken together, careful design and policy considerations will underpin trust in CBDCs. But let us not forget that trust must be anchored in credible central banks with a history of delivering on their mandates.

Introducing a CBDC is no substitute for this underlying trust built over decades—a public good that allows money to grease the wheels of our economies.

The success of a CBDC, if and when issued, will depend on sufficient trust. And, in turn, any successful CBDC should continue to build trust in central banks.

So, let me conclude.

The history of money is entering a new chapter.

Countries are seeking to preserve key aspects of their traditional monetary and financial systems, while experimenting with new digital forms of money.

The paper we are releasing today shows that for those experiments to succeed policymakers need to deal with many open questions, technical obstacles, and policy tradeoffs.

It may not be easy or straightforward, but I am confident that the bright minds in Central Banks can succeed, thanks to their trademark resourcefulness and perseverance.

Fittingly, even the great inventor Thomas Edison acknowledged that: "There is no substitute for hard work."

And this is what we embrace at the IMF: This hard work has already advanced. We are supporting countries in their CBDC experiments—to understand big picture trade-offs, to provide technical assistance, and to serve as a transmission line of learning and best practice across all 190 members. And we are stepping up collaboration with other institutions, such as the Bank for International Settlements, at par with the rapidly growing significance of digital money.

Today's discussion is only the beginning of an exciting journey — and we have a great panel to take us further on it.

Outlook 2022: Shaping a CBDC Future for Consumers and Businesses*

By WOLFRAM SEIDEMANN*

The past year has seen many countries intensifying their work and moving plans forward to explore central bank digital currencies. There are now more than 100 central banks conducting studies or CBDC pilot schemes to foster financial inclusion and grow digital economies.

In 2022, digital money initiatives will continue at pace, making it the most important year for the development and progress of CBDCs worldwide. Many countries will be looking to cross the bridge from the research stage to announcing pilot projects. Some countries, like Ghana where we are involved, will start using insights and feedback from their first trial stage to adjust wider rollout plans.

The user needs to be at the centre of CBDC design

As the discussions and efforts to issue CBDCs speed up, central banks have a task on their hands to ensure successful public adoption. Conversations will shift, placing the users of CBDCs – including businesses – front and centre. Like the digital currency itself, the measures and strategy for adoption need to be tailored to meet the requirements of an individual country as well as expectations and concerns of consumers and businesses there. This is even more important as the digital economy brings new use cases and efficiency gains through the adoption of CBDC.

The potential lies in sharing power within the CBDC ecosystem

Central banks are guided by public interest, not by profit. Similarly, CBDCs have the power to let users participate in the digital economy independently from issuers – central banks. A CBDC can only ensure this if its design follows strict privacy by design principles and a share of power approach between government, businesses and consumers. While infrastructure and trust in the currency is guarded by the central bank, innovation, new products and services as well as consumer interfaces are developed by the market.

Innovative consumers and new businesses will drive CBDC adoption

A recent G+D and OMFIF survey has revealed a significant contrast in attitudes towards CBDCs between consumers in emerging markets and countries with solid digital infrastructure. In Nigeria, where a pilot project launched in October 2021, 91% of respondents said they were likely to use digital currencies, with 60% of consumers from Indonesia saying so too. However, these figures fall to just 24% in the US and 14% in Germany, suggesting CBDCs could offer a 'leapfrog' moment in payments in emerging markets rather than developed countries with well-established payment options.

There is also variance in awareness of digital currencies, with a visible correlation between attitudes towards CBDCs and familiarity with the concept. The survey has shown that 40% of consumers in both Nigeria and Indonesia are aware of CBDCs, compared to just 15% in the US. A greater focus should therefore be placed in the coming months on educating citizens in

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developed countries, with clear communication from central banks and private sector businesses about the convenience, security and low cost benefits CBDCs will bring. That way, we can all move closer to embracing digital currencies.

Functionality and trust will be essential for CBDCs adoption

To be widely accepted, a currency needs to be universal. It needs a general purpose while being fully functional in existing and future infrastructures and business models. People and businesses require functionality to use digital currencies in various scenarios, from offline peer-to-peer payments to automated machine-to-machine transactions. An innovative digital option needs to be inclusive for all use cases while evoking trust in the value of money among people.

It is the responsibility of central banks to ensure that trust and provide a secure infrastructure for financial service providers' programme features, functions and mechanisms outside of the currency, enabling new processes and fostering innovation. G+D Filia – a universal CBDC protocol – follows a pioneering programmability approach to enable programmable payments and performs secure consecutive offline payments to ensure full digital as well as financial inclusion.

Collaboration is required to bring CBDC to life

To offer seamless experiences and ensure interoperability, greater collaboration between the private and public sector will be needed. While central banks will have to make sure the right infrastructure is in place to issue CBDCs, commercial banks and fintechs will take on a more consumer-facing and operational role. Their insights about user behaviour and success factors for adoption will be crucial for tailoring to the needs of individual countries and bringing CBDCs to life.

To say a new form of public money is on the horizon would be an understatement. CBDCs are offering an array of benefits to businesses and consumers alike and revolutionising our relationship with the digital economy. 2022 will be defined by the greatest progress in shaping the framework conditions and rules of a CBDC future, driving digital innovation and extending financial inclusion on a global scale.

Financial Market

Challenging Times Ahead for Reserves Managers*

By Massimiliano Castelli*

2021 was a difficult year for fixed income investors, particularly those exposed primarily to high-quality government bonds. Even short-duration, investment-grade fixed income, widely regarded as the poster child for conservative fixed-income investing, delivered a slightly negative return for the first time in nearly 30 years.

Why is this happening? Low yields from developed market bonds have failed to offset the negative price return from bonds in a rising interest rate environment. The road ahead is a challenging one from a total returns standpoint, likely to be characterised by low absolute – albeit rising – yields and negative price returns as central banks move to normalise policy rates.

The losses experienced on the most liquid and low-volatility government bonds is a wake-up call for reserves managers. In the last 20 years, central banks have enjoyed strong returns on their reserves. Using a portfolio mix of select developed market government bonds, we estimate that short duration (one- to three-year) government bonds have generated a return of more than 2% on an annualised basis over the last two decades. A portfolio of longer-duration government bonds from these same markets has returned more than 4%.

Beyond government bonds, returns in investment-grade spread products have ranged between 4% for asset-backed securities on the lower end to nearly 8% for hard currency-denominated emerging market debt on the upper end (see table).

Table 1: Historical returns compared to expected returns under four potential scenarios

	Historical returns	Base case	Recession	Stagflation	Inflationary growth
		Return	Return	Return	Return
Cash	1.6%	0.68%	0.00%	0.56%	0.77%
Global government bond, 1-3 years	2.4%	0.70%	0.17%	-0.04%	-0.05%
Global government bond	4.1%	0.60%	0.80%	-2.69%	-3.22%
Corporates	5.4%	0.61%	1.73%	-0.92%	-1.27%
TIPS	5.3%	-0.55%	-0.50%	0.60%	-1.81%
Securitised	4.0%	1.17%	1.35%	-0.34%	-0.66%
Supranational	4.3%	1.20%	1.23%	-1.12%	-1.49%
EMD hard currency	7.8%	2.98%	4.28%	2.50%	1.13%
EMD local currency	5.1%	1.26%	4.48%	3.44%	4.86%

International Monetary Review

In the last 20 years, central banks have been able to fulfil the primary objectives of their mandate in reserves management – liquidity and capital protection – while enjoying an additional premium above the inflation rate. The attractive rates of return on government bonds have not only protected their purchasing power in real terms but have also played an important role as a diversifier from the exposure to equity markets for those central banks that have invested in this asset class.

The ability of conventional fixed-income assets to serve the dual role of providing returns above inflation and diversification from equity risk will be tested going forward. For a portfolio of developed market government bonds, our base case is that over the next five years future returns could decline dramatically from a historical average of 2.4% for the short-duration portfolio and 4.1% for the longer-duration portfolio, to as low as 0.7% and 0.6%, respectively.

This assumes the current high bout of inflation is transitory and that interest rates will normalise over the next two to three years. In an environment of stagflation characterised by low growth, high inflation and high interest rates, our hypothetical portfolios fare even worse, as expected returns become negative across short- and long-duration bonds.

There are similar outcomes in an inflationary growth scenario. It is therefore not surprising that even shorter-duration, high-quality portfolios are in the red so far this year. At the individual asset class level, returns are also expected to be meaningfully lower on a forward-looking basis, even in spread sectors like investment-grade corporates and securitised assets.

Fixed-income investors are realising that, after almost three decades of a bull market in bonds, the road ahead will be more challenging. The combination of record low starting yields and rising interest rates, as central banks begin policy normalisation, make the starting point particularly difficult. These challenges are not insurmountable, however.

To bridge the gap between the current environment of meagre yields and low returns and a future state where yields are high enough to better cushion against losses, we believe investors need to move away from a siloed approach to fixed-income markets and embrace flexibility. This can be accomplished either by broadening their investable universe to include more countries, sectors and instruments, or by adopting more flexible fixed-income strategies that are actively managed across these different dimensions. The combination of expanded opportunities and diversification of return sources can play an important role in helping protect fixed-income portfolios.

Over the last two decades, central banks have made tremendous progress in how they manage reserves. A further step has to be taken now to adapt their investment strategies to the changed economic and financial conditions and to protect the value of their reserves.

Embracing Uncertainty is Vital for Optimal Portfolio Construction*

By STEPHAN MESCHENMOSER AND ANTHONY CHAN*

The Covid-19 shock has brought sharply into focus the inherent uncertainty of life. Such uncertainty extended into financial markets as investors grappled with the unprecedented nature of the shock, policy response and reaction of asset prices. The experience of the past two years has reinforced the benefits of incorporating uncertainty into portfolio construction. Standard investment models only consider risk – situations where we do not the know the outcome but can measure the odds of different outcomes. But they often ignore uncertainty – situations where we may not have enough information to even define the odds.

Arguably, the coming years present a scenario that remains highly uncertain. New central bank frameworks are being put to the test, a rewiring of global supply chains is taking place and major shifts such as the transition to net zero are underway. Such a backdrop warrants some humility around economic projections and estimates of asset price returns – the building blocks of strategic asset allocation. Importantly, we need to acknowledge that there is no single portfolio that will be optimal for the wide range of significantly divergent yet plausible economic outcomes.

Yet traditional portfolio techniques, such as mean variance optimisation, take the approach of seeking to achieve an 'optimal' asset allocation. They arrive at such a portfolio by placing too much confidence in a set of economic and market estimates that leaves little room for uncertainty. The risk is that such an approach typically leads to concentrated – or less diversified – portfolios that are ill-prepared for outcomes that differ materially from a base case.

How can uncertainty be embraced in portfolio construction? A recent joint paper from GIC and BlackRock discusses how uncertainty can be better incorporated in strategic asset allocation to overcome shortcomings in traditional portfolio construction methods.

One approach is to seek to minimise 'regret risk'. Here, a handful of reasonably probable macroeconomic scenarios could be modelled explicitly using key variables, such as inflation, growth and valuations, which would then lead to a set of capital market assumptions – or long-run expectations for asset class returns. Optimal portfolios for each scenario are identified and then blended using scenario-probability weights. The resulting blended portfolio may not be perfectly optimal for the outcome that unfolds, but it seeks to minimise the lost returns from reality being too different from the scenario-optimal portfolios.

Another approach seeks to 'minimise downside risk'. Instead of explicitly specifying alternative scenarios, thousands of possible market outcomes are simulated within a set macroeconomic scenario and used to reflect both the uncertainty and volatility of future asset returns. When constructing portfolios, we seek to identify the portfolio with the 'best worst outcome', defined as the best average outcome in a given proportion of the simulated outcomes with the biggest downside. The choice of what proportion to select ought to reflect the investor's aversion to uncertainty and risk. This approach accounts for the behavioural finance finding that the pain felt from losses exceeds the joy felt from (similarly sized) gains.

Both approaches seek to achieve a desired portfolio outcome: a more diversified asset allocation than under the traditional approach and one that is likely to perform better in adverse market environments. Both approaches also provide investors with the flexibility to reflect their specific aversion to uncertainty. While the first approach explicitly specifies a few alternative scenarios and their likelihoods, the second approach defines a full range of plausible outcomes. These two approaches are not mutually exclusive: for each alternative macroeconomic scenario, a wide range of market scenarios could be calculated and used as an input for portfolio construction.

Incorporating uncertainty serves two important purposes. First, it acknowledges that most investors might not have full conviction on a specific value for expected returns. More plausible is that asset prices may follow a few potential pathways. Accounting for these pathways can either be done by adding uncertainty to the input variables – that is the expected return itself – or by employing bespoke capital market assumptions for different macroeconomic scenarios. Second, the variability in levels of uncertainty across time and asset classes can be captured by attaching different probabilities to certain macroeconomic environments or varying the level of uncertainty by asset class. Why is this important? A lower ability to estimate returns for one asset class – for instance when an asset's returns are poorly explained by well-known public market factors – should warrant higher uncertainty around its expected returns.

Most of us deal with uncertainty in our daily lives by considering various scenarios and staying flexible and adaptable. As investors, we should look to mirror this approach when designing long-term portfolios in today's financial markets. There is no guarantee that this alone will lead to better returns, but it could help in making more deliberate investment decisions and making communication with key stakeholders more effective.

Financial Markets Need Stimulus to Stay On*

By NEIL WILLIAMS[*]

A triple blow of policy tightening, including quantitative tightening, fiscal correction and rate hikes, set against the backdrop of Russia's invasion of Ukraine, inflation and social disparities will test the two-year-old 'reflation trade' put on by many asset managers. Yet, by exacerbating stagflation and jittery stock markets, central banks and governments will hold back from reaching anything close to historical monetary and fiscal policy norms.

Global stimulus has been vital for risk assets and the recovery. The damage to equities in early 2020, prior to fiscal packages, was both outright and relative to 'safer' government bonds (Figure 1). This relative hit dwarfed that of 2008-9, reflecting the clamp on bond prices that over a decade of quantitative easing established.

But the relative recovery of equities since the second quarter of 2020 and lower expected volatility have been impressive, returning the equity-bond yield gap to its pre-Covid-19 level. On a forward-earnings basis, it's even been close to 2007 levels. Much of this must be owed to monetary expansion and the fiscal splurge since 2020.

Figure 1: Elevated equity markets had powered back

US equity-bond yield gap (using S&P 500 Composite & 10-year Treasury) vs VIX volatility index. Grey is US recession
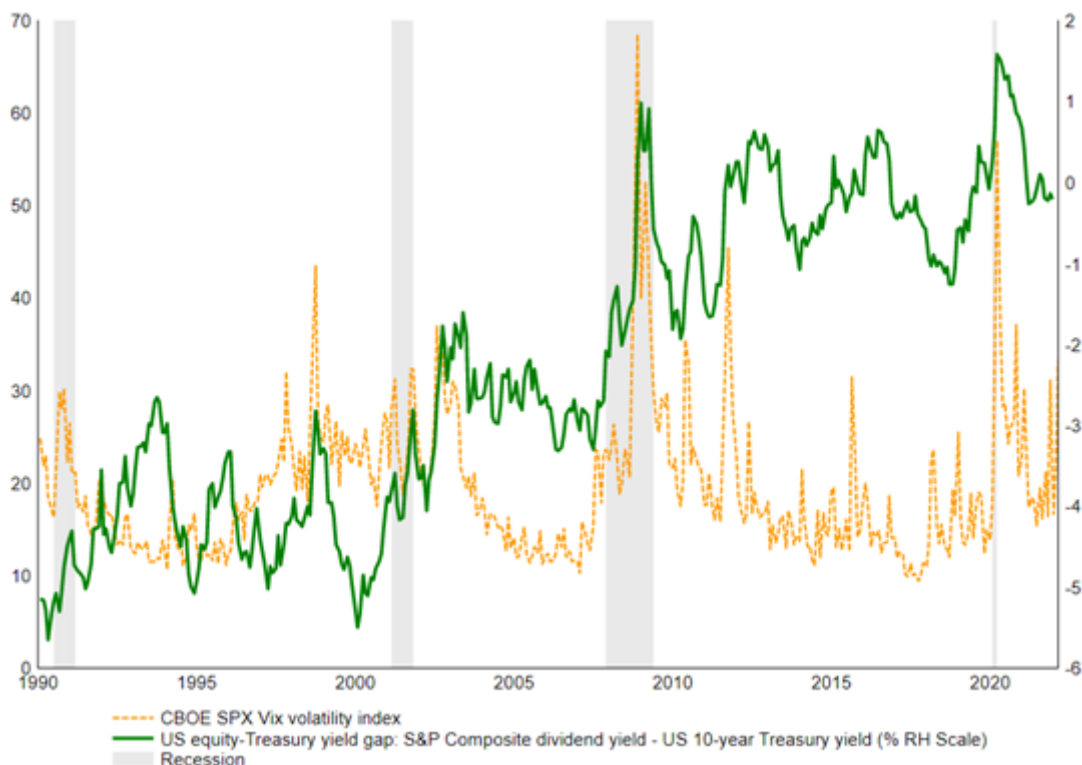
CBOE SPX Vix volatility index
US equity-Treasury yield gap: S&P Composite dividend yield - US 10-year Treasury yield (% RH Scale)
Recession

Source: Refinitiv Datastream

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* Neil Williams is Chief Economist at OMFIF.

Comparing the Federal Reserve's balance sheet and the S&P 500 since the start of QE in 2008 yields a simple correlation, as high as 0.88. The relationship is strongest with a 10-week lead, suggesting the S&P, on average, pre-empted QE changes by two to three months. Symmetry for QT suggests a similar pre-emption, though in the opposite direction. On this basis, whittling away the balance sheet via gradually re-investing fewer maturing bonds – which the Fed has been hinting at from March with the European Central Bank somewhat later – would erode an important prop to equity markets.

More potent could be fiscal correction, already flagged in the US and UK. A noticeable difference in 2021 is the strongly positive contribution of stimulus to growth assets; it was negative in 2008. This reflects 2020's comprehensive approach, as fiscal packages augmented monetary stimulus.

For policy-makers, the test will be the extent to which stimulus withdrawal impedes the real economy. The US unemployment rate, a long-term proxy for global activity, throws up a simple correlation with the S&P 500 of just -0.23 since 1964, revealing a nine-month lead. Restricting this to the period since 2008, when QE kicked in, renders a stronger correlation of -0.83, with the same lead.

The S&P's estimated price-equity ratio exhibits far more long-term fluctuation than the equity index itself. Comparing this to the unemployment rate similarly offers rising correlations of -0.55 and -0.71, for 1964-2022 and 2008-22 respectively, with an eight-month lead.

This is even with the short-term relationship breaking down in 2020, as US job losses reached eye-watering levels. However, the ability of the S&P's price-equity ratio to scale new heights during 2020, before Covid-19 vaccines were available, suggested that record stimulus was sufficient to reassure markets that recession and job losses would prove temporary.

Figure 2: Risk assets have been pre-empting further macro improvement
Estimated p/e ratio for S&P 500 Composite (RHS) vs US unemployment rate (inverted axis).
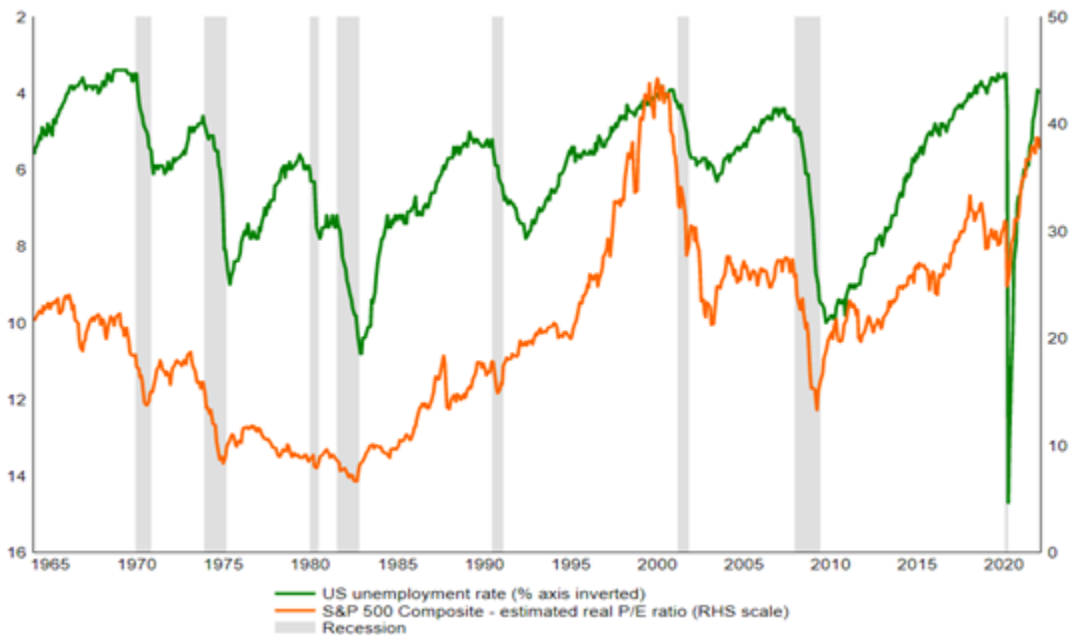
Source: Refinitiv Datastream, based on US Bureau of Labor Statistics data

This highlights that the importance of employment as a demand-indicator for risk assets has risen over time, as labour markets became less regulated. Furthermore, shifts in these assets typically pre-empt changes in QE – and presumably in QT – by up to three months. In

employment it is by up to nine months. Hopes of sustaining the recovery and maintaining the reflation trade would, even without the Russian invasion of Ukraine, rest on further job gains. Failing that, more stimulus, especially fiscal, would be required.

Yet the reverse is more likely. Policy-makers are talking 'correction' and hopes of reflationary wage growth may be trampled if liquidity and stimulus dry up. This suggests QT, less accommodative fiscal positions and the realisation that the best of the jobs recovery may have passed could, without offsetting measures, test growth assets – even if the Russo-Ukrainian war is resolved quickly.

Climate Change

Measuring Climate Change: The Economic and Financial Dimensions*

By LI BO*

It is my pleasure to open the Ninth IMF Statistical Forum. As Louis Marc mentioned, the theme of this year's Forum is the measurement of climate change, with a special focus on its economic and financial dimensions. Climate change is one of the biggest threats faced by the global community, and hence a critical topic that requires in-depth forward-looking analysis and the best possible data. We already see the effects everywhere. From the increases in wildfires and droughts in some parts of the world, to the melting ice caps and flooding in other parts.

At the IMF, we are committed to supporting our members in the fight against climate change. We are putting climate at the heart of our economic and financial surveillance. We are scaling up our capacity development. We are active in the global policy debate. And we are trying to mobilize resources for developing economies, including through the Poverty Reduction and Growth Trust (PRGT) and possibly also a new Resilience and Sustainability Trust (RST) to channel part of the recent $650 billion SDR allocation to our members that need it the most.

But effective climate policy action must be grounded in accurate and reliable indicators—and right now these face serious limitations. For example, many countries are not measuring and reporting emissions data on a timely basis. "If you don't measure it, you can't manage it," as they say. This applies to emissions as well as many economic and financial aspects of climate change.

Both policymakers and investors face a lack of reliable and comparable indicators – especially on the transition to more sustainable business models. While a growing number of firms set emission reduction targets for themselves, the vast majority still do not provide this information. Data gaps are particularly large for small and medium enterprises and for firms in emerging markets.

To make progress, harmonization will be essential. A part of the problem is the multitude of existing frameworks currently used by firms and financial institutions. There are more than 200 frameworks, standards, and other forms of guidance on sustainability reporting and climate-related disclosures across 40 countries. This undermines consistency and comparability.

Therefore, I see an urgent need to strengthen the climate information architecture. There are three building blocks needed to support this: (i) high-quality, comparable, and timely indicators; (ii) a harmonized and consistent set of climate disclosure standards; and (iii) a broadly agreed upon global taxonomy. This taxonomy must be flexible enough to recognize the complex efforts taken by companies to transition to a climate-sustainable business model. The statistical community also has the responsibility of integrating climate change data into international statistical standards and making the resulting data available to the public.

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*Opening Remarks at the 9th IMF Statistical Forum, November 17, 2021.
* Li Bo, Deputy Managing Director, IMF.

Such a harmonized, timely, and reliable set of data can help unlock action by both the public and private sector. Policymakers can properly develop fiscal, monetary, and financial policies and address physical, transition, and financial risks. The private sector can assess climate exposures, and investors can facilitate the flow of capital towards climate-sustainable investments.

Fortunately, we have grounds for optimism. Extensive work has already been done to bridge the data gaps on both macro and micro levels. For instance, the Network for Greening the Financial System has been working on identifying and prioritizing data needs. For its part, the IMF launched the Climate Change Indicators Dashboard earlier this year. The Dashboard provides timely and standardized climate change-related experimental indicators. It improves the frequency and timeliness of some existing climate change data, bringing their publication to par with the general pattern in macroeconomic statistics. Equally important, it aims to ensure a common methodology to make data comparable across countries. This will serve as a framework for the new G20 Data Gaps Initiative that is being prepared and would set climate data as a high priority.

The IMF Dashboard is a truly international statistical initiative and a product of close cooperation with other international organizations and institutions – the OECD, the World Bank Group, the United Nations, the European Commission, Eurostat, the Food and Agriculture Organization, the International Energy Agency, and the National Oceanic and Atmospheric Administration, among others. The close cooperation avoids duplication, maximizes synergies with other existing climate-related workstreams, and leverages the Fund's leadership in relevant statistical methodologies.

Despite the progress in bridging data gaps, more work still needs to be done. Consistent, timely, and uniform implementation of internationally agreed sustainability reporting standards are necessary. Here, strong international commitment will be needed, while considering regional, institutional, and legal specificities. Moreover, implementation challenges for emerging and developing economies—and for many small and medium enterprises—will have to be considered carefully. At the same time, it is important to continue to develop statistical standards and methodologies, building on the existing statistical macroeconomic frameworks, including the System of National Accounts, the Balance of Payments and International Investment Position Manual, and the System of Environmental Economic Accounting.

These considerations motivate the theme of this year's Statistical Forum, where we will aim to advance our understanding of the measurement of climate change and its economic and financial impacts. Among the questions to be considered this year are: (i) How is economic activity affecting the planet, and what are we doing to combat rising temperatures?; (ii) Where are the financial risks?; (iii) What fiscal policies are governments responding with?; (iv) Where are the data gaps?; and (v) What is the role of economic and financial statistics in combating climate change?

Over the next two days, we will learn what policymakers, experts, academics, statisticians, private sector executives, and international organizations are doing to answer these questions. Today's presentations will focus on the economic and financial dimensions of climate change, including its cross-border implications. We also have a session with three interesting country cases.

Tomorrow, Gabriel Quirós-Romero, Deputy Director of Statistics Department will kick off the day with a presentation of the IMF Climate Change Indicators Dashboard. We will also have two high-level panel discussions on key issues in measuring climate change in macroeconomic statistics and the role of these statistics in informing decision makers and the public.

Finally, Johan Rockström, Director of the Potsdam Institute for Climate Impact Research, will deliver the keynote speech tomorrow afternoon. Many of you already know about Professor Rockström's impressive research on planetary boundaries, featured in a fascinating recent

Netflix documentary.   Professor Rockström's keynote speech will be followed by a one-on-one discussion with the IMF's Managing Director, Kristalina Georgieva.

I hope that you will enjoy the Ninth IMF Statistical Forum and that this event will help to further ignite collaboration among participants as we tackle climate change. I look forward to the discussions and your ideas.

Four Climate Questions for Central Bankers*

By Steven Rothstein[*]

Central banks have an important role to play in protecting our financial systems. As the guardians of monetary policy and supervisory practices in their respective nations, they need to fortify our economic systems against the ever-growing threat of climate risk. After all, we know more about the risks that the climate crisis is creating within our economies than we knew about the subprime loan crisis that nearly crippled the financial system in 2008.

Climate change is not only limited to the physical threats of increasing temperatures, rising sea levels and intensifying storm systems that are already impacting our planet and our people. It also presents a growing risk to our financial markets and institutions. This is not a problem that a business-as-usual approach can solve.

If a banker or a bank regulator suggested they did not need to plan for another pandemic or cyberattack, they would be met with criticism that they were not meeting their fiduciary responsibility. Potential exposure to climate risk is bigger and more systemic. Our research from the past two years found that the syndicated lending of 28 of the largest US banks is exposed to physical risk. This exposure could cost more than $250bn annually, approaching 10% of these banks' loan portfolios. At the same time, more than half of bank lending is exposed to transition-related climate risk.

During the past year, record-setting floods, fires and storms caused $145bn in damages in the US. We've seen early progress from financial regulators acknowledging the systemic financial risks of climate change, in particular the Federal Reserve's move to identify climate as a near-term 'financial stability risk', and the Office of the Comptroller of the Currency's proposed principles for climate-related financial risk management. However, the stark reality is that, despite all we know about climate risk and its impacts, there is simply not enough being done by regulators and financial institutions to address it.

There are four important questions that central bank officials must ask themselves. First, has the central bank publicly recognised the systemic nature of the climate crisis and its impact on financial market stability? This recognition should take the form of a statement from an agency chair or an agency-issued report to underscore the risks posed to financial markets.

Second, is the central bank taking steps to integrate climate change into prudential supervision of the financial institutions in its jurisdiction? Bank regulators have explicit responsibilities to supervise the risks that financial institutions take on. Consistent with this authority, financial regulators should integrate climate change into their prudential supervision of banks, insurance companies and other regulated financial institutions.

We admire the leadership of several central bankers who have already taken steps and urged others to assess the climate risk to financial markets, requiring scenario analyses by the banks and other financial institutions they supervise. We believe they should also outline plans for conducting scenario analysis and climate stress tests on these institutions to measure the impact of climate-related shocks and consider enhancing capital and liquidity requirements to integrate climate risk.

Third, what is the central bank's perspective on climate disclosure? The first step in managing a problem is measuring it. We believe that financial regulators should include climate disclosure requirements for companies in their annual financial filings. Clear, consistent and comparable

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reporting is required to ensure that financial markets can price and act on the physical and transitional risks and opportunities from climate change.

Finally, is the central bank's staff versed in climate risk management? Climate change is altering the landscape of financial regulation and bank examiners should be trained on the related physical and transition risks. It is important that central bank staff throughout each agency are trained on these risks. This is one of the most straightforward ways to guarantee the safety and soundness of our financial systems.

It is also crucial to build capacity for smart decision-making on climate change by coordinating action by financial regulators at the global, national and local levels.

Each central bank has a critical role to play in ensuring the resilience of national economies, as well as the global economy, which has already been weakened by the pandemic and is now threatened by future climate shocks. The safety and soundness of financial institutions, and our planet, requires immediate action by regulators worldwide.

Working Paper

Exchange Rate Exposure and its Determinants in China*

By HE QING, LIU JUNYI AND ZHANG CE*

Abstract: *This paper investigates the foreign exchange rate exposure and its determinants using the data of all firms listed on the Chinese stock market from 2005 to 2018. We find significantly linear and nonlinear exposures to bilateral as well as multilateral foreign exchange rates. Our temporal study also shows that considerably more Chinese firms were exposed to exchange rate fluctuations after the major exchange rate reform in 2015. We find a negligible role played by international operations of firms in explaining exposures. The level of exchange rate exposure is primarily explained by variables that are proxies for a firm's hedging costs. Larger firms, or firms with less leverage ratio, tend to have smaller exposures. Exposure is found to increase with a firm's growth opportunity. Last but not least, we find that leverage ratios and growth opportunities impact more significantly on exposures for firms with separation of control and cash flow rights.*

1. Introduction

It is well recognized that changes in the rate of exchange can affect a firm's value. Nevertheless, the relationship between exchange rate changes and firm's stock return remains a contentious issue, as a significant correlation between these variables has only been found in a small proportion of enterprises in developed countries (Jorion, 1990; He and Ng, 1998; Williamson, 2001; Bartram, 2004). An increasing number of studies aim to explain the so-called "foreign exchange exposure puzzle" (Bartram et al., 2010; Snaith et al., 2017).

In this paper, we add to this literature by presenting a comprehensive study of a large sample of Chinese public firms. The case of China is of academic interest for several reasons. First, while multiple studies have examined the foreign exposure of firms in developed countries, little is known about their counterparts in emerging market economies; and China is a large and important emerging economy where the foreign exchange exposure has yet to be thoroughly investigated. Second, exploration of foreign exchange exposure in an emerging economy such as China will offer some distinct perspectives. For instance, corporate hedging activities have long been regarded as crucial for managing exchange rate risks in developed countries.[1] Within China's underdeveloped financial system, however, hedging instruments are still limited. Whether and

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[1] Please see Flood and Lessard (1986), Logue (1995), Geczy et al. (1997), Bodnar et al.(1998), Chowdhry and Howe (1999), Allayannis and Ofek (2001), Allayannis et al. (2001).

how hedging needs influence exchange rate exposure is therefore an intriguing issue to explore. Third, the corporate ownership structure in China differs from that of many developed countries[2], as corporate ownership in China is highly concentrated in a small group; more distinctly, controlling rights of the largest shareholder are greater than the cash flow rights (He and Rui, 2016; Tan and Tang, 2016; Zheng et al., 2018). This feature we explained below will add insights on the determinants of exchange rate exposure.

Using the data from July 21, 2005 to December 31, 2018, we empirically estimate and find statistically significant linear and nonlinear foreign exchange rate exposures of all Chinese public firms. Specifically, 5.6 percent more Chinese public firms show greater sensitivity to nonlinear exposures compared with linear exposures. In addition, considerably more firms were exposed to exchange rate fluctuations after the August 2015 reform: 26.2 percent of firms respond to nonlinear risks of the US dollar after the milestone exchange reform in 2015, whereas merely 1.4 percent respond to those risks before the reform.

We also examine whether a firm's exchange rate exposure is determined by its international operations and hedging needs. We find an insignificant role played by international operations in explaining a firm's exposure, as its proxy, the variable of foreign sale ratio, is marginally correlated with exposures. Firms that have high costs of hedging, however, are found to be more vulnerable facing the volatility of foreign exchange rates. The empirical results show that small firms, or firms with high leverage, or firms with a low book-to-market ratio, are more exposed to exchange rate fluctuations, though these effects are less pronounced prior to the exchange rate reform in 2015.

To address possible endogeneity issues, we conduct three additional tests. First, we implement a dynamic panel GMM using lagged values as the instruments. Second, we employ a two-stage least squares (2SLS) model using the previous three years' industry average of explanatory variables as instrument variables. Third, we employ event studies to examine whether the reactions of stock price to exchange rate shocks vary with potential determinants of exchange rate exposures. Stock market reactions to exchange rate shocks are unlikely to influence a firm's foreign sales and other characteristics, and may consequently alleviate the endogeneity issue (Bartov et al., 1996). Our main results survive those tests.

Finally, we examine whether the separation of control and cash flow rights plays a role in determining foreign exchange rate exposures. One distinct feature of Chinese corporations is that in most firms that have controlling shareholders, the controlling rights of the largest shareholder are much larger than her cash flow rights (He and Rui, 2016; Fang et al., 2017, Zheng et al., 2018; He et al., 2019). The separation of control and cash flow rights enables controlling shareholders to engage in a variety of self-serving transactions, extracting private benefits of control from the firms that they run (Shleifer and Vishny, 1989; La Porta et al., 1999; Djankov et al., 2008; He et al., 2019). The more likely controlling shareholders extract the private benefits of control, the less likely she or he pursues the maximization of firm value (Bebchuk and Roe, 1999; La Porta et al., 2002; Claessens et al., 2002). Because entrenchment effects lower firm's sensitivity to cash flow, we expect that highly entrenched firms would be less likely to take risk management strategies to hedge against exchange-rate volatility. As a result, firms with the separation of control and cash flow rights are more exposed to exchange rate movements when there are greater costs of implementing hedging, i.e. high leverage ratio or low book-to-market ratio. The empirical results strongly support this hypothesis.

Our study contributes to the foreign exchange exposure literature in the following ways. First, to the best of our knowledge, this is the first academic attempt to comprehensively investigate foreign exchange rate exposure in China. Second, our evidence specifically suggests that in

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[2] In most developed economies, corporate ownership and control are often separated and as such, strong legal mechanisms are needed to protect the owner's interests since the primary concerns are the conflicts of interests between the owners (principals) and managers (agents) (Jensen and Meckling, 1976).

emerging market economies, China included, high costs of hedging may prevent firms from effectively managing foreign exchange exposures. Perhaps, a comprehensive reform of financial markets in emerging countries is therefore necessary to cope with growing exchange rate fluctuations. Last but not least, we find that a particular agency cost, entrenchment of controlling shareholders, reduces a firm's incentive to hedge against exchange rate volatility. Our study hence enriches the literature by identifying a linkage between controlling shareholders' risk attitude and exchange rate exposure in countries where corporate ownership is highly concentrated.

The remainder of the paper is organized as follows: Section 2 reviews the institutional background of our investigation and the literature relevant to it; Section 3 describes the data and our methods of research; Section 4 presents our empirical results; Section 5 discusses some robustness checks, and Section 6 concludes the paper.

2. Institutional background and literature review
2.1 Institutional background

The RMB exchange rate began fluctuating in 2005, when China undertook its first major exchange rate reform. Before then, the government had intentionally pegged the rate of the RMB to the value of the USD. From 1994 to 2005, 1 USD was equivalent to 8.28 RMB. With the value of their currency held constant, Chinese firms of this period were minimally exposed to the risks associated with rate changes.

But on July 21, 2005, the People's Bank of China (PBOC), the central bank of China, announced an end to the RMB/USD peg and adopted a managed floating exchange rate regime that made use of a "reference basket" of currencies.[3] The RMB was allowed to fluctuate against the US dollar with a bandwidth of + or - 0.3 percent around the central parity.[4] In May 2007, the PBOC widened the bandwidth of the RMB against the USD from 0.3 percent to 0.5 percent, so as to hasten the marketization of the RMB exchange rate. However, the market oriented reform was interrupted by the 2008-2009 global financial crisis. During the crisis period, the RMB was de facto pegged to the USD at the rate of 6.83 RMB per USD. This reform was resumed on June 19, 2010, when PBOC made yet another announcement, declaring that its policy would be "to proceed further with the reform of the RMB exchange rate regime and to enhance the RMB's exchange rate flexibility," and re-emphasized that the RMB exchange rate was meant to "reflect market supply and demand with reference to a basket of currencies." The trading bandwidth was further widened to + or – 1 percent in 2012, and + or -2 percent in 2014.

Whether or not the PBOC has made use of a managed floating exchange rate for the RMB, the central bank has historically maintained a critical role in determining the RMB exchange rate. The central parity rate barely moves from day to day as a result, even though the spot exchange rates always approach the edge of the bandwidth. One of the goals of the PBOC's intervention in the foreign exchange market is to moderate the volatility of the RMB, particularly to lean against the appreciation of the RMB. China's foreign exchange reserves consequently increased from USD 733 billion in 2005 to around USD 4 trillion in 2014. Thanks to the PBOC's effort, the RMB/USD exchange rate was significantly less volatile than other foreign currencies under managed floating exchange rate regimes despite the persistence of market forces in continuing push up the value of the RMB against the USD. As shown in Figure 1, from July 2005 to July 2015, RMB/USD exchange rate had appreciated by 26 percent, an increase so gradual and steady that it might be called monotonous. During the financial crisis of 2008-09, however, the RMB/USD exchange rate hardly changed while those of the RMB/EURO, RMB/yen, and RMB/pound fluctuated a lot.

To speed up the marketization of the RMB exchange rate, on August 11, 2015 (hereafter the date of the 811 Reform), the PBOC announced its intent of "[i]mproving quotation of the central parity

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[3] In a speech in 2005, the then-governor of the PBOC, Zhou Xiaochuan, said "…the basket should be composed of currencies of the countries to which China has a prominent exposure in terms of foreign trade, external debt, and foreign direct investment."
[4] There is a daily central RMB/US parity announced by China Foreign Exchange Trading System (CFETS), an affiliate of the PBOC.

of the RMB against the USD[5]" targeted at the central parity quotation system. Under the new reform, the daily central parity rate set by the China Foreign Exchange Trading System (CFETS) before the market opens would be based on the closing rate of the inter-bank foreign exchange rate market the previous day, supply and demand in the market, and price movement of major currencies. The CFETS quickly launched its own foreign exchange rate index (CFETS Exchange Rate Index) in December 2015 and hence officially established an updated version of a managed floating exchange rate framework that allows for two-way fluctuations of the RMB based on the central parity, and that better responds to the supply-and-demand conditions of the foreign exchange market.

Occurring in 2015, the 811 Reform coincided with a turning point for the RMB/USD exchange rate, as well a period of profound volatility in the global financial market. In the following years, the foreign exchange market of China witnessed a significant increase in volatility of the exchange rate of the RMB against major currencies. Figure 1 presents the trends of the bilateral exchange rates between each one of the five foreign currencies and the RMB during the sample period. Overall, the RMB had appreciated against the USD until the reform, then depreciated for around two years; in 2017 it finally began to appreciate again. Given the pegged bilateral exchange rate between the USD and the Hong Kong dollar (HKD), it would be reasonable to expect the same pattern of historical fluctuation from the RMB and the HKD. It is, however, surprising to observe the two distinguishable patterns of RMB/Euro and RMB/Pound.

In particular, after 811 Reform, the RMB had appreciated relative to the euro while depreciating relative to the pound. Additionally, the 2008-09 financial crisis shook the RMB/euro exchange rate to a greater degree than it shook the RMB against the pound. The RMB/yen rate showed a similar pattern to that of RMB/euro during the 2008-09 financial crisis before subsequently diverging from that pattern. Before the "811 Reform", the foreign exchange rate index had trended steadily upward. After it came into effect, the index took a precipitous dive and eventually stabilized. Among the five foreign currencies, the RMB/USD and the RMB/HKD demonstrated the least volatility.

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[5] Available at http://www.pbc.gov.cn/english/130721/2941603/index.html.

Figure 1: The bilateral foreign exchange rates (five foreign currencies) and the foreign exchange rate index
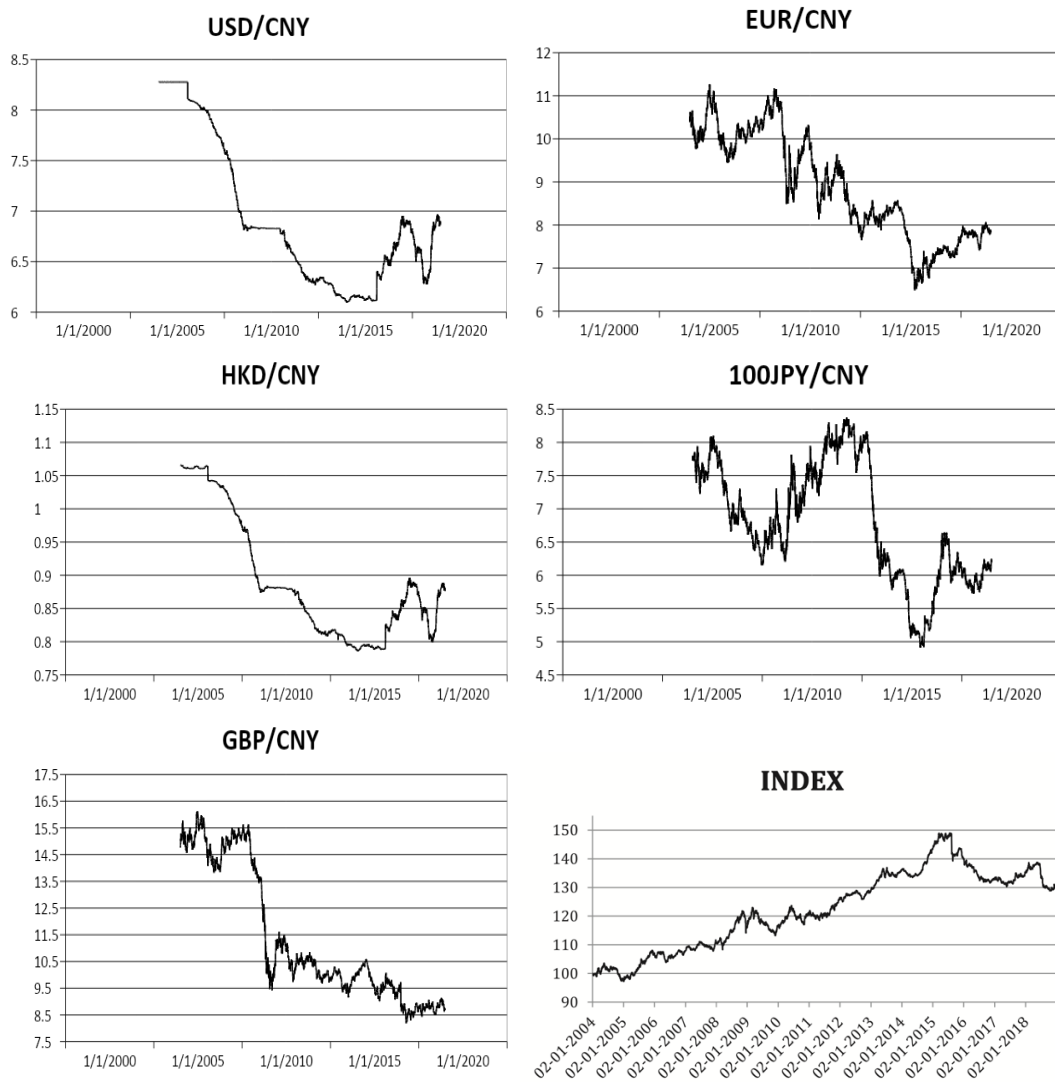
Many Chinese public firms have suffered losses caused by the unexpectedly volatile RMB exchange rate. Reuters reports that on October 10, 2017, nearly 1,400 listed Chinese manufacturers recorded currency-induced losses during the first six months after the 811 Reform. More firms turned to financial derivatives to hedge the increased exchange rate fluctuations, and only to find out that, unfortunately, China's underdeveloped financial market failed to fully arm domestic firms against the volatilities.

2.2 Literature review

Foreign exchange rate exposures have increasingly been explained as the rising volatility of the exchange rate market stemming from the ever-greater degree of economic linkage among countries. The expansion of multinational corporations in combination with the increasingly specialized subdivision of industry chains places further pressure on the exchange rate market, mainly due to the unprecedented volume of foreign currency denominated transactions. Even a

firm that does no business abroad may need to adjust its activity to indirectly tackle possible foreign exchange rate risks faced by the whole industry (Hodder, 1982).

Jorion (1990), among the first to study these risks, empirically estimates foreign exchange rate exposure by analyzing the influence of exchange rate risks on a sample of the US firms. The line of the literature was further extended by the studies on a single nation (He and Ng, 1998), and studies that traced the influence of those risks across countries (Bartram and Karolyi, 2006; Doidge et al., 2006). Most empirical results, however, have found scant support for the existence of a significant effect both economically and statistically of exchange rate risks on firm value. Jorion (1990), for instance, claims that only 5.2 percent of US firms were exposed to foreign exchange rate risks in a study of 287 US multinational corporations. He and Ng (1998) also report that no more than 26.3 percent of Japanese multinational corporations whose foreign income is greater than 10 percent of their total income were significantly exposed to foreign exchange rate risks.

While most aforementioned studies are focused on a linear relationship between exchange rate risk and firm value, several researchers suggest that the relationship could be nonlinear (Bartram and Bodnar, 2012; Chaieb and Mazzotta, 2013). The nonlinearity may result from the asymmetric transitivity of exchange rates, the time lag of asset price change, or some financing arbitrage. For instance, Christophe (1997) argues that the nonlinear competitive effects result from firms' tendency toward delayed response to market changes[6]. Bartram and Bodnar (2007) show that financial hedging plays a key role in alleviating foreign exchange rate exposures. Most hedging activities are one-sided. Accordingly, the difference in how firms expect the foreign exchange rate to change will cause their respective hedging costs to vary. This may introduce nonlinearities in the relationship between firm value and the exchange rates.

Although nonlinear functions relax the assumption of the linear exposure, it is still challenging to justify a specific functional forms of linearity (Bartram and Bodnar, 2012). Chaieb and Mazzotta (2013) find that higher exposures of firms were captured when assuming the time variation relationship between firm value and exchange rates. Bodnar et al. (1998) report that 22 percent of firms use foreign exchange rate options to manage exchange rate risks; consequently, suggest that the nonlinearity relationship depends on the financial strategy of option use. Assuming different generic types of nonlinear functions, Bartram (2004) finds that nonlinear exposure are substantially more significant than linear exposure in a large sample of German nonfinancial corporation. Koutmos and Martin (2003) and Priestley and Ødegaard (2007) find that the exposures of public firms are boosted by the inclusion of the nonlinearity factor that originates from the asymmetric impacts of appreciation and depreciation, respectively.

In addition to measuring firms' exposure to the risks of foreign exchange rates, some studies have investigated what factors determine those exposures. Along with others, Jorion (1990) reports that larger foreign sales are correlated with higher exchange rate exposure since foreign income raises the sensitivity of firm value to the volatility of the foreign exchange rate (Choi and Prasad, 1995; Doidge et al., 2006; Hutson and Laing, 2014). Financially distressed firms may have limited ability to manage exchange rate exposure, which may make their fundamental value sensitive to the cash flow that is subject to the volatility of exchange rate (Wei and Starks, 2013). Firms' future prospects are another important factor in exchange rate exposure. A fluctuating exchange rate disturbs firms' future cash flow and discount factor, so growing firms that rely heavily on cash flow may be more vulnerable to exchange rate risks. Chaieb and Mazzotta (2013) show that both macroeconomic variables such as GDP, inflation and monetary policy stance, and sectoral idiosyncrasy influence exchange rate exposure.

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[6] New competitors will usually enter the market as the domestic currency depreciates, and the incumbents may be reluctant to leave the market due to the heavy sunk costs they have already incurred. They thus endure the fluctuation of foreign exchange rate to compete with newcomers. The sunk costs fluctuate with the foreign exchange rate—sometimes to such an extreme extent that incumbents may have to exit the market.

As the financial derivatives market has been booming internationally, the attitude toward and extent of using hedging tools has profoundly affected exchange rate exposure. He and Ng (1998), for example, find that while firms that are large in terms of asset size enjoy lower unit hedging cost, small ones are better incentivized to hedge against exchange rate risks. By contrast, Pantzalis et al. (2001) show that larger multinational corporations that are supposed to be exposed to greater exchange risks end up having smaller ones, which is attributable to their effective hedging activities. Wei and Starks (2013) conclude that financially distressed firms are exposed to exchange risks because they have limited access to hedging channels.

3. Data and research design

Our sample covers all Chinese public firms from July 21, 2005 to December 31, 2018.[7] Given the decisive influence of the 811 Reform, we divide the main sample into two subsamples. Further considering that the market oriented reform was interrupted by the 2008-09 financial crisis and resumed in July 2010 (PBOC, 2010), we generate two sub-periods: the first spans from July 21, 2005 to June 18, 2010; the second spans from June 19, 2010 to August 11, 2015[8]. Analyzing sub-periods help us to understand structural changes in the impacts of exchange rate fluctuations on the firm's value.

While most existing research tends to favor the trade-weighted foreign exchange rate index, we also choose the US dollar as a foreign currency variable as it has a dominating impact on the performance of Chinese economy. This approach allowed us to explore foreign exchange rate exposures in a more comprehensive way.[9] We pick the US dollar (USD), the euro (Euro), the Japanese yen (Yen), the Hong Kong dollar (HKD), the British pound (Pound), and the foreign exchange rate index weighted by monthly bilateral-trade volume in the five foreign currencies.[10] The risk-free rate in the sample is the 3-month benchmark deposit rate released by the PBOC, the market index is the CSI300 (China's main stock market index), and all exchange rate data are referenced to the exchange rate released by the PBOC. All data are daily and their sources are RESSET and the PBOC.[11]

3.1 Measures of foreign exchange rate exposures

Empirical literature has investigated almost linear exchange rate exposure. Although it appears reasonable to assume the nonlinear relationship between exchange rates and firm, we are agnostic about the true nature of the nonlinearities. Motived by these potential shortcomings in the empirical studies, we utilize both linear and nonlinear exchange rate exposures estimations.

3.1.1. Linear exchange rate exposures

Foreign exchange rate exposure is largely defined as how responsive a firm's value is to the fluctuation of the foreign exchange rate; quantitatively, it is reflected in the change of stock return of a firm in response to the change of foreign exchange rate, provided that average market return is controlled for (He and Ng, 1998; Bartram, 2004; Bartram and Bodnar, 2007; Hutson and Laing, 2014). Following the literature, we empirically assessed foreign exchange rate exposure employing the reduced-form regression model as below:[12]

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[7] Chinese public firms here are referred to as A-shares (a.k.a. domestic shares) companies that are mainland China-based companies listed on the Shanghai Stock Exchange and the Shenzhen Stock Exchange.

[8] To further justify the split of the sample, we also test for structure break points for both August 11, 2015 and June 19, 2010 in the regressions. We don't report these results for brevity.

[9] On January 4, 2006, the PBOC had authorized a foreign exchange trade system & national interbank funding center to release the central parity rates of the Chinese RMB against the US dollar, the euro, the Japanese yen, and the Hong Kong dollar, and requested the rates be the spot exchange rates and over-the-counter exchange rates of any interbank transactions; the British pound joined the club around four months later on August 1, 2006. We excluded other foreign currencies in the sample owing to the dominant volume of those five main ones in the foreign exchange rate market of China.

[10] The foreign exchange rate index used in the sample was constructed in the same way that the Chinese foreign exchange trade system & national interbank funding center do for the foreign exchange rate index, which is trade-weighted using monthly bilateral trade data.

[11] The information of RESSET is available at: http://www.resset.com/enindex

[12] We also follow Choi and Jiang (2009) using the Fama-French three factors to estimate foreign exchange rate exposure. Similar results are obtained (see Table 9).

$$R_{it} = \alpha_i + \beta_i R_{mt} + \gamma_i R_{st} + \varepsilon_{it} \qquad (1)$$

where R_{it} is the logarithm of stock return in excess of the risk-free rate, R_{mt} is the return of the stock market index in excess of the risk-free rate, and R_{st} is the logarithm of the change of the exchange rate index (R_{st} is positive when the exchange rate variable rises). The exchange rate variable is presented in the form of foreign currency per RMB, meaning that the RMB appreciates as R_{st} rises. The degree of foreign exchange rate exposure is hence reflected in the coefficient, γ_i, associated with R_{st}; positive γ_i indicates higher stock return resulting from appreciation of the RMB, and negative γ_i suggests that appreciation of the RMB leads to lower stock return of firms. One way our approach distinguishes itself from the regression method in Bartram et al. (2010), however, is through its use of the GARCH (1,1) model, which better captures the characteristics of concentrated volatility of the stock market and exchange rate market (Koutmos and Martin, 2003; Berndt et al., 1974).

3.1.2. Nonlinear measures of foreign exchange rate exposure

Since it is difficult to justify a priori functional form of the nonlinear relationship, we adopt some exemplary and generic functional forms suggested by Bartram (2004). More specifically, we consider the functional forms with the inclusion of nonlinear exposures originating from (i) the asymmetric effects of appreciation and depreciation and (ii) the nonlinearity of volatility of foreign exchange rates.

First, it may be realistic to expect that firms react different in response to the currency appreciation and depreciation. To capture this the asymmetric effects, we conducted the sign bias test in regression (2)

$$\frac{\varepsilon_{it}}{\sigma_{\varepsilon_{it}}} = \mu_{it} + \tau_i Sign_t + \varphi_i Sign_t R_{st} + \omega_i (1 - Sign_t) R_{st} + \theta_i \qquad (2)$$

where ε_{it} is the residual from equation (1), and $\sigma_{\varepsilon_{it}}$ is the standard error of ε_{it} ; $Sign_t$ is a dummy variable that is 1 if R_{st} is negative (RMB depreciates); and $Sign_t$ equals 0 otherwise. This model is a diagnostic residual test that examines the potential misspecification of the linear regression model (equation 1). Including the variable, $Sign_t$, can test the impact of positive and negative exchange rate movements on firm value that are not captured by the linear model.

Second, residual, ε_{it} of equation (1) has excluded the effects caused by the linear variations in exchange rate. Alternatively, we can estimate the residual, θ_{it}, from a regression using the market index as the only regressor. Specifically, we ran regression (3) to screen out the effects caused by variations of the market index (Bartram, 2004):

$$R_{it} = \alpha_i' + \beta_i' R_{mt} + \varepsilon_{it}' \qquad (3)$$

Then, we use θ_{it} to replace ε_{it} in equation (2) to examine the distinctions between positive and negative shocks on firm values. Note that there is no exchange rate variables in equation (3), θ_{it} should be more sensitive than ε_{it} to the exchange rate movements.

Finally, following Bartram (2004), we adopt the cubical function to capture the nonlinear property of exchange change rate movement. The cubical function forms can estimate a convex exchange rate exposure, consistent with the idea that large exchange rate movements have a very strong effect on firm value, while small exchange rate movement exert few impacts on firm values. The regression model is as followed:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \gamma_i R_{st}^3 + \varepsilon_{it} \qquad (4)$$

where R_{st}^3 is the cubical function of the foreign exchange rate.

3.2 Determinants of exchange rate exposure

To illustrate the potential determinants of the exchange rate exposure, we employ a sample model following Choi and Prasad (1995) and Bodnar et al. (2002). By definition, exchange rate exposure ($exposure_i$) can be expressed as:

$$exposure_i = \frac{dlnFV_{it}}{dlne_t} = \frac{dln\pi_{it}}{dle_t}$$

Thus, exchange rate exposure is equal to the firm value (FV_{it}) return divided by the percentage change of exchange rate movement (e_t). Assuming tax, discount and growth rates to be constant, the equation becomes the derivative of the profit (π_{it}) versus exchange rate return. A firm's profit is the sum of its domestic profit and its foreign profit, and each part equals sales revenue (Rev_{it}^d, Rev_{it}^f) minus costs ($Cost_{it}^d, Cost_{it}^f$) including both fixed cost and variable cost. The exposure can be expressed in terms of revenue and cost:

$$exposure_i = \frac{dln(Rev_{it}^d + Rev_{it}^f - Cost_{it}^d - Cost_{it}^f)}{dlne_t}$$

Additionally, Hodder (1982) consider exchange rate expose as the function of firm's net wealth, which is the assets minus liabilities. In this definition, we can re-express the exposure as:

$$exposure_i = \frac{dlnFV_{it}}{dlne_t} = \frac{dlnNW_{it}}{dlne_t} = \frac{dln(Asset_{it}^d + Asset_{it}^f - Lib_{it}^d - Lib_{it}^f)}{dlne_t}$$

Where $Asset_{it}^d$ and Lib_{it}^d are dominated in local currency, and $Asset_{it}^f$ and Lib_{it}^f are in foreign currency. Combining both equations, exposure can be expressed as a function of domestic and foreign profits, revenue, cost, and assets and liabilities in both local and foreign currency.

This functional form presumes that exchange rate risks faced by a firm is not fully hedged, and demonstrated that a firm's exposure arises from its international operations, i.e. foreign revenue, costs and assets. If there is no hedging, we can expect that a firm's exposure is inevitably associated with foreign revenue, foreign debt and assets (Jorion, 1990; He and Ng, 1998; Hutson and Laing, 2014).

Proxies of international operations are likely to be the important determinants of exchange rate exposure in Chinese listed firms. China has experienced an explosive growth in international trade since the accession to the World Trade Organization (WTO) in 2001. By the end of 2018. China has been the world's largest exporter and second largest importer. Many Chinese firms have foreign subsidiaries via either green or brown foreign direct investment. Moreover, in the aftermath of 2008-09 financial crisis, many Chinese firms raised funds from international financial market. The high portion of foreign debts had subsequently exposed the firms to an unexpectedly foreign exchange risk. To quantify the level of international operations of Chinese firms, we use the following variables suggested by the literature: foreign sales to total sales, foreign loans (loans denominated by non-RMBs) to total loans, foreign subsidiary (a dummy variable, which takes the value of one if the firm has at least one oversea subsidiary, and zero otherwise). As detailed trade information is unavailable at firm level, the effects of foreign sales on exposure may be unclear[13]. Following Wei and Starks (2013), we set $FSales_i^+$ ($FSales_i^-$) as

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[13] The exchange rate exposure of exporters is different from that of importers. Firms have above (below) average foreign sales are more likely to be net exporter (importer) (Wei and Starks, 2013)

the positive (negative) difference between a firm's foreign sales ratio and the average ratio in the industry during the year. It is expected that exposures increase with $FSales_i^+$ (net exporters) and decreases in $FSales_i^-$ (net importers).

With the increasing globalization of product and sales market, more recent studies show that many firms involve a range of hedging strategies in alleviating exchange rate risks (Mello et al., 1995;Huston and Laing, 2014). It is well established that extensive use of hedging can diminish a firm's exposure to exchange rate variations. As a result, a firm's incentive to hedge against currency risks is also important determinant on its exposure (He and Ng, 1998; Bartram, 2004; Hutson and Laing, 2014).

To examine whether Chinese firms' exchange rate exposures are significantly related to their hedging incentives, we consider a variety of variables that existing studies find to be important in explaining a firm's hedging needs. The size of firms is considered in nearly all studies of foreign exchange rate exposures (He and Ng, 1998; Bartram, 2004; Dominguez and Tesar, 2006; Hutson and Laing, 2014). Nance et al. (1993) show that larger firms are more motivated to hedge against risks including foreign exchange rate related ones, and the working of economies of scale may also reduce hedging costs. We therefore adopt the logarithm of a firm's total assets as a proxy for its size, and predict a negative relation between the size of a firm and its foreign exchange rate exposure.

Financial distress of firms generates ambiguous impacts on its exchange rate exposures. On the one hand, financially troubled firms are more vulnerable to the volatility of foreign exchange rates[14]. He and Ng (1998) also find that financially distressed firms are more motivated to hedge against and hence be exposed less to the foreign exchange risk. On the other, financial distress may prevent firms from effectively hedging against exchange rate risks for lack of the needed resources. Wei and Starks (2013) show that financial distressed firms have limited ability, or inability to smooth out the unfavorable movements of exchange rates because of high hedging costs[15]. These firms would therefore face increased cash flow volatility and end up being exposed to pervasive foreign exchange rate risks (Hutson and Laing, 2014). The latter view will be more relevant to the case of China, as there are limited hedging tools available in China (He et al., 2016). We use two variables to measure a firm's probability of financial distress: the leverage ratio and long-term debt ratio, and expect their positive correlations with exchange rate exposure.

Firm's liquidity serves as a buffer against the volatility of foreign exchange rate for its function of lowering the expected cost of financial shocks. For example, Nance et al. (1993) demonstrate that firms with more liquid assets in the short run are less likely to stumble into financial trouble. Froot et al. (1993), suggest that firms with high short-term liquidity may lack incentives to conduct any hedging activity, and may face even more serious foreign exchange rate risks as a result. Consistent with this view, several empirical studies have found that firms with high levels of liquidity are more exposed to exchange rate movements (He and Ng, 1998; Bartram, 2004). We use the ratio of current asset to current liability (quick ratio) as the proxy of short-term liquidity, and its correlation with foreign exchange rate exposures is expected to be positive.

The potential underinvestment is more of a problem in firms with greater prospects of growth (Froot et al., 1993). A firm with good growth opportunity will have a greater incentive to employ financial derivatives to hedge against the underinvestment costs (Froot et al., 1993; He and Ng, 1998). High costs of external capital, however, may diminish a growth firm's ability to effectively hedge exchange rate movements (Wei and Starks, 2013). Provided the underdevelopment of the financial derivative market in China, exchange rate movements may cause large cash flow

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[14] Smith and Stulz (1985) find that hedging activity reduces the probability of a firm's bankruptcy, and that firms hungry for credit have strong incentives to conduct hedging.
[15] Financial distressed firms have difficulties in accessing the external capital market (Opler and Titman, 1994; Molina and Preve, 2012). In addition, hedging costs relate positively with a firm's creditworthiness. Financial distressed firms have significantly difficulty finding financial institutions willing to sign financial derivative contracts. (Allayannis and Ofek, 2001)

volatility for growth firms due to their inability of hedging underinvestment costs. We follow Geczy et al. (1997) by using book-to-market value of equity (BM) to proxy a firm's prospects. A lower BM ratio indicates a greater potential for growth and is expected to negatively correlate with foreign exchange rate exposures.

Finally, foreign exchange rate exposures may also depend on idiosyncratic characteristics of sectors where firms price the products, build the volatility of foreign exchange rates into the output price, and hedge the foreign exchange rate risks that they may run (Allayannis and Ihrig, 2001; Bartram et al., 2010). Bartram (2004) also empirically reports significant impact of sector-specific variables on foreign exchange rate exposure. In equation (5), we thus classify firms into sectors based on the "guidelines for the industry classification of listed companies (2012)" issued by the China Securities Regulatory Commission (CSRC).

We employ the following regression model to test above hypotheses:

$$|\gamma_i| = a_1 + a_2 size_i + a_3 FSales_i^+ + a_4 FSales_i^- + a_5 Subsidiary_i + a_6 FLoan_i + a_7 Leverage_i + a_8 QR_i + a_9 DE_i + a_{10} BM_i + IndDummy + \varepsilon_i \quad (5)$$

Where γ_i is estimated exchange rate exposure. Considering exchange rate exposure exhibits either positive or negative signs, we transform this variable by taking absolute value. All variables are *Winsorized* at 1 percent of the forward and backward to overcome the danger of extreme values biasing our results. We also ruled out the financial sector for its anomalous features of its balance sheets. The data source of all explanatory variables of equation (5) is CSMAR, and the data are yearly averages. Please note that the data of foreign sales and foreign loans are unavailable before 2007—a major revision of financial accounting principles took place in 2007. The limited availability of the data dictated the form of regression (5). Detailed definitions of the variables are presented in the Appendix.

Table 1 reports the descriptive statistics of the main variables of equation (5).

Table 1 The descriptive statistics of the main variables

Variables	Mean	Median	Standard Deviation	25% percentile	75% percentile
August 12, 2015 to December 31, 2018					
size	3.682	3.458	1.476	2.724	4.403
$FSales^+$	0.050	0	0.125	0	0.007
$FSales^-$	-0.050	-0.016	0.061	-0.086	0
Subsidiary	0.306	0	0.405	0	0.667
FLoan	0.050	0	0.125	0	0.020
Leverage	0.519	0.514	0.305	0.368	0.656
QR	1.976	1.413	2.442	0.985	2.073
DE	0.188	0.138	0.167	0.054	0.280
BM	0.413	0.364	0.238	0.253	0.527
June 19, 2010 to August 11, 2015					
size	3.904	3.673	1.461	2.940	4.585
$FSales^+$	0.060	0	0.171	0	0.021
$FSales^-$	-0.060	-0.032	0.069	-0.105	0
Subsidiary	0.475	0.5	0.454	0	1
FLoan	0.082	0	0.175	0	0.063

Leverage	0.436	0.425	0.201	0.276	0.585
QR	2.407	1.744	2.419	1.221	2.741
DE	0.183	0.138	0.160	0.060	0.263
BM	0.356	0.302	0.244	0.204	0.443

Note: this table shows firm characteristics descriptive statistics in three sub-periods. In particular, these characteristics include firm size (size), foreign sales ($FSales^+$, $FSales^-$), subsidiary (Subsidiary), foreign loans (FLoans), leverage (Leverage), quick ratio (QR), long-term debt ratio (DE) and book to market ratio (BM). The columns show (from left to right) mean, median, standard deviation, 25% percentile, 75% percentile. All variables are averaged across the period (2014-2017, 2009-2014).

4. Empirical results
4.1 Estimations of linear exchange rate exposures

We first estimate the linear exchange rate exposure using regression equation (1) and present the main results in Table 2. Standard errors are corrected for via auto-correlation and heteroscedasticity by Newey-West method. We categorize the percentage of firms whose γ_i is at the significance level of 5 percent or better as having a statistically significant γ_i. Belonging to this category indicates that these firms are exposed to risks associated with changes in exchange rates. To illustrate, positive γ_i means appreciation of the RMB raises the stock return of firms; negative γ_i says otherwise. Table 2 shows that 20.6 percent of Chinese public firms were exposed to the USD risk after 811 Reform, which represents a significant change in comparison with 11.8 percent rate of exposure that preceded the reform. While the foreign exchange rate exposures to the yen and the Hong Kong dollar show a pattern that mirrors that of the US dollar, those of the euro and the pound plummeted from 29 percent and 32.4 percent to 17.6 percent and 13.3 percent, respectively. By contrast, the exposure associated with the foreign exchange rate index went up mildly, going from 16.4 percent to 20.7 percent.

The finding that the exchange rate exposure to the USD has been more stable than that of the other currencies in the sample may be attributable to the attention constantly paid to the USD by the monetary authority of China before 811 Reform. The PBOC has been working diligently to ensure the stability of the USD exchange rate for decades. In particular, the PBOC sees USD exposure as an integral part of systemic financial risk borne by China's market. In keeping with this view, the bank monitors the USD exchange rate closely. Being closely watched, the USD exchange rate exerts influences on firm value through a restricted channel, and hence produces lower exposure than other foreign currencies do after 811 Reform. On the flip side, with foreign exchange rate monitoring policy leaning heavily toward the USD market, the Chinese government intervened more sparingly in the markets of the euro and the pound, thus permitting these two foreign exchange rate exposures to fluctuate. The results shown in Table 2 confirm that a disproportionate amount of exposures associated with the euro and the pound were positive prior to the 811 Reform. Only after the reform did the exposures become natural[16].

Table 2 The percentage of the Chinese public firms that show linear exposures

August 12, 2015 to December 31, 2018			July 21, 2005 to August 11, 2015			June 19, 2010 to August 11, 2015		
-	+	-&+	-	+	-&+	-	+	-&+

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[16] We also conduct the Chow-test to see whether there is a structural change in the sensitivity of exchange rate (bilateral and index) on firm's value. Both August 11, 2015 and June 19, 2010 are significant at 1% level.

USD	15.7	4.9	20.6	9.1	2.7	11.8	17.1	1.9	18.9
EUR	6.1	11.5	17.6	3.2	25.8	29	5	7	12
HKD	16.1	4.7	20.8	7.8	2.3	10	14.6	2	16.5
JPY	8.1	7.5	15.6	8.5	4	12.5	2.3	8.9	11.3
GBP	5.5	7.8	13.3	2.6	29.8	32.4	2.6	13.8	16.4
INDEX	11.9	8.8	20.7	3.3	13.1	16.4	5.2	7	12.1

Note: This table reports the percentage of Chinese public firms that show linear foreign exchange rate exposure (significant at 5% level). The three columns in each period are negative, positive and total form left to right, respectively. USD=the US dollar, EUR=the euro, HKD=the Hong Kong dollar, JPY=the Japanese yen, GBP=the British pound, INDEX=currency index weighted by the five currencies.

To document the impact of foreign exchange rates on the stock return of Chinese public firms by level, following Bartram (2004), we multiplied the mean exposure coefficient, γ_i, by one standard deviation of the exchange rate. We found that in firms with negative exposure, the appreciation of the RMB relative to the US dollar by one standard deviation results in 0.195 percent decrease of the firms' market value. In firms with positive exposure, appreciation of the RMB relative to the US dollar by one standard deviation results in a 0.242 increase in the firms' market value.

Table 3 The linear exposures of Chinese public firms

	August 11, 2015 to December 31, 2018		July 21, 2005 to August 11, 2015		June 19, 2010 to August 11, 2015	
	-	+	-	+	-	+
USD	-0.195	0.242	-0.129	0.131	-0.226	0.177
EUR	-0.229	0.212	-0.156	0.118	-0.147	0.124
HKD	-0.195	0.232	-0.132	0.109	-0.214	0.160
JPY	-0.234	0.252	-0.111	0.105	-0.143	0.137
GBP	-0.228	0.216	-0.160	0.120	-0.171	0.154
INDEX	-0.203	0.235	-0.157	0.116	-0.144	0.129

Note: this table reports the impact of foreign exchange rates on the stock return of firms by level. We multiply the mean exposure coefficient, γ_i, in exposure samples by one standard deviation of the exchange rate. Foreign exchange rate exposures are estimated through equation (1). The two columns in each period are negative exposure samples and positive exposure samples, respectively. USD=the US Dollar, EUR=the euro, HKD=the Hong Kong dollar, JPY=the Japanese yen, GBP=the British pound, INDEX=currency index weighted by the five currencies.

Table 4 presents the foreign exchange rate exposures by sector as classified by CSRC. 15.6 percent of 1,520 manufacturing firms in China show negative exchange rate exposure indicating that their firm value fluctuated mildly facing the depreciation of the RMB against the USD. Mining sector by contrast suffers from the depreciation of the RMB due to the fact that the main part of its debt and investment are denominated in foreign currency. In specific, between the USD and the INDEX exchange rate risk, the mining sector is relatively vulnerable to the latter as more than one foreign currency play important roles in its overseas investment, debt, inventory adjustment and sales forecast. Exposures of airline companies in the transportation sector, for another instance, also correlates positively with the depreciation of the RMB as reflected in Table

4 that the percentage of firms showing positive USD exposures in the transportation, storage and package sector jumped from 0 to 13.1 after 811 Reform.

Table 4 The percentage of firms having linear exposures by industry

	August 12, 2015 to December 31,2018				July 21, 2005 to August 11, 2015				
	# of firms	USD		INDEX		# of firms	USD		INDEX	
		-(%)	+(%)	-(%)	+(%)		-(%)	+(%)	-(%)	+(%)
Farming, forestry, animal husbandry, and fishery	37	2.7	5.4	8.1	10.8	19	0	0	0	15.8
Mining	62	9.7	9.7	21	8.1	44	0	20.5	31.8	2.3
Manufacturing	1520	15.6	5.7	11.6	8.1	675	9.5	2.4	3.1	13.8
Electricity, heat, gas, and water utility	94	17	5.3	20.2	13.8	79	6.3	2.5	0	13.9
Construction	72	18.1	6.9	13.9	9.7	31	6.5	0	3.2	3.2
Whole sales and retails	128	26.6	5.5	20.3	8.6	109	8.3	0.9	1.8	21.1
Transportation, storage, and package	84	10.7	13.1	4.8	10.7	52	11.5	0	0	15.4
Hotel and restaurant	8	0	0	12.5	0	6	0	16.7	0	16.7
Telecommunication, software, and information & technology service	160	16.9	10	13.8	10	43	11.6	2.3	0	7
Financial service	60	15	3.3	8.3	0	32	18.8	3.1	0	15.6
Real estate	109	19.3	5.5	11	4.6	112	7.1	3.6	2.7	8
Rental service and business service	31	19.4	19.4	3.2	25.8	17	17.6	0	0	17.6
Scientific research and technological service	22	18.2	0	9.1	4.5	5	20	0	0	0
Water resources, environment and public facilities management	31	29	3.2	12.9	6.5	15	13.3	0	6.7	6.7
Education	2	0	0	0	0	2	50	0	0	0
Public health and social work	7	14.3	0	0	14.3	3	33.3	0	0	33.3
Culture, sports, and entertainment	31	9.7	6.5	6.5	12.9	20	5	0	0	20
Others	19	15.8	0	5.3	10.5	24	12.5	0	0	8.3

Note: this table displays the percentage of firms having linear exposures by industry, as classified by China Securities Regulatory Commission (CSRC). The first column for each period reports the number of the firms in each industry and the next four columns report the percentage of Chinese public firms that show significant foreign exchange rate exposure with regard to both US dollar (USD) and exchange rate index (INDEX).

4.2 Estimations of nonlinear exchange rate exposures

Nonlinear exchange rate exposures of Chinese public firms are presented in Table 5, which shows that more than 26 percent of Chinese public firms have been exposed to nonlinear exchange

risks after the 811 Reform. Relative to linear exposures, 5.6 percent more firms show nonlinear exposures to the USD. As for the euro, 20.3 percent of firms are exposed to nonlinear exchange risks, as opposed to 17.6 percent to linear ones. Table 5 and 2 combined suggest Chinese public firms as a whole are more sensitive to nonlinear exchange rate risks than linear ones. In terms of the temporal study of the 811 Reform watershed, a mere 1.4 percent of firms responded to nonlinear risk of the USD prior, as opposed to 26.2 percent after; 8 percent and 4.7 percent responded to the euro and the HKD prior, respectively, compared to 20.3 percent and 26.5 percent after. The fact that a growing number of Chinese public firms are exposed to nonlinear exchange risks may signal the efficacy of China's efforts to marketize the RMB exchange rate. Another way of expressing the same idea is that supply and demand have begun to play a more critical role in determining the market value of the RMB. That Chinese public firms are more sensitive to nonlinear exchange risks also suggests they are vulnerable to the extreme volatility of the foreign exchange rate. To hedge against this volatility, they have resorted to using financial derivatives to hedge against nonlinear exchange rate risks.

Table 5 The percentage of firms having nonlinear exposures

	August 11, 2015 to December 31, 2018			July 21, 2005 to August 11, 2015			June 19, 2010 to August 11, 2015		
	-	+	-&+	-	+	-&+	-	+	-&+
USD	21.6	4.6	26.2	0.8	0.6	1.4	11.1	2.5	13.6
EUR	15.0	5.3	20.3	1.9	6.1	8.0	6.8	6.1	12.8
HKD	22.1	4.4	26.5	2.1	2.6	4.7	9.6	2.9	12.5
JPY	8.1	5.9	14.0	3.1	4.9	8.0	1.4	4.0	5.4
GBP	2.5	5.2	7.7	3.6	17.8	21.4	4.3	11.4	15.8
INDEX	16.5	7.6	24.1	3.1	11.3	14.4	6.5	4.3	10.8

Note: This table reports the percentage of Chinese public firms that have nonlinear foreign exchange rate exposure (significant at 5% level). The three columns in each period are negative, positive and total form left to right, respectively. USD=the U.S. dollar, EUR=the euro, HKD=the Hong Kong dollar, JPY=the Japanese yen, GBP=the British pound, INDEX=currency index weighted by the five currencies.

Table 6 presents the results of the sign bias test, based on equation (2), of exposures that capture the biased component attributable to the asymmetric influences of appreciations and depreciations. As shown in Table 6, three coefficients of USD exposure are similar in Panel A and Panel B before 811 Reform, indicating the volatility of the USD exchange rate may have been absorbed by the market return index. The USD exchange rate risk in China has become an integral part of the systemic financial market risk rather than an idiosyncrasy of it before 811 Reform. By contrast, notable changes in the exposures to the euro and to the foreign exchange market index as well as USD after 811 Reform may still merit consideration as idiosyncrasies.

Table 6 Sign bias test of exposures

	August 11, 2015 to December 31, 2018			July 21, 2005 to August 11, 2015			June 19, 2010 to August 11, 2015		
	τ_i	φ_i	ω_i	τ_i	φ_i	ω_i	τ_i	φ_i	ω_i
					Panel A				
USD	2.7	6.1	2.5	6.1	3.2	5.3	5.5	5.8	1.2

EUR	5.5	3.1	16.4	3.4	2.6	3.8	4.7	3.8	2.4
HKD	2.5	5.6	2.2	6.8	2.5	3.1	4	4.5	1.6
JPY	2.6	3.4	4.6	3.3	4.7	4.4	3.3	7.2	4.5
GBP	3.4	7.1	7.3	2.8	3.6	3	2.9	5.6	1.8
INDEX	4.9	7.6	3.4	6.5	2.6	3	3.7	3.7	2.1
Panel B									
USD	2.8	9.1	1.8	6	3.4	5.7	5.4	5.8	2.8
EUR	5.4	6	13.1	3.4	6.4	12	4.7	3.5	5.5
HKD	2.6	8.7	2.3	6.8	3.2	5.8	4	5.6	3.6
JPY	2.5	4.1	5.6	3.3	7.1	4.5	3.3	7.6	6.8
GBP	3.4	9.5	6.9	2.8	5	10.4	2.9	4.3	5.4
INDEX	5	9.7	4	6.5	8.2	9.9	3.7	4.8	4.6

Note: This table reports the percentage of Chinese public firms that show significant sign bias foreign exchange rate exposure (at 5% level). The three coefficients, $\tau_i, \varphi_i,$ and ω_i, henceforth work together to reflect the possible biased influences of exchange rate change, upward versus downward, on a firm's stock market value. Panel A presents the estimated exposures using equation (1) and (2), while Panel B presents the estimated exposures using equation (3) and (2). USD=the U.S. Dollar, EUR=the Euro, HKD=the Hong Kong dollar, JPY=the Japanese yen, GBP=the British pound, INDEX=currency index weighted by the five currencies.

4.3 The determinants of exchange rate exposure

We focus in this section on the determinants of exchange rate exposures to both USD and the foreign exchange rate market index. We follow Bartram et al. (2010) and Wei and Starks (2013) by taking the absolute value of the coefficient γ_i in the equation (2) to measure foreign exchange rate exposure. Referring to related research and considering the special characteristics of China's market, we include the nine determinants of foreign exchange rate exposures in equation (5), which we previously discussed in section 3.2. We also conduct a Chow test to examine whether the driving forces of exchange rate exposure have changed around the 811 reform.

The regression results of equation (5) are presented in Table 7, in which column (I) and (III) show the results of the sample period from June 19, 2010 to August 11, 2015. Column (II) and (IV) show the period from August 11, 2015 to December 31, 2018.

In terms of the USD risk exposure, the results in column (I) and (II) of Table 7 show a consistent correlation between exchange rate exposures and hedging costs. We find that size of firms presents a negative effect at the 99-percent significance level, which indicates that larger firms suffer less foreign exchange rate exposure in all subsamples. Larger firms are found by several studies to have a low cost for their economies of scale (Nance et al., 1993; Hutson and Laing, 2014). In addition, the leverage ratio positively correlates with the exposures to the USD at 95-percent significance level in both subsample periods, indicating that highly leveraged firms are more exposed to exchange rate risks. More leveraged firms essentially bear a greater probability of financial distress, hence the consequent higher costs of hedging may have prevented these firms from effectively managing impacts of exchange rate volatilities on their firm values. Statistically insignificant notwithstanding, we find a positive relationship between exchange rate exposure and long-term debt ratio (DE), which is consistent with the hedging cost hypothesis. Finally, firms' international operations ($FSales^+$) are found to correlate with exchange rate exposure only marginally in both sample periods.

The regression results of foreign exchange rate index show a similar pattern, which is perhaps due to the fact that the USD exchange rate leads in weight among the main foreign currencies constituting the index. The results of the Chow tests confirm the existence of structural change around the 811 reform period. The F-statistics for all specifications statistically significantly reject the hypothesis that the coefficient vectors are the same for the two periods. Interestingly, we find that the magnitude of leverage is smaller in USD exposure than it is in index exposure. This may be due to the rapid development of hedging tools against USD after 811 reform, even though the number of tools is still small in China relative to developed nations. As a result, highly leveraged firms are less (more) exposed to USD (Index) exchange rate risks after the 811 reform. We also find the size of firms significantly negatively correlated with the index exposure only after 811 reform. Considering the increased exchange rate volatilities after 811 reform, larger firms are more incentivized to hedge against index volatility. Book-to-market ratio is also found to correlate with index exposures negatively suggesting high growth firms are more easily exposed to overall exchange rate risks, as the exchange rate market volatility may make hedging more costly for the firms with high growth opportunities.

Table 7 The determinants of linear exchange rate exposures

	(I)	(II)	(III)	(IV)
	USD(γ_i)	USD(γ_i)	INDEX(γ_i)	INDEX(γ_i)
size	-0.0641***	-0.0484***	-0.0000	-0.0391***
	(-3.88)	(-5.97)	(-0.01)	(-4.07)
$FSales^+$	0.1721	0.0275	0.0008	0.0275
	(1.43)	(0.42)	(0.02)	(0.34)
$FSales^-$	-0.0442	-0.1197	0.0163	-0.1439
	(-0.16)	(-0.87)	(0.16)	(-0.91)
Subsidiary	0.0199	0.0010	-0.0133	0.0184
	(0.57)	(0.06)	(-0.87)	(0.94)
FLoan	0.0258	-0.0269	0.0061	-0.0698
	(0.25)	(-0.62)	(0.15)	(-1.49)
Leverage	0.2563**	0.1177**	0.0789*	0.1436**
	(2.49)	(2.00)	(1.91)	(2.20)
QR	0.0137	0.0039	0.0043	0.0036
	(1.14)	(0.67)	(1.08)	(0.59)
DE	0.0403	0.0577	-0.0411	0.0802
	(0.40)	(1.09)	(-1.14)	(1.39)
BM	0.0066	-0.0007	-0.0093	-0.0254*
	(0.30)	(-0.06)	(-0.68)	(-1.75)
IND Dummy	YES	YES	YES	YES
Constant	0.4248***	0.3045***	0.1970***	0.4175***
	(5.32)	(5.24)	(7.00)	(5.11)
Observations	1,541	2,417	1,541	2,417
R-squared	0.121	0.075	0.086	0.084
Chow-test	8.03***		4.05***	

Note: This table reports the regression of firm characteristics and industry dummies on linear exchange rate exposures. Coefficient and robustness t-statistics for firm characteristics are reported in the table. Column (I) and (III) show the results of the sample period from June 19, 2010 to August 11, 2015. Column (II) and (IV) show the period from August 11, 2015 to December 31, 2018. We report F-statistics for the Chow-test on the existence of structural break around the August 11, 2015. Significant level: ***1 percent; ** 5 percent; * 10 percent.

4.4 The determinants of nonlinear foreign exchange rate exposure

Table 8 reports the regression results of equation (5), which are similar to those in Table 7 except that the value of γ_i is estimated nonlinearly based on equation (4), instead of the linear equation (1). A positive correlation between exposures and the cost of hedging activity is presented, and size of firms remains negatively correlated with exposures, while leverage turns to an insignificant factor prior to the 811 reform in the nonlinear regression. Book-to-market ratio is also found to be nonlinearly negatively correlated with exposures after 811 reform. In gauging the nonlinear impact of hedging motivation on exposures, we find that firms with greater quick ratios (more liquidity) appear to have significantly larger exchange rate exposure after 811 reform. Similar to the linear findings, firms with high short-term liquidity are less incentivized to hedge, and hence more nonlinearly exposed to increased exchange rate fluctuations after 811 reform.

In terms of international operations, a firm's foreign sale is found to significantly increase nonlinear exchange rate exposures when the firm is a net-exporter, or proxied by $FSales_i^+$ in the regression (He and Ng, 1998; Wei and Starks 2013). This impact of foreign sales turned insignificant after the 811 reform, however, both in statistical significance and magnitude. The reverse may indicate the growing capability of Chinese public firms in terms of hedging against exchange rate risk due to international operations. Confirming the split of time in the sample, the Chow test shows structural change and the F-statistics for all specifications statistically significantly reject the hypothesis that the coefficient vectors are the same for the two periods divided by the 811 reform.

Table 8 The determinants of nonlinear exchange rate exposures

	(I) $USD(\gamma_i)$	(II) $USD(\gamma_i)$	(III) $INDEX(\gamma_i)$	(IV) $INDEX(\gamma_i)$
size	-0.7088***	-0.0474***	-0.0060	-0.0756***
	(-2.92)	(-4.98)	(-0.55)	(-4.33)
$FSales^+$	1.6026	0.0728	0.0968**	-0.0078
	(0.99)	(1.23)	(2.52)	(-0.06)
$FSales^-$	4.0051	0.0127	-0.0621	0.2312
	(1.11)	(0.08)	(-0.39)	(0.72)
Subsidiary	0.1598	-0.0138	-0.0032	-0.0046
	(0.31)	(-0.45)	(-0.14)	(-0.12)
FLoan	1.0706	-0.0142	-0.0957	0.0126
	(0.77)	(-0.23)	(-1.67)	(0.11)
Leverage	0.3014	0.1302**	0.0249	0.2367*
	(0.22)	(2.32)	(0.49)	(1.91)
QR	0.0443	0.0054**	0.0017	0.0120**

	(0.44)	(2.75)	(0.27)	(2.12)
DE	0.0363	0.0173	-0.0101	0.0236
	(0.27)	(0.65)	(-0.36)	(1.29)
BM	0.3080	-0.0448**	0.0031	-0.0396*
	(0.75)	(-2.61)	(0.21)	(-1.70)
IND Dummy	YES	YES	YES	YES
Constant	2.1813**	0.4738***	0.1992***	0.6640***
	(2.23)	(8.40)	(4.25)	(8.99)
Observations	1,541	2,417	1,541	2,417
R-squared	0.086	0.057	0.059	0.062
Chow-test	4.85***		3.52***	

Note: This table reports the regression of firm characteristics and industry dummy on nonlinear exchange rate exposures. Coefficient and robustness t-statistics for firm characteristics are reported in the table. Column (I) and (III) show the results of the sample period from June 19, 2010 to August 11, 2015. Column (II) and (IV) show the period from August 11, 2015 to December 31, 2018. A Chow-test is conducted to examine the existence of structural break around the August 11, 2015. F-statistics and significant level for the Chow-test are displayed in the table. Significant level: ***1 percent; ** 5 percent; * 10 percent.

4.5. Robustness Check

Two methodological issues merit attention and need to be addressed. First, Dominguez and Tesar (2006) show that $|\gamma_i|$ changes the distribution of original γ_i and hence deviates the resulting error term away from normal distribution. To resolve this problem, they transform it into $\sqrt{|\gamma_i|}$ to run the final regression. Hutson and Laing (2004) adopt this method in their study of foreign exchange rate exposure. Second, in both linear and nonlinear regressions of the determinants of exchange rate exposures, the coefficients estimated from the first stage may be influenced by measurement error and hence confound the results of the second stage. Allayannis and Ofek (2001) and Kim et al. (2006) mitigate this possibility by inversing the standard error from the first stage and using it as the weight for the second stage of the WLS regression.

We adopt all these remedies and report estimated results in Table 9. The sample time in the regression ranges from August 11, 2015 to December 31, 2018. The first two columns are the results of linear exposures of $\sqrt{|\gamma_i|}$ replacing $|\gamma_i|$; The second two columns report the results of the WLS regression; We omit the year 2015 in the third two columns; Finally, we apply Fama-French three factors model to re-estimate γ_i, and show the results in the last two columns. Reassuringly, Table 9 confirms that the firm size and leverage ratio remain the statistically significant determinants of the foreign exchange rate exposure of Chinese public firms.

Table 9 Robustness Check

	(1) $USD(\gamma_i)$	(2) $INDEX(\gamma_i)$	(3) $USD(\gamma_i)$	(4) $INDEX(\gamma_i)$	(5) $USD(\gamma_i)$	(6) $INDEX(\gamma_i)$	(7) $USD(\gamma_i)$	(8) $INDEX(\gamma_i)$
size	-0.0429***	-0.0336***	-0.0465***	-0.0370***	-0.0440***	-0.0322***	-0.0492***	-0.0421***
	(-6.88)	(-4.37)	(-5.19)	(-3.37)	(-5.55)	(-3.42)	(-6.21)	(-4.51)
$FSales^+$	0.0195	0.0172	0.0386	0.0545	0.0235	0.0303	0.0799	0.0517
	(0.32)	(0.29)	(0.56)	(0.57)	(0.36)	(0.33)	(1.18)	(0.55)
$FSales^-$	-0.0819	-0.1201	-0.1551	-0.1472	-0.1104	-0.1457	-0.0867	-0.1787

(-0.97)	(-1.01)	(-1.09)	(-0.88)	(-0.81)	(-1.09)	(-0.63)	(-1.23)

Subsidiary	-0.0017	0.0165	-0.0070	0.0101	0.0034	0.0158	-0.0053	0.0256
	(-0.10)	(1.09)	(-0.39)	(0.47)	(0.21)	(0.89)	(-0.32)	(1.10)
FLoan	-0.0214	-0.0491	-0.0523	-0.0844	-0.0325	-0.0764	-0.0100	-0.0471
	(-0.48)	(-1.27)	(-1.07)	(-1.51)	(-0.76)	(-1.52)	(-0.24)	(-1.06)
Leverage	0.0842*	0.1280**	0.1157*	0.1194*	0.1267**	0.1548*	0.1454**	0.1789**
	(1.79)	(2.54)	(1.88)	(1.72)	(2.17)	(1.97)	(2.52)	(2.51)
QR	0.0010	0.0038	0.0055	0.0035	0.0059	0.0064	0.0054	0.0054
	(0.26)	(0.85)	(0.90)	(0.58)	(1.00)	(1.01)	(0.92)	(0.99)
DE	0.0410	0.0846*	0.0629	0.0910	0.0646	0.0738	0.0339	0.0520
	(0.82)	(1.89)	(1.12)	(1.50)	(1.27)	(1.61)	(0.66)	(1.21)
BM	0.0049	-0.0172	0.0051	-0.0211	-0.0101	-0.0289*	0.0017	-0.0171
	(0.42)	(-1.41)	(0.38)	(-1.22)	(-0.93)	(-1.77)	(0.14)	(-1.08)
IND Dummy	YES	YES	YES	YES	YES	YES	YES	YES
Constant	0.5358***	0.6076***	0.2876***	0.4271***	0.2860***	0.3871***	0.3140***	0.4143***
	(18.22)	(9.39)	(4.72)	(5.20)	(4.93)	(8.52)	(5.55)	(9.75)
Observations	2,417	2,417	2,379	2,380	2,417	2,417	2,417	2,417
R-squared	0.074	0.074	0.079	0.084	0.075	0.082	0.084	0.082

Note: This table reports four robustness results during the period from August 11, 2015 to December 31, 2018. The first two columns are the results of linear exposures of $\sqrt{|\gamma_i|}$ replacing $|\gamma_i|$; The second two columns report the results of the WLS regression; We omit the year 2015 in the third two columns. Finally, we apply Fama-French three factors model to re-estimate γ_i, and show the results in the last two columns. Robust t-statistics are reported between parentheses. Significant level: ***1 percent; ** 5 percent; * 10 percent.

Admittedly, the OLS regressions in the study may be subject to endogenous problems, especially considering that foreign exchange rate exposure and the leverage, foreign trade, capital flow could be determined simultaneously. In addition, the endogeneity problem may also rise due to the omission of important variables. To address the possible endogeneity concern, we employ three additional tests.

First, we adopt Arellano and Bover (1991) dynamic panel GMM procedure to address potential endogeneity where one or more of the explanatory variables are not strictly exogenous. This technique utilizes appropriate lags of the changes in both dependent variables and regressors to address the potential endogeneity of all the regressors, and can also account for time-invariant unobservable heterogeneity (i.e. time-invariant firm-specific characteristics). Table 10 presents the GMM regression results of equation (3)[17]. The GMM instrumental variables are validated by the Sargan and Hansen over-identification tests. The first-order and second-order serial correlations of the Arellano-Bond tests are conducted to show that the original error terms are serially uncorrelated (Arellano and Bond, 1991.) Supporting the hedging cost hypothesis, firm

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[17] We re-estimated equation (1) for each year of 2009-2018. 2010-2014 and 2015-2018.The lag variables are one period lagged.

size and leverage ratio remain the statistically significant determinants of the foreign exchange rate exposure of Chinese public firms. In addition, firms with lower BM ratios, or higher quick ratios, are more exposed to exchange rate fluctuations after the 811 reform.

Table 10 Endogeneity—Two-step GMM

	(I) USD(γ_i)	(II) USD(γ_i)	(III) INDEX(γ_i)	(IV) INDEX(γ_i)
l. γ_i	0.0098	-0.0973	-0.0226	-0.0216
	(0.11)	(-0.83)	(-0.67)	(-1.32)
size	-0.1399***	-0.1433**	-0.2020**	-0.0472***
	(-5.23)	(-2.32)	(-1.99)	(-3.61)
$FSales^+$	-0.1278	-0.0790	-0.4298*	-0.0153
	(-0.94)	(-0.45)	(-1.76)	(-0.19)
$FSales^-$	0.6550*	-0.6413	0.0960	0.0714
	(1.88)	(-1.30)	(0.19)	(0.53)
Subsidiary	0.0333	0.5112*	0.3687	0.0852**
	(0.86)	(1.65)	(1.10)	(2.37)
FLoan	-0.0895	-0.0580	0.7029	-0.2446**
	(-0.86)	(-0.14)	(1.00)	(-2.15)
Leverage	0.0051***	0.0023**	0.0138***	0.0028***
	(2.58)	(2.49)	(2.74)	(3.20)
QR	0.0161*	-0.0054	0.1473***	0.0052
	(1.73)	(-0.76)	(2.69)	(1.08)
DE	-0.0970	-0.0776	-2.0485**	-0.1105
	(-0.88)	(-0.76)	(-1.99)	(-1.23)
BM	0.0147	0.0013	0.1343	-0.0397***
	(0.53)	(0.04)	(1.37)	(-2.74)
Controls	YES	YES	YES	YES
AR(1)	0.006	0.009	0.000	0.000
AR(2)	0.753	0.329	0.909	0.253
Sargan test	0.839	0.393	0.125	0.247
Hansen J test	0.102	0.122	0.310	0.296

Note: This table provides the results estimated by the dynamic GMM using one-year lagged values and the difference of size and leverage as instruments. Industry dummy, year dummy and constant are included but not reported. Robust t-statistics are reported between parentheses. AR(1) and AR(2) are the p-values of Arellano-Bond test for AR(1) and AR(2), respectively. Sargan test and Hansen J test report the p-value of the over-identification test. Column (I) and (III) show the results of the sample period from June 19, 2010 to August 11, 2015. Column (II) and (IV) show the period from August 11, 2015 to December 31, 2018. Significant level: ***1 percent; ** 5 percent; * 10 percent.

Second, we employ a two-stage least squares (2SLS) approach to examine the relationship between explanatory variables and the exchange rate exposure. A valid instrument should be related with the potential explanatory variable, but have no direct impact on the exchange rate exposure. Following the literature (Liu et al., 2015; Coles et al., 2018), we use the previous three years' industry average of explanatory variables, to proxy for firm level variables accordingly. This methodology satisfies both relevant and exclusive conditions. For instance, the previous three years' industry mean of leverage ratio is likely to affect a firm' leverage ratio, satisfying the relevant criteria. However, it is unlikely that this variable affect future firm specific exchange rate exposure, except through its effects on firm's leverage ratio. We report the second-stage results of the 2SLS tests in Table 11[18].

Table 11 Endogeneity—IV-2SLS

| | (I) | (II) | (III) | (IV) |
	USD(γ_i)	USD(γ_i)	INDEX(γ_i)	INDEX(γ_i)
size	-0.2072***	-0.0836**	0.0729	-0.0294**
	(-3.18)	(-2.15)	(0.87)	(-2.41)
Fsales	0.0361	0.0780	0.4301	0.0072
	(0.10)	(0.25)	(0.92)	(0.14)
Subsidiary	0.0068	-0.0096	-0.4769	0.0184
	(0.02)	(-0.16)	(-1.26)	(0.85)
FLoan	0.6325	0.1795	0.7773	-0.0743
	(1.03)	(0.52)	(1.11)	(-1.33)
Leverage	0.9097**	0.4013*	3.3573**	0.5441**
	(2.08)	(1.74)	(2.06)	(2.04)
QR	0.1219**	0.0183	0.1793	0.0264*
	(1.97)	(1.46)	(1.42)	(1.96)
DE	0.0535	-0.0052	0.3521	-0.0059
	(0.17)	(-0.08)	(0.97)	(-0.11)
BM	0.0844	0.0096	-0.4672**	-0.0844**
	(0.89)	(0.19)	(-2.21)	(-2.37)
Controls	YES	YES	YES	YES
Observations	1,541	2,417	1,541	2,417

Note: This table shows the results of second stage of 2SLS using the previous three year industry average as instrument variables. Independent variables reported include firm size (size), foreign sales (Fsales), subsidiary (Subsidiary), foreign loans (FLoans), leverage (Leverage), quick ratio (QR), long-term debt ratio (DE), book to market ratio (BM) and constant are included but not reported. Column (I) and (III) show the results of USD and INDEX exchange rate shock during the period from June 19, 2010 to August 11, 2015, respectively. Column (II) and (IV) show the results of USD and INDEX exchange rate shock during the period from August 11, 2015 to December 31, 2018, respectively. Robust t-statistics are reported between parentheses. Significant level: ***1 percent; ** 5 percent; * 10 percent.

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[18] To save space, first stage results are available upon request.

Finally, we employ event study analysis to examine whether reactions of stock prices to exchange rate shocks vary with firm characteristics. One advantage to this method is that market reactions to exchange rate shocks are unlikely to influence a firm's foreign sales and other characteristics, and that may consequently alleviate the endogeneity concern. Following Wei and Starks (2013), we define exchange rate shocks as daily currency movements beyond three standard deviations. We drop the event days if they are no more than 7 days apart and include only the first event day to avoid the possible bias caused by overlapping windows. Eventually we sample 11 and 6 event days for USD/CNY exchange rate movements before and after the 811 reform, while 13 and 6 for INDEX exchange rate. Then, a three-day window cumulative abnormal returns (CAR_i) is calculated for each event days; and its absolute value ($|CAR_i|$) proxies the market reaction as the independent variable. Firm characteristics in the regression are one-year lagged, reducing the possibility that exchange rate movement affects a firm's balance sheet causing reverse causation. We also include industry and time dummies. The regression model is thus as follow:

$$|CAR_i| = \varphi_1 + \varphi_2 size_i + \varphi_3 FSales_i^+ + \varphi_4 FSales_i^- + \varphi_5 Subsidiary_i + \varphi_6 FLoan_i + \varphi_7 Leverage_i + \varphi_8 QR_i + \varphi_9 DE_i + \varphi_{10} BM_i + IndDummy + Time\ Dummy + \varepsilon_i \qquad (6)$$

The results are reported in Table 12. As expected, firms with higher leverage ratio, lower book-to-market ratio, or smaller size appear to have significantly larger market reactions. In addition, quick ratio is significantly positively correlated with the market reaction, indicating that short term liquidity lowers the incentive to hedge.

Table 12 Endogeneity—Event Study

	(I)	(II)	(III)	(IV)
	|CAR(-1,+1)|	|CAR(-1,+1)|	|CAR(-1,+1)|	|CAR(-1,+1)|
size	-0.0019***	-0.0032***	-0.0007***	-0.0071***
	(-8.34)	(-6.63)	(-4.37)	(-16.49)
$FSales^+$	0.0013	0.0009	0.0004	0.0020
	(0.65)	(0.99)	(0.39)	(0.83)
$FSales^-$	0.0055	0.0006	-0.0012	0.0089
	(1.52)	(0.24)	(-0.58)	(1.30)
Subsidiary	-0.0004	-0.0001	-0.0001	0.0009
	(-0.77)	(-0.25)	(-0.42)	(1.34)
FLoan	0.0002	-0.0013	-0.0007	0.0018
	(0.08)	(-1.53)	(-0.62)	(1.39)
Leverage	0.0032***	0.0059***	0.0024**	0.0100***
	(2.99)	(3.45)	(2.55)	(10.72)
QR	0.0206***	0.0117*	0.0165***	0.0048
	(2.80)	(1.91)	(5.98)	(0.44)
DE	-0.0008	0.0016	-0.0003	0.0029
	(-0.71)	(0.80)	(-0.40)	(1.14)
BM	-0.0071***	-0.0183***	-0.0064***	-0.0083***
	(-4.50)	(-16.80)	(-9.23)	(-3.70)
Controls	YES	YES	YES	YES

Observations	22,937	15,782	27,882	20,114
R-squared	0.190	0.077	0.127	0.140

Note: This table shows the results of event study. The dependent variable is the absolute value of firms' cumulative abnormal returns over the 3-days window (-1, +1). Independent variables reported include firm size (size), foreign sales (〚FSales〛^+, 〚FSales〛^-), subsidiary (Subsidiary), foreign loans (FLoans), leverage (Leverage), quick ratio (QR), long-term debt ratio (DE), book to market ratio (BM), industry dummy, year dummy and constant are included but not reported. Column (I) and (III) show the results of USD and INDEX exchange rate shock during the period from June 19, 2010 to August 11, 2015, respectively. Column (II) and (IV) show the results of USD and INDEX exchange rate shock during the period from August 11, 2015 to December 31, 2018, respectively. Robust t-statistics are reported between parentheses. Significant level: ***1 percent; ** 5 percent; * 10 percent.

5. Effects of controlling shareholder entrenchment

In this section, we examine whether the difference in the governance structure of Chinese corporations has an impact on the variation of exposure to exchange rate risks. Unlike the listed firms in developed market economies, corporate ownership in most emerging market economies is highly concentrated. China is not an exception. Corporations are usually controlled through pyramid structures and cross-holdings among firms. Firms' daily operational activities and risk management practices are actually the products of controlling shareholders' decision making (He and Rui, 2016; Tan and Tang, 2016). In addition, control rights are commonly separated from cash flow rights (Claessens, et al., 2000). In companies with such governance structure, agency costs due to the separation of ownership and control are less prevalent and severe. The separation of cash flow and control rights, however, has facilitated controlling shareholders to tunnel resources away from firms for their own benefits through self-dealings at the expense of minority shareholders (Johnson et al., 2000; Claessens et al., 2002; Du et al., 2013). This entrenchment effect is particularly prevalent for China. For example, Jiang et al. (2010) show that a large proportion of firms' financial resources are siphoned off by controlling shareholders through inter-corporate loans in China.

Controlling shareholders have substantial discretion over the exchange rate risk management, and their attitude towards risk management is tied to their maximization of private benefits of control. It is, therefore, reasonable to examine whether the entrenchment effect contributes to the foreign exchange rate exposure. To test this hypothesis, we split our sample into two subgroups: firms that have a separation of control and cash flow rights (Entrenched firms) and those otherwise. We accordingly construct a dummy variable for entrenched firms, and incorporate this dummy into our benchmark regression (He and Ng, 1998). The regression model with entrenched firms is as below:

$$|\gamma_i| = b_1 D + b_2 size_i D + b_3 FSales_i^+ D + b_4 FSales_i^- D + b_5 Subsidiary_i D + b_6 FLoan_i D + b_7 Leverage_i D + b_8 QR_i D + b_9 DE_i D + b_{10} BM_i D + c_1 + c_2 size_i + c_3 FSales_i^+ + c_4 FSales_i^- + c_5 Subsidiary_i + c_6 FLoan_i + c_7 Leverage_i + c_8 QR_i + c_9 DE_i + c_{10} BM_i + IndDummy + Time\ Dummy + u_i \quad (7)$$

Where D is a dummy variable that takes the value of one if a firm has a separation of control and cash flow rights, and zero otherwise. We include the dummy variable, firm characteristics and their interaction terms to examine the entrenchment effects on exchange rate exposure. The results are reported in Table 13.

Expectedly, the effects of leverage and BM ratios on exchange rate exposure are not only statistically significant, but also significantly different between entrenched firms and the other firms. In particular, the interaction terms, Leverage*D, are significantly positive, while interaction

terms, BM*D, are significantly negative. The results report in column (VI) shows that a one unit increase in leverage ratio causes the level of exchange rate exposure for an entrenched firm to increase by 0.0018, while that for the other firms to increase by 0.0009, a 50 percent difference. Similarly, a one unit increase in BM ratio leads to a drop of 0.286 for entrenched firms and 0.187 for the other firms. The results indicate that hedging costs play a more pronounced role in explaining a firm's exchange rate exposure for entrenched firms. This may be due to the fact that entrenched firms have less incentive to hedge facing high costs, hence their firms' values are more exposed to exchange rate movements[19].

Table 13 Separation

VARIABLES	(I) USD(γ_i)	(II) USD(γ_i)	(III) USD(γ_i)	(IV) INDEX(γ_i)	(V) INDEX(γ_i)	(VI) INDEX(γ_i)
D	0.0784	0.0003	0.0835	0.0195	-0.0196	0.0372
	(1.58)	(0.02)	(1.30)	(0.70)	(-0.94)	(1.01)
size*D	-0.0097		-0.0178	-0.0016		-0.0007
	(-0.83)		(-1.08)	(-0.23)		(-0.08)
$FSales^+$*D			-0.0920			-0.0747
			(-0.80)			(-0.97)
$FSales^-$*D			0.3016			0.1963
			(1.11)			(1.12)
Subsidiary*D			-0.0276			-0.0236
			(-0.79)			(-1.02)
FLoan*D			0.0862			-0.0026
			(1.13)			(-0.07)
Leverage*D		0.0010*	0.0018*		0.0008*	0.0009*
		(2.00)	(1.83)		(1.72)	(1.67)
QR*D			0.0025			0.0009
			(0.72)			(0.69)
DE*D			-0.0701			0.0354
			(-0.73)			(0.53)
BM*D			-0.0308			-0.0984***
			(-0.50)			(-2.84)
size	-0.0470***	-0.0497***	-0.0451***	-0.0196***	-0.0202***	-0.0205***
	(-5.45)	(-6.46)	(-4.92)	(-4.11)	(-4.50)	(-4.42)
$FSales^+$	0.0535	0.0540*	0.0827	0.0425	0.0426	0.0647*
	(0.92)	(2.01)	(1.16)	(1.50)	(1.50)	(1.74)
$FSales^-$	0.1174	0.1196	0.0355	-0.1001	-0.0986	-0.1565
	(0.78)	(0.79)	(0.21)	(-1.06)	(-1.05)	(-1.60)
Subsidiary	0.0168	0.0163	0.0247	-0.0027	-0.0031	0.0038
	(1.00)	(0.54)	(1.25)	(-0.24)	(-0.27)	(0.30)
FLoan	-0.0317	-0.0319	-0.0675	0.0078	0.0074	0.0074
	(-0.80)	(-1.03)	(-1.29)	(0.33)	(0.31)	(0.27)

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[19] Please note that, the positive sign of dummy variable (D) in most specifications, although statistically insignificant, is consistent with the expectation that entrenched firms have less incentive to hedge than other firms.

Leverage	0.0015***	0.0012**	0.0010*	0.0011***	0.0009**	0.0009**
	(2.70)	(2.26)	(1.73)	(3.47)	(2.62)	(2.50)
QR	0.0073*	0.0074*	0.0064	-0.0007	-0.0005	-0.0009
	(1.75)	(1.79)	(1.47)	(-0.39)	(-0.31)	(-0.47)
DE	-0.0612	-0.0620*	-0.0449	0.0265	0.0256	0.0152
	(-1.28)	(-1.97)	(-0.83)	(0.94)	(0.91)	(0.46)
BM	-0.3605***	-0.3589***	-0.3520***	-0.2141***	-0.2135***	-0.1874***
	(-10.35)	(-11.20)	(-9.07)	(-11.04)	(-11.06)	(-8.86)
Controls	YES	YES	YES	YES	YES	YES
Observations	18,934	18,934	18,934	18,892	18,892	18,892
R-squared	0.257	0.257	0.257	0.091	0.091	0.092

Note: This table reports the effect of separation between cash flow rights and controls rights on the relationship between exchange rate exposure and the variables associated to firm's operation and hedging activities. D is a dummy variable that takes the value of one if a firm has a separation of control and cash flow rights, and zero otherwise. Independent variables reported include firm size (size), foreign sales ($FSales^+$, $FSales^-$),), subsidiary (Subsidiary), foreign loans (FLoans), leverage (Leverage), quick ratio (QR), long-term debt ratio (DE), book to market ratio (BM), industry dummy, year dummy and constant are included but not reported. Coefficient and robustness t-statistics for firm characteristics are reported in the table. Column (I)-(III) and Column (IV)-(VI) show the results of USD and INDEX exchange rate exposure, respectively. Significant level: ***1 percent; ** 5 percent; * 10 percent.

6. Conclusion

This paper investigates foreign exchange rate exposure and its determinants for all Chinese listed firms since China's first major exchange rate reform in 2005. We find significantly linear and nonlinear exposures to bilateral as well as multilateral foreign exchange rates, and 5.6 percent more Chinese public firms are found to show greater sensitivity to nonlinear exposure. And in terms of timeline, considerably more firms were exposed to exchange rate fluctuations after the August 2015 reform. Our temporal study further shows that 26.2 percent of firms were exposed to nonlinear risks of the USD after the 811 Reform, whereas a mere 1.4 percent had been exposed to such risks before the reform.

In regards to the determinants of exposures, we find a mere effect of international operations in explaining a firm's exposure, in specific foreign sales ratio as its proxy only marginally positively correlates with exposures. However, a firm's exposure can be explained by its hedging costs. For example, smaller firms, or firms with high leverage ratio or greater growth opportunity, tend to be limited in hedging, and thus tend to have a greater exposure.

Last but not least, we examine the impact of the separation of control and cash flow rights in determining a firm's foreign exchange rate exposure. Our empirical results show that entrenched firms, i.e. firms with the separation of control and cash flow rights, are less likely to hedge than other firms and as such, are more exposed to exchange rate fluctuations when they are more leveraged or have greater growth opportunities.

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Appendix   Variable definition

Variables	Definitions
size	Natural logarithm of firm asset.
$FSales^+$	The difference between firm's foreign sales ratio (foreign sales/total sales) and the average value in the industry during the year if it has above average foreign sales and zero otherwise.
$FSales^-$	The difference between firm's foreign sales ratio (foreign sales/total sales) and the average value in the industry during the year if it has below average foreign sales and zero otherwise.
Subsidiary	A dummy variable takes the value of 1 if the firm has foreign subsidiary and 0 otherwise.
FLoan	Non-RMB loan/ total loan
Leverage	Total liabilities divided by total assets
QR	Current asset/current liability
DE	Long-term debt/ total debt
BM	The balance sheet value of the equity divided by the market value of the equity

Digital Financial Capabilities and Household Entrepreneurship*

By LUO YU AND ZENG LIANYUN*

Abstract: *This study investigates the impact of digital financial capabilities on household business ownership and business innovation. Utilizing China Household Finance Survey 2015 data, this paper constructs robust capabilities scores and finds positive associations between digital financial capabilities and household entrepreneurship. After specifying instrumental variables, the results still hold. In addition, we compare the driving forces of impact through componental dimensions, and discuss the different function channels that digital financial capabilities affect business ownership and business innovation. What's more, we add in the interaction term of digital capability and financial capability, illustrate its role in improving the goodness of fit of the models, and further discuss the interaction effect both generally and at each level of the capabilities scores. Finally, we conduct robustness check across socioeconomic groups and provide policy implications. This study highlights the different driving forces of digital financial capabilities concerning different entrepreneurial activities, as well as the importance of interaction effect in understanding how digital financial capabilities affect household entrepreneurship.*

Keywords: digital capability; financial capability; household entrepreneurship; business ownership; business innovation

Subject classification codes: L26, D14, J24, O18, O31, I31

Introduction

Over recent years, tremendous attention has been anchored on the digitization of financial services worldwide, for its potential to change real lives, especially those in developing countries. That is why promoting digital financial inclusion has become a critical strategy for both global agencies and emerging economies (Demirgüc-Kunt, Klapper, Singer, Ansar, and Hess, 2018; GPFI, 2016; Lauer and Lyman, 2015; PBOC & WBG, 2018). In China, the mushrooming volume of digital transactions from both commercial and financial activities is a standout phenomenon in the evolution of digital financial inclusion, making China the revenue generation engine of the industry around the world. Such heady growth has brought prominent disruptive changes to the business world (Mckinsey, 2018), where new business models keep flooding out. As a result, digital financial capabilities have steadily become crucial productive capacity for potential and existing business owners.

In fact, both digital literacy and financial literacy have become key policy concerns regarding employment and entrepreneurship in China (NDRC, 2018; PBOC, 2017). Further, mass entrepreneurship and innovation are also expected to make differences in the course of China's supply-side structural reform (The State Council, 2018), including transforming industrial structures and creating jobs (Arzeni, 1997; Hu and Zhang, 2014; Xie, Shen, Zhang, and Guo, 2018). However, literacy might not work well if people do not actually realize financial behaviours (Atkinson, McKay, Collard and Kempson, 2007; Johnson and Sherraden, 2007). Thus, we propose to look at the impact of digital financial capabilities on household

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entrepreneurship.

Apart from that, by talking about digital finance, we seem to give tacit consent to the interacted relationship between digital technologies and financial services. After all, it is not difficult to observe their mutual influences. However, when it comes to socioeconomic indicators like entrepreneurship or innovation, would one capability significantly influence the marginal effect of the other, on the separate indicator? The answer is till now not clearly examined in the literature.

Using the China Household Finance Survey 2015 data, this paper specifically studies the impact of digital financial capabilities on household business ownership and business innovation. We make three important contributions to the existing literature. First, by taking into account different dimensions of digital financial capabilities to construct measuring scores, we conduct considerably comprehensive examinations around the association between digital financial capabilities and household entrepreneurship. Second, we compare and explain how digital financial capabilities are affecting business ownership and business innovation through different channels. Third, for the first time, we illustrate the interacted impact of digital and financial capabilities, and rigorously examine both the general interaction effect and derivative effects of one capability at each level of the other. Overall, for better understanding the impact of digital financial capabilities on household entrepreneurship, this paper presents new methods and insights, as well as policy implications to benefit strategic development interventions.

The rest of this paper is arranged as follows. The second section illustrates the literature review and explains how we extend existing literature, which is followed by a section describing the data and variables. The fourth and fifth sections introduce our method and result respectively. The final section presents concluding remarks.

Literature review

This paper relates to three strands of literature as below. By reviewing studies on digital capability and household entrepreneurship, financial capability and household entrepreneurship, as well as the interacted impact of both capabilities, we illustrate the critical gaps and key contributions of this paper.

Digital capability and household entrepreneurship

By mentioning digital capability, it is inevitable to refer to the concept 'digital literacy'. Originated by Gilster (1997), digital literacy was initially regarded simply as the literacy in the digital age, about reading, writing, and dealing with information, while using the digital technologies of the time. More specifically, Martin (2006) elaborates about compositional dimensions including awareness, attitude and ability of properly using digital technologies, as well as functionings concerning enabling constructive social action and reflection upon the process. Comparatively, until present, there is no generally accepted consensus on the definition of digital capability, and very limited literature on its framework. However, by learning from the Capability Approach of Sen (1990), and observing the socioeconomic lives widely penetrated by digital technologies, we can think of it as the vector of alternative 'doings' using technologies to make and realize socioeconomic decisions, which meet one's best interest. What makes digital capability distinguished from digital literacy is the 'realization' or behavioural part. When searching, communicating, and trading online, digital literacy is the stepping-stone, but we need more power from attitudes and behaviours to actually make and realize well-informed decisions. While lacking the evidence discussing the association between very comprehensive assessment of digital capability and household entrepreneurship, we try to summarize and review the impact and function channels from three perspectives, namely, digital technologies usage in broad sense, usage of social media and e-commerce, and usage of digital payment, all of which are

closely related with socioeconomic lives in China.

To start with, we focus on broad technological categories like internet, mobile phones, and computers. As early as 2003, the European Commission had regarded digital literacy 'fast becoming a prerequisite for creativity, innovation and entrepreneurship' (Martin, 2006). By such statement, being able to use digital technologies appropriately is not only a day-to-day life skill, but also a critical productive capability. Empirical studies shed light on the positive impact of digital technologies usage on household entrepreneurship (Aker and Mbiti, 2010; Andjelkovic and Imaizumi, 2012; Becker, Crandall, Fisher, Kinney, Landry, and Rocha, 2010; Fairlie, 2006; Mathew, 2010; West, 2012; Zhou and Fan, 2018; to name a few). As argued, usage of digital technologies can empower different procedures of starting businesses, from making business plans by searching and investigating information like industry prospect, inventory cost, tax and legal regulations, to locate and reach supply chain and potential customers, and further to increase capital sources and carry out transactions. In developing countries, considerable number of households also started small businesses directly related to ICT services, such as airtime agents and mobile phone repair stores. Besides, Zhou and Fan (2018) also contributes the examination of channels through which internet usage promotes household entrepreneurship, including facilitating information flow, relieving liquidity constraints, benefiting social interactions and transforming risk preference. Beyond that, rigorous examinations on those function channels are still limited.

In addition to the start-up period, digital capability of existing enterprises is also crucial for business innovation. Literature has been increasingly addressing the role of connection or networking in innovation (Berman, 2012; Bughin, Chui, and Johnson, 2008; Chesbrough, Vanhaverbeke, and West, 2006; Huston and Sakkab, 2006; Sadafiyine, Dominguez-Péry, and Le Dain, 2015; Sullivan Mort and Weerawardena, 2006; Westerman, Bonnet, and McAfee, 2014). Compared to traditional mode of R&D, which invests heavily in internal innovation processes, open innovation relying on networking costs less but brings changes prominently, the efficiency of which lies heavily on functional digital mechanisms to touch both customers and commercial networks frequently. Further, businesses can even organize their digital system to be prepared for unpredictable innovation (Austin, Devin, and Sullivan; 2012; Yoo, Boland Jr, Lyytinen, and Majchrzak, 2012). With open innovation in mind and thinking about small businesses started by households, it is no doubt that small business owners would need such lower-cost innovation mode more. Nonetheless, how would small business owners without R&D budget construct an innovation-enabling digital system? We argue that social media and e-commerce platforms can act as effective public infrastructures for small business innovation (Mount and Martinez, 2014).

Social media and e-commerce are profoundly changing the way people communicate, consume, and create (Aral, Dellarocas, and Godes, 2013). Nowadays, one may find it hard to isolate social media with e-commerce, especially concerning the fast rising of social commerce. That is why we combine the social media and e-commerce when reviewing their impact. As a matter of fact, traditional way of social network, measured by household relational expenditure, has been proved to have positive push on household entrepreneurship (Hu and Zhang, 2014; Ma and Yang, 2011). Apart from that, as addressed by management literature (Sulistyo, 2016), relational capital also has significant influence on business innovation capability. However, most rigorous studies look at digital impact on business transformation, from the standpoint of business management, rather than how they influence households' entrepreneurial decisions. Since experience has been observed on association between social media/ e-commerce usage and household entrepreneurship (Faz and Naji, 2018; Ibrahim, Ros, Sulaiman, Nordin, and Ze, 2014; Jagongo and Kinyua, 2013; Marstio and Kivelä, 2014), it is reasonable to empirically examine the impact on household entrepreneurship. One of our contributions is to examine and compare the impact of social media and e-commerce usage on households' business ownership and innovation.

Further, as the underlying technology of e-commerce, well accepted digital payment is the prerequisite to carry out remote transactions, which is also the pathway of many other digital financial services. Until now, there are two major sources of service providers, namely, banks and third-party institutions. Concerning the latter, both mobile payment in China and mobile money in other developing economies show positive impact on household entrepreneurial activities, such as entrepreneurial decisions, business performance, initiative entrepreneurship and innovative activities. Function channels are found as reducing cost led to by distance and low coverage of financial service points, and relieving credit constraint (Kikulwe, Fischer, and Qaim, 2014; Sekabira and Qaim, 2017; Vong, Fang, and Insu, 2012; Yin, Gong, and Guo, 2019). Comparatively, concerning the former, while there is evidence around the impact of online banking on SMEs' financial status (Dalla Pellegrina, Frazzoni, Rotondi, and Vezzulli, 2017; Han, 2008), little is found on the association between usage of online banking or mobile banking with household entrepreneurial decisions.

In summary, while evidence is observed around the impact of digital capability on household entrepreneurship, rigorous examinations on driving forces and function channels are still needed. We propose to compare the varying impact of different dimensions of digital capability, and explore the driving forces regarding how they are making differences toward different household entrepreneurial activities, beyond thinking of digital technologies generally.

Financial capability and household entrepreneurship

Financial capability is more than financial literacy, in its emphasis on taking actual benefit of financial policies, instruments and services (Johnson and Sherraden, 2007). For a thorough review of literature on financial capability and household entrepreneurship, we illustrate below with regard to impact on household entrepreneurship brought by financial knowledge & skills, financial attitudes and financial behaviours.

Concerning financial knowledge & skills, only a few studies show their significant and positive impact on household entrepreneurial decisions (Ćumurović, and Hyll, 2019; Yin, Song, Wu, and Peng, 2015). As examined by Yin, Song, Wu, and Peng (2015), the function channels through which financial knowledge promotes household entrepreneurship include changing household borrowing preference, increasing households' demand and accessibility for formal credit, as well as improving households' risk tolerance. With regard to business innovation, though evidence is found on the association between financial knowledge & skills of entrepreneurs and enterprise performance (Adomako, Danso, and Ofori Damoah, 2016; Dahmen and Rodríguez, 2014; Kojo Oseifuah, 2010; Wise, 2013), specific discussion on the relationship between financial knowledge & skills and business innovation is very limited. It is heuristic to look at such relationships since evidence has already been found around the relationship between general knowledge acquisition and business innovation (Darroch and McNaughton, 2002; Kostopoulos, Papalexandris, Papachroni, and Ioannou, 2011; Liao, Wu, Hu, and Tsui, 2010). Besides, till now, little literature concerns comparison of impact on entrepreneurship between financial knowledge & skills and other dimensions of financial capability.

Financial attitudes usually relate to preferences or opinions toward financial matters (Atkinson, McKay, Collard, and Kempson, 2007; Atkinson and Messy, 2012; Kempson, Perotti, and Scott, 2013; Moore, 2003), such as preference toward achieving short-term or long-term financial goals. While positive association is found by Atkinson and Messy (2012) between financial attitudes and financial behaviours in some countries, few studies shed light on the impact of financial attitudes on household entrepreneurship.

When it comes to financial behaviours, usage of many financial services, especially those regarding credit and savings, can be directly related to relieving liquidity constraint, which has long been considered a vital barrier to the entry of firms (Aghion, Fally, and Scarpetta, 2007;

Blanchflower and Oswald, 1998; Evans and Jovanovic, 1989; Gnyawali and Fogel, 1994; Kerr and Nanda, 2009). For those regarding insurance and diversified investment, the function channels can be quite different. As followed, we review empirical evidence regarding impact of major financial services usage, including bank loans, credit card, savings, insurance and diversified investment.

With respect to bank loans, evidence is found from both macro and micro perspectives. For the former, deregulation and competition of the banking sector, which extend bank credit to more potential entrepreneurs, increase new incorporations (Black and Strahan, 2002; Cetorelli and Strahan, 2006; Chong, Lu, and Ongena, 2013). For the latter, opinions are divided on the impact of bank loan holdings. For example, Beck, Lu, and Yang (2015) does not find any significant relationship between the use of formal finance and firm growth. Comparatively, not a few studies show the positive impact of bank loan usage on business performance and innovation (Ayyagari, Demirgüç-Kunt, and Maksimovic, 2010, 2011; Demirgüc-Kunt, Klapper, and Panos, 2011; Hernández-Trillo, Pagán, and Paxton, 2005). Besides, evidence on the association between bank loan holding and entrepreneurial entry is actually very limited. Thus, our analysis would complement those discussions.

In relation to credit card usage, it is critical to notice that small business owners' personal credit sources are important channels of business credit (Cole and Wolken, 1995; Lahm Jr, Stowe, Carton, and Buck, 2011; Robinson and Finley, 2007). Further, Chatterji and Seamans (2012) shows that the increase in credit card rate extended credit to previously discriminated populations, and led to increased entrepreneurial entries. Herkenhoff, Phillips, and Cohen-Cole (2016) illustrates the important role of consumer credit access for different stage of entrepreneurship. That said, little evidence is found around the specific association between credit card usage and business innovation.

As for savings, many studies find that saving rates are higher for entrepreneurial households (Cagetti and De Nardi, 2006; Gentry and Hubbard, 2004; Quadrini, 2000), which is considered to be caused by high cost of external capital (Eisfeldt and Rampini, 2007). In addition, Buera (2006) also demonstrates higher saving rates of households during years before starting businesses. Thus, we expect savings contribute significantly to household entrepreneurial decisions, but the association between savings and business innovation is in need of exploration.

Apart from credit and savings, insurance adoption is also found to increase the probability of self-employment (Ilmakunnas and Kanniainen, 2001; Olds, 2016; Velamuri, 2012; Wellington, 2001). However, the mechanism is not explained as mitigating liquidity constraint, but rather, a reduction of risk (Olds, 2016). With respect to diversified investment, both Fossen, Rees, Rostam-Afschar, and Steiner (2018) and Gentry and Hubbard (2004) point out the undiversified pattern of business owners' portfolios, but till now little literature examines the association between diversified investment and household entrepreneurship.

In summary, although the impact of many dimensions of household financial capability on entrepreneurship has been examined by existing literature, there are still blank spaces, as discussed above. What's more, we propose to treat financial capability both as a comprehensive capability and as differential dimensions, to look at their distinct influences on household entrepreneurial decisions and business innovation.

The interacted impact of digital and financial capabilities

It is not difficult to observe the changing trend from the narrative of 'financial inclusion' to 'digital financial inclusion', which demonstrates the digitization of financial services. The digital revolution equips financial system with new opportunities to expand development interventions (Gabor and Brooks, 2017). Taking China as an example, regional gaps of digital financial inclusion shrank significantly from 2011 to 2018.While the digital financial inclusion indices of most cities were lower than 60% of the max value in 2011, those in 2018 were mostly higher

than 70% of the max (Guo, Wang, Wang, Kong, Zhang, and Cheng, 2019). However, to our knowledge, there is no rigorous literature on the interacted impact of digital and financial capabilities on any socioeconomic indicator until present.

On the ground of literature review above, studies around the impact of digital financial capabilities on household entrepreneurship are still nascent, especially those concerning their function channels and driving forces. This paper provides a considerably comprehensive view on whether and how digital financial capabilities affect household business entrepreneurship. In addition, our comparison of driving forces corresponding to business ownership and business innovation would strengthen knowledge on different function channels of entrepreneurial activities. Further, we contribute the insight on the interacted impact of digital and financial capabilities on household entrepreneurship, in an effort to unveil empirical evidence on such relationship, which is often referred to but actually rather ambiguous. Last but not the least, we also illustrate future policy implications by comparing the varying influences across different socioeconomic populations.

Data

The data we utilize are from the 2015 China Household Finance Survey (CHFS), which collected micro-level information on broad dimensions of household balance, income and expenditure, as well as attitudinal, behavioural and demographic characteristics (Gan, Yin, Jia, Xu, and Ma, 2013). Compared to the first two versions, the third wave of the survey carried out in 2015 asked more about household entrepreneurship and digital behaviors, which benefits us to look into households' business decisions and digital financial capabilities more comprehensively. Variables are explained as bellow.

Business ownership and business innovation

The dependent variables on household entrepreneurship include business ownership and business innovation. For business ownership, households were asked, "Is your family engaged in production and operation of industry and commerce, including individual business, leasing, transportation, online stores, and enterprises?" Based on the question, we code respondents' "Yes/ no" answers as a binary variable. To look at its relationship with digital financial capabilities, the sample kept are made up with 34,872 respondents, with some observations dropped for missing values of key variables. For business innovation, households were asked, "Compared with the situation of last year/first half of this year[1], are there any innovative activities concerned with products, technology, arrangement, culture, marketing, service, etc. such as R&D, new ideas, new methods, etc.?" We also code a binary variable for this question. The sample used to study its relationship with digital financial capabilities are limited within those who reported running businesses when surveyed and take up 15.65% of the entire sample. Thus, there are 4,825 observations after dropping ones with key variables missing.

Digital capability score

Based on the capability approach of Sen (1990), as discussed in the literature review, a vector of capabilities are the choice alternatives to realize specific functioning. To stay focused on our research topic, we measure digital capability of households by centring on dimensions that are closely related with shaping households' socioeconomic decisions, including, online shopping, online banking, mobile banking, social network with a smartphone, and information search with a smartphone. We generate componential variables regarding whether respondents reported their families using those digital services, and then add them up as the digital capability score, which

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[1] If the business was initiated in the survey year (2015), respondents were asked "Compared with the situation of first half of this year…"

ranges from 0 to 5. As shown by the factor analysis adopting iterated principal-factor method and subsequent scree plot (see Appendix 1 for reference), only the first factor has eigenvalue greater than 1. The percentage of variability explained by factor 1 is 83.9%, accounting for most of the total variability, and the Kaiser-Meyer-Olkin test (Kaiser, 1974) shows the KMO index is 0.7916.

Financial capability score

Compared with digital capability, financial capability is more specific to the functioning of making informed financial decisions, and there are well-developed frameworks to measure financial capability of households (Atkinson, McKay, Collard, and Kempson, 2007; Johnson and Sherraden, 2007; Kempson, Perotti, and Scott, 2013; Lusardi, 2011). We adopt the three dimensional approach which incorporate financial knowledge and skills, financial attitude, and financial behaviors, while allocating more emphasis on the latter dimension for both the availability of survey questions and very diversified nature of financial behaviors. For financial knowledge and skills, there are three related questions, asking about knowledge and skills to calculate interest, inflation, and comparison of potential risks of stocks and funds. Concerning that most financial behaviours can involve knowledge and skills on interest, inflation and risks, it's more reasonable to generate a united financial knowledge and skills variable to be one component of financial capability. We define the componential variable '*Financial knowledge & skills*' as 1 if the respondent provided at least one right answer for the three questions, which is the median level in the survey. For financial attitude, we use the question asking about respondents' degree of attention to economic and financial information. We define the componential variable '*Economic & financial information awareness*' as 1 if a respondent reported paying at least some attention to economic and financial information, compared to paying little or no attention. For financial behaviours, there are five componential variables. '*Use credit card*' indicates whether the household reported using credit cards. *'Have outstanding bank loans'* indicates whether the household reported having outstanding bank loans. *'Invest: liquidity'* indicates whether the household reported having deposit[2] no less than the value of 3-month household consumption[3]. *'Invest: risk management'* indicates whether the household reported using any commercial insurance. *'Invest: growth'* indicates whether the household reported investing in any financial instrument other than deposit or insurance. We then add up the 7 componential variables to form the financial capability score, which ranges from 0 to 7. As shown by the factor analysis adopting iterated principal-factor method and subsequent scree plot (also see Appendix 1), only the first factor has eigenvalue greater than 1. The percentage of variability explained by factor 1 is 75.6%, accounting for most of the total variability, and the KMO index is 0.7772.

Control variables

Krasniqi (2009) identifies determinants impacting household entrepreneurial activities, including age, gender, marital status, education, family size, rural/urban residence, as well as industries and regions. Astebro (2014) complements the list by pointing out the limitation of basing entrepreneurship on standard theories of risk and return, and provides behavioural insights on the relationship between risk preferences, overconfidence, nonpecuniary benefits preference, and the probability of becoming entrepreneurs. Hvide and Panos (2014) also confirms that more risk tolerant individuals are more likely to become entrepreneurs. In addition, both Ma and Yang (2011) and Hu and Zhang (2014) point out the impact of social network on household entrepreneurship, which, in the background of Chinese culture, can be especially measured by household relational expenditure. Further, Yin, Gong, and Guo (2019) takes into

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[2] Here, deposit includes current deposit, fixed term deposit, and balance of social security account.
[3] Calculated by dividing household annual total consumption last year by 4.

consideration number of children, number of labour force, number of family members who have poor health, as well as household asset. Benefiting from existing research, we utilize two comprehensive lists of control variables respectively for both the business ownership model and the business innovation model. For the latter, we also include some variables capturing business characteristics, namely, business history in years, business motivations, business e-accounting, online/offline business models, as well as whether the business received tax deduction.

Descriptive statistics of control variables for both samples are shown separately in Table 1. In the entire sample for studying digital financial capabilities and business ownership, the average age of respondents[4] was around 52 years old, 47.51% of whom were female, while 84.90% were married. Regarding educational levels, we adopt the 9-year compulsory education standard, which means whether the respondent finished only junior high school or below education. Shown by the statistics, 63.95% of respondents attained no more than junior high school education. Besides, we utilize the variable *'Risk tolerant'*[5] as the indicator for risk preference, and '*Happiness*'[6] as the indicator for optimism, as discussed above, individuals' behavioural preferences might well influence their probability of becoming entrepreneurs. From the perspective of household demographics, the average family size were 3 to 4 people. 30.83% of surveyed households resided in rural areas, 30.29% had at least one family member whose health was poor , 37.18% had at least one child 15 years old or below, and 47.52 had at least one elder 60 years old or above. Concerning household economic conditions, 91.46% of the entire sample owned home, the average household asset[7] was 823212.82 yuan, the average household income per capita was 27095.07 yuan, while the average household relational expenditure was 4206.41 yuan.

In the business sample for studying digital financial capabilities and business innovation, which contains households who reported running businesses, respondents were averagely over 6 years old younger than the entire sample, 2.25% fewer were females, 3.74% more were married, and 2.91% fewer attained only junior high school or below education. Regarding behavioural characteristics, 10.56% more respondents were risk tolerant, while 4.04% more were happy or extremely happy. As for household demographics, average family size in the business sample was larger and nearly 10% fewer households resided in rural areas. The average household relational expenditure was 35.29% more than that of entire sample. With respect to business characteristics, the average business history was more than 10 years, 25.04% of business owners started the business for the possibility to earn more, while 12.60% did it for ambition[8], which can act as one indicator for nonpecuniary benefits preference discussed above. 8.73% of business owners used computers or mobile phones as the bookkeeping tool, 3.03% had only online businesses, 3.44% had both online and offline businesses and 7.67% business owners received business tax deduction last year[9].

Table 1. Descriptive statistics of sample demographics.

Entire sample	N=34, 872	Business sample	N=4,825
Age (years)	51.98	Age (years)	45.11

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[4] We adopt the demographics of the respondent who answered all the questions for the household, because as required by the survey, the respondent should be the one who knew best about household economic conditions.

[5] In the 2015 CHFS questionnaire, respondents were asked, "Which of the choice below do you want to invest most if you have adequate money?" We define 'Risk tolerant' as 1 if the respondent reported preferring average or above risk and return.

[6] In the 2015 CHFS questionnaire, respondents were asked, "How happy do you feel?" We define 'Happiness' as 1 if the respondent reported "Extremely happy" or 'Happy'.

[7] Here we exclude business asset from household asset.

[8] In the 2015 CHFS questionnaire, respondents were asked, "Why did your household start a business?" We define 'Business for ambition' as 1 if the respondent chose 'Ideal job/Entrepreneurial drive'.

[9] For those businesses, which were started in 2015, the question asked about the situation in the first half of the year.

Female (%)	47.51	Female (%)	45.26
Married (%)	84.90	Married (%)	88.64
Education: Junior high or below (%)	63.95	Education: Junior high or below (%)	61.04
Risk tolerant (%)	25.88	Risk tolerant (%)	36.44
Happiness (%)	60.89	Happiness (%)	64.93
Family size (#)	3.35	Family size (#)	3.92
Rural (%)	30.83	Rural (%)	21.64
Poor health (%)	30.29	Household relational expenditure (CNY)	5690.86
Has child (%)	37.18	Business history (years)	10.31
Has elder (%)	47.52	Business for more money (%)	25.04
Own home (%)	91.46	Business for ambition (%)	12.60
Household asset (CNY) *	823212.82	Business with e-accounting (%)	8.73
Household income per capita (CNY)	27095.07	Business online only (%)	3.03
Household relational expenditure (CNY)	4206.41	Business online & offline (%)	3.44
		Received business tax deductions (%)	7.67

Source: 2015 China Household Finance Survey (CHFS)

* Excluding business assets. The same hereinafter.

Note: For brevity, we do not list the 172 Providence dummies for the business ownership model (entire sample), or the 17 industry dummies and 29 province dummies for the business innovation model (business sample). Since there are only 4825 observations in the business innovation model, we change to control province dummies rather than the 172 Providence dummies.

Table 2 provides an initial glimpse on the relationship between digital financial capabilities and household entrepreneurial activities through descriptive statistics. What we can first observe and calculate from numbers of observations in different groups is that, the proportion of business owners in the entire sample is 15.65%, while that of business owners who undertook innovative activities in the business sample is 10.53%. Both percentages are relatively small. Second, means of the capability scores and componential dimensions are impressively larger for business owners in the entire sample and those who undertook business innovation in the business sample. Third, the differences among the four sub groups, i.e., column (2), (3), (5) and (6), are generally greater regarding digital capability score and its componential variables, compared with those regarding financial capability and its componential variables.

When we take a further step to look specifically at componential variables, some eye-catching gaps stand out. In respect of digital capability, the greatest gaps, measured by percentage difference, are those regarding *'Mobile banking'*. Only 8.95% of non-business owners reported their families using mobile banking, while the percentages for business owners and innovation executors were 20.50% and 36.22% respectively, with the latter quadrupled. As for *'Online banking'*, the gaps are also impressive. While 15.55% of non-business owners reported their families using online banking, those of business owners and innovation executors were 30.68% and 50.59%, nearly doubled and more than tripled respectively. Comparatively, the gaps regarding *'Online shopping'*, *'Social network with a smartphone'* and *'Information search with*

a smartphone' are smaller, though not remarkably. However, from the perspective of absolute values, penetration rates with regard to these three dimensions are generally higher. For innovation executors, i.e., column (5), penetration rate of social network with a smartphone is as high as 71.65%, while those of online shopping and information search with a smartphone are 61.61% and 51.77% respectively.

With regard to financial capability, the greatest gap between business owners and non-business owners is that regarding *'Have outstanding bank loans'*. While only 10.46% of non-business owners had outstanding bank loans, the proportion for business owners doubled as 22.90%. In comparison, the greatest gap between innovation executors and non-innovation executors is that regarding *'Use credit card'*. While 23.91% of non-innovation executors reported their families using credit card, the percentage for innovation executors doubled as 50%. Concerning absolute values, those of *'Financial knowledge & skills', 'Economic & financial information awareness'* and *'Invest: liquidity'* are generally higher. The relatively high rate of liquidity investment seems to accord with the 'saving genes' of Chinese; however, it also raises the question of financial security. Though over half of surveyed households prepared savings no less than 3-month household consumption, there were still more than 40% who did not. If they met unexpected shocks, such as job losses, there might well be challenges for them to remain financially resilient before transferring to new jobs. Further, from the statistics of *'Invest: risk management' and 'Invest: growth'*, we can see that investment diversification was still not widely realized for most surveyed households. The result is especially impressive if we recall that *'Invest: growth'* indicates any investment other than deposit or insurance.

Table 2. Digital financial capabilities and household entrepreneurial activities.

%	Entire sample			Business sample		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Business owne	Non-busin ess	All	Innovati on executor	Non-inno vation executor
	N=3	n=5,4	n=29,	N=4	n=508	n=4,317
Digital capability score (#)	1.05	1.71	0.93	1.60	2.72	1.47
Online shopping	24.2	39.44	21.39	37.3	61.61	34.47
Online banking	17.9	30.68	15.55	27.7	50.59	25.09
Mobile banking	10.7	20.50	8.95	18.5	36.22	16.49
Social network with a smartphone	30.5	46.73	27.54	44.6	71.65	41.44
Information search with a	21.4	33.74	19.13	31.9	51.77	29.58
Financial capability score (#)	2.08	2.75	1.95	2.64	3.67	2.51
Financial knowledge & skills	57.9	70.42	55.67	69.4	87.20	67.41
Economic & financial information	32.9	40.85	31.53	39.0	57.28	36.90
Use credit card	17.7	29.79	15.57	26.6	50.00	23.91
Have outstanding bank loans	12.4	22.90	10.46	21.5	36.61	19.76
Invest: liquidity	53.9	63.18	52.17	62.4	69.29	61.69
Invest: risk management	15.7	25.50	13.90	24.1	31.30	23.35
Invest: growth	16.8	22.82	15.79	20.2	35.43	18.46

Source: 2015 China Household Finance Survey (CHFS)

Note: The business sample contains fewer observations than those who reported running businesses, because some observations are not included for missing variables.

Method

Digital financial capabilities and business ownership

To explore the impact of digital financial capabilities on households' business ownership, we first adopt probit model (1) to look at the marginal effects of digital and financial capabilities simultaneously. As in practice, both digital and financial capabilities could have impact on household entrepreneurial decisions.

$$Business\ ownership_i = \alpha_{11} + \alpha_{12}D_i + \alpha_{13}F_i + \boldsymbol{\beta X} + \varepsilon_{1i}$$
(1)

where dependent variable $Business\ ownership_i$ represents whether or not household i is a business owner. Independent variables D_i and F_i are digital and financial capabilities of household i respectively. The vector $\boldsymbol{X}$ represents household i's socioeconomic characteristics, as well as Providence dummies, as described in table 1. ε_{1i} is the error term. We specify to obtain robust standard errors in all our models, otherwise clarified.

What cannot be ignored in model (1) is that, there can probably be two-way relationships between digital financial capabilities and business ownership. Though we propose to look at the impact of digital financial capabilities on household entrepreneurial activities, it is also likely for households to become business owners first, and then acquire some digital financial capabilities in an effort to optimize business operation. To address such endogeneity in model (1), we utilize '*Own smart devices*'[10] as the instrumental variable for digital capability (Yin, Gong and Guo, 2019)), *"Trust in banks"*[11] as the IV for financial capability, and conduct two-step IV regression. The argument is that, owning smart devices is much related with digital capability, but can only have impact on entrepreneurial activities through their functions, which are components of digital capability. Similarly, trust in banks would not make differences to household entrepreneurship without counting on households' financial knowledge and skills, financial attitudes and financial behaviours. By comparing the significance of coefficients and margins from both probit and IV probit, as well as checking instruments weakness, over identification and exogeneity, we illustrate the validity of model settings.

On the ground of model (1) discussion, which shows the difference of marginal effects between digital and financial capabilities, we then turn to explore the driving forces of impact, that is, which componential dimensions in digital financial capabilities are driving significant and larger marginal effect? What are the characteristics of those acting as driving forces? To realize it, we put all the componential variables into model (2). By looking at the marginal effects, we try to capture what matters more for household entrepreneurial activities.

$$Business\ ownership_i = \alpha_{21} + \boldsymbol{\varphi D} + \boldsymbol{\omega F} + \boldsymbol{\theta X} + \varepsilon_{2i}$$
(2)

where, $\boldsymbol{D}$ stands for the vector of all the componential variables of digital capability, $\boldsymbol{\varphi}$ presents the vector of $\boldsymbol{D}$'s coefficients; $\boldsymbol{F}$ stands for the vector of all the componential variables of financial capability, $\boldsymbol{\omega}$ presents the vector of $\boldsymbol{F}$'s coefficients.

In addition, by observing the development of digital finance, it is easy for us infer that the impact of financial capability on household entrepreneurship might well be influenced by their digital capability, or vice versa. To testify such hypothesis, we take one more step to look at the changes brought by the interaction term of digital and financial capabilities, as shown in model (3).

$$Business\ ownership_i = \alpha_{31} + \alpha_{32}D_i + \alpha_{33}F_i + \alpha_{34}D_i * F_i + \boldsymbol{\rho X} + \varepsilon_{3i}$$
(3)

where, $D_i * F_i$ is the interaction term of digital and financial capabilities.

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[10] In the 2015 CHFS questionnaire, respondents were asked, "What durable goods does your family currently own?" and, "Which kind of mobile phone do you use?" We define "Own smart devices" as 1 if the respondent reported having computer or smart phone.

[11] In the 2015 CHFS questionnaire, respondents were asked, "If you can borrow money from all of the following channels, which one is the most reliable way you think?" We define 'Trust in banks' as 1 if the respondent chose 'Bank'.

To account for the endogenous regressors and their interaction term, we adopt the Control Function Approach (Papies, Ebbes, and Van Heerde, 2017; Wooldridge, 2015) to conduct the estimation. By regressing digital capability and financial capability on the IVs and relevant control variables respectively, we store the residuals for the Control Function and acquire the instrumented result. By checking the significance and "+/-" sign of its coefficient, we can infer the general relationship between one capability and the marginal effect of the other.

Further, to illustrate on how digital financial capabilities are interacting with each other concerning their impact on household entrepreneurship, as well as the policy implications shown by the process, we turn to compute and compare the marginal effect of one capability at each level of the other, based on model (3).

Digital financial capabilities and business innovation

In order to study the impact of digital financial capabilities on business innovation among business owners, we turn to the business sample, which has 4825 observations. As discussed and shown in the data section, we adopt a different list of control variables, to address distinct influencing factors. Apart from that, the modelling process is the same as above, during which we use model (4), (5) and (6).

$$Business\ innovation_i = \alpha_{41} + \alpha_{42}D_i + \alpha_{43}F_i + \boldsymbol{\gamma Y} + \varepsilon_{4i}$$
(4)
$$Business\ innovation_i = \alpha_{51} + \boldsymbol{\tau D} + \boldsymbol{\mu F} + \boldsymbol{\sigma Y} + \varepsilon_{5i}$$
(5)
$$Business\ innovation_i = \alpha_{61} + \alpha_{62}D_i + \alpha_{63}F_i + \alpha_{64}D_i * F_i + \boldsymbol{\delta Y} + \varepsilon_{6i}$$
(6)

where, $\boldsymbol{Y}$ is the vector of a different list of control variables, including industry and province dummies. $\boldsymbol{\tau}$ and $\boldsymbol{\mu}$ present the vectors of $\boldsymbol{D}$'s and $\boldsymbol{F}$'s coefficients.

As for the endogeneity issue, we expect there would be much weaker endogeneity problems. Considering the varieties of pressures from running a business, as well as the actual low ratio of households who undertook business innovation (10.53% of all surveyed business owners), we expect there would be the need of relatively strong attitudinal and behavioural power to initiate any business innovation. After all, for those who were actually running businesses, only 12.60% of them reported doing business for ambition, while most business owners were probably faced with the stress of making a living. Undertaking business innovation does not seem to be a have-to-do issue for running a business. As a result, there might well be the need of push power like digital financial capabilities, to realize some sort of innovation. We then testify the exogeneity of independent variables with Wald test of exogeneity.

Robustness checks by socioeconomic groups

To check the robustness of results, we conduct probit regressions by different socioeconomic populations, including gender, age cohorts, rural/urban, and whether the household is relatively poor concerning their consumption levels. On such basis, we further analyse heterogeneous impacts of digital financial capabilities among different populations and discuss relevant policy implication.

Result

Digital financial capabilities and household business ownership

Table 3 first presents the probit results on the relationship between digital financial capabilities and household business ownership from estimation of model (1), showing, households with higher digital financial capabilities were more likely to be a business owner. The controlled individual and household characteristics show expected relationships with household business ownership. Younger, male, less educated, risk tolerant and happy individuals

were more likely to be business-running households' respondents[12]. Apart from that, households, with fewer, unhealthy, elder family members, residing in rural areas, with less asset, income per capita, relational expenditure, were less likely to be business owners.

However, as discussed in the method section, there can probably be endogeneity in model (1). We then continue to conduct two-step IV probit estimation, using '*Own smart devices*'[13] as the IV for digital capability, *"Trust in banks"* for financial capability. From the Kleibergen-Paap rk LM statistic, we can see that there is no under identification issue. Kleibergen-Paap rk Wald F statistic is larger than the10% maximal IV size critical value of Stock-Yogo weak ID test. Multivariate F-tests for both capabilities are significant. Thus, we can conclude that instrumental variables are not weak, much related to the independent variables. Besides, we can see from the Durbin-Wu-Hausman test that the statistics reject the hypothesis that the explanatory variables are exogenous. Therefore, the IVs are valid and we do need to conduct the IV regression. With other variables at means, one-unit increase in digital capability score from its mean results in a 5.2% increase in the probability of a household being a business owner, at 5% confidence level; one-unit increase in financial capability score from its mean results in a 5.1% increase in the probability of a household being a business owner, at 5% confidence level.

Table 3. Digital financial capabilities and household business ownership.

Business ownership	Probit	IV Probit
Digital capability score	0.0043***	0.0520**
	(0.0017)	(0.0254)
Financial capability score	0.0098***	0.0505**
	(0.0015)	(0.0229)
N	34,872	34,872
Kleibergen-Paap rk LM statistic		137.997
Kleibergen-Paap rk Wald F statistic		69.686
- Stock-Yogo weak ID test critical values: 10%		7.03
Multivariate F-test for Digital capability		644.40
Multivariate F-test for Financial capability		481.99
Durbin (score) chi2(2)		52.9937
Wu-Hausman F(2,34824)		26.5007

Standard errors in parentheses, * p<.1, ** p<0.05, *** p<0.01. The same hereinafter.

Note: 1. For brevity, we used but do not list control variables here. The same hereinafter, see Appendix 2 for complete lists of results.

2. We report margins at means in the table. The same hereinafter, otherwise clarified.

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[12] Recall that the respondent was designed and required by the survey, to be the one who knew best about household economic conditions.
[13] See Data and Method sections for variable definitions, The same hereinafter.

To look further at the driving forces among different dimensions of digital financial capabilities, we conduct probit regression as model (2). Table 4 presents the relationships between componential variables of digital financial capabilities and household business ownership. All componential variables of financial capability except "use credit card" have significant impact. Comparatively, concerning digital capability, only online shopping and mobile banking have significant impact on household business ownership.

In order to understand the marginal effects of componential dimensions measuring digital capability, we propose to look back at the development dynamics of digital finance during and before the survey year. The significant impact of online shopping goes along with the booming phenomenon of digital finance in China, i.e., the fast growth of e-commerce. According to Yang (2016), e-commerce transaction volume in China, rose from 1.55 trillion yuan in 2006 to 20.82 trillion yuan in 2015, more than tenfold in ten years. The fast penetration of e-commerce not only benefited mass customers, but also inspired households to start online businesses or provide products to online retailers (Faz and Naji, 2018). With regard to online banking and mobile banking, shown by Table 2, penetration rate of online banking was much larger than that of mobile banking in 2015. However, online banking was actually experiencing a downward turning during that year, by market size of active customers. As reported by China Financial Certification Authority (CFCA), number of online banking customers who did carry out transactions dropped dramatically during 2015, compared to previous years[50]. Major reason pointed out was the mobilization of trading scenarios, including popularity of third-party payment, as well as substitution effect of mobile banking. An investigation in the report also revealed that, 43% of mobile banking customers preferred mobile banking to online banking, who only used online banking for functions unrealizable by mobile banking. Thus, the reason why mobile banking has significant impact on household business ownership, while online banking does not, may be that, households using mobile banking were generally more active e-banking users, practically adopting mobile banking as a tool for day-to-day usage, right at hand. We suppose the effect could be even more standout for small business owners whose transactions have smaller values. In fact, over 90% of surveyed business owners in 2015 CHFS reported their formation of businesses as individual businesses or non-formal organizations. In comparison, the impact of social network and information search is not significant when regressed together with componential variables discussed above, though we expected that they might have peer and information effect. Thus, we can infer that, digital capability directly related with transactions, no matter for fund transfer or business trading, could have more significant and larger impact on household business ownership, than information search and sharing channels. Although the 2015 CHFS does not provide us with mobile payment variable, we are lucky to capture the componential variables in our list, which enable us to not only explore the impact of heated areas like online shopping, social network, and information search, on household business ownership, but also compare the effects of online and mobile banking as above.

The marginal effects of componential dimensions measuring financial capability are consistent with existing literature (Aghion, Fally, and Scarpetta, 2007; Evans and Jovanovic, 1989; West, 2012; Wise, 2013; Yin, Song, Wu, and Peng, 2015; to name a few). *'Financial knowledge & skill', 'Economic & financial information awareness'*, as well as aspects related to mitigating liquidity constraints, namely, *'Have outstanding bank loans', 'Invest: liquidity',* are found to have positive impact on entrepreneurship. The significant and positive impact of *'Invest: risk management'*, which represents the usage of commercial insurance, may not only indicate the importance of planning and preparation for risks, but also show the power of insurance to reduce the fear of shocks. With the risk floor provided by insurance, households can become more

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[50] See, http://zhuanti.cebnet.com.cn/upload/pdf/dcbg.pptx.

confident to invest in their businesses. Analogous phenomena have already been observed on agricultural areas (Cole, Giné, and Vickery, 2017; Karlan, Osei, Osei-Akoto, and Udry, 2014). The significant and negative impact of *'Invest: growth'* accords with Gentry and Hubbard (2004), which points out undiversified pattern of portfolios held by entrepreneurial households, who invest most assets in their own businesses, rather than various financial products.

Table 4. Componential variables of digital financial capabilities and household business ownership.

Business ownership			
Digital capability score		**Financial capability score**	
Online shopping	0.0120**	Financial knowledge & skills	0.0077*
	(0.0049)		(0.0042)
Online banking	-0.0010	Economic & financial information	0.0067*
	(0.0060)		(0.0040)
Mobile banking	0.0211***	Use credit card	0.0086
	(0.0063)		(0.0052)
Social network with a	0.0005	Have outstanding bank loans	0.0401***
	(0.0051)		(0.0050)
Information search with a	0.0029	Invest: liquidity	0.0104**
	(0.0050)		(0.0040)
		Invest: risk management	0.0335***
			(0.0047)
N	34,872	Invest: growth	-0.0351***
R-squared	0.134		(0.0056)

When mentioning 'digital finance' and thinking of its evolution, it is not difficult to observe the enabling force of digital technologies toward financial services. Hence, we take a further step to come up with the question, 'Does the level of digital capability impact the marginal effect of financial capability on household entrepreneurship, or vice versa?' To examine how they interact with each other's marginal effect on household business ownership, we introduce the interaction term of digital and financial capabilities scores to our model (3). Distinguished from model (1), there arises the need of a different method to address the endogeneity issue in model (3) for the existence of the interaction term. We then utilize the Control Function Approach to address the endogeneity of independent variables and their interaction term. From Table 5, the coefficients of the interaction term from both probit and IV probit are significant, indicating that, first, the interaction term improves the goodness of fit of the model (Karaca-Mandic, et al., 2012); second, digital and financial capabilities have significant impact on each other's marginal effect on household business ownership.

Table 5. Digital financial capabilities and household business ownership with the interaction term.

Business ownership (N=34,872)	Probit	IV Probit
	Coefficients	Coefficients
Digital capability score	0.1004***	0.4419***
	(0.0142)	(0.1273)
Financial capability score	0.0888***	0.1846*
	(0.0096)	(0.1053)
The interaction term	-0.0234***	-0.0164***

	Margins of digital capability		Margins of financial capability
	(0.0034)		(0.0036)
Financial capability score=0	0.0192***	Digital capability score =0	0.0182***
	(0.0028)		(0.0020)
Financial capability score=1	0.0156***	Digital capability score =1	0.0141***
	(0.0024)		(0.0017)
Financial capability score=2	0.0115***	Digital capability score =2	0.0094***
	(0.0021)		(0.0017)
Financial capability score=3	0.0068***	Digital capability score =3	0.0044**
	(0.0019)		(0.0020)
Financial capability score=4	0.0016	Digital capability score =4	-0.0012
	(0.0020)		(0.0027)
Financial capability score=5	-0.0041*	Digital capability score =5	-0.0072**
	(0.0025)		(0.0036)
Financial capability score=6	-0.0105***		
	(0.0033)		
Financial capability score=7	-0.0174***		
	(0.0043)		

Note: The standard error in IV Probit based on the Control Function Approach was obtained by bootstrapping 1000 times (Papies, Ebbes, and Van Heerde, 2017).

To illustrate the varying marginal effects of one capability at different levels of the other, we conduct further computation of the marginal effects of digital capability score while financial capability score changes from 0 to 7, as well as the marginal effects of financial capability score while digital capability score changes from 0 to 5, as shown by the lower part of Table 5. Concerning digital capability, its impact on household business ownership keeps significant, positive and decreasing when financial capability score ranges from 0 to 3, then turns insignificant when financial capability score is 4, while turns significant and decreasing again from the 5-to-7 range. However, the difference is that the marginal effect turns negative through the latter range. Similarly, financial capability's impact on household business ownership keeps significant, positive and decreasing when the household's digital capability score ranges from 0 to 3, but becomes insignificant when the household's digital capability score is 4, and negative when the household's digital capability score is 5. The rationality of those patterns is that, households who previously had lower digital or financial capabilities were more likely to have unsatisfactory employment status. Thus, the improvement of their digital and financial capabilities was more likely to empower them to start their own businesses. Comparatively, for households with high digital or financial capabilities, it is more likely for them to hold satisfactory jobs. There would be more opportunity cost for them to take the risk of starting businesses with unpredictable returns. Thus, one capability's marginal impact on household business ownership decreases when the score of the other rises high.

From table 2, we can see that the means of digital capability score and financial capability score for the entire sample are only 1.05 and 2.08 respectively. In addition, Figure 1 illustrates the percentage distribution of digital and financial capabilities scores. Based on discussion on Table 5 above, groups, whose probability of being business owners could be significantly increased by improvement of digital or financial capabilities, were those who scored 3 or lower concerning either capability score, taking up majority of the sample. Therefore, there is still much space for both capabilities to have positive push on household entrepreneurship.
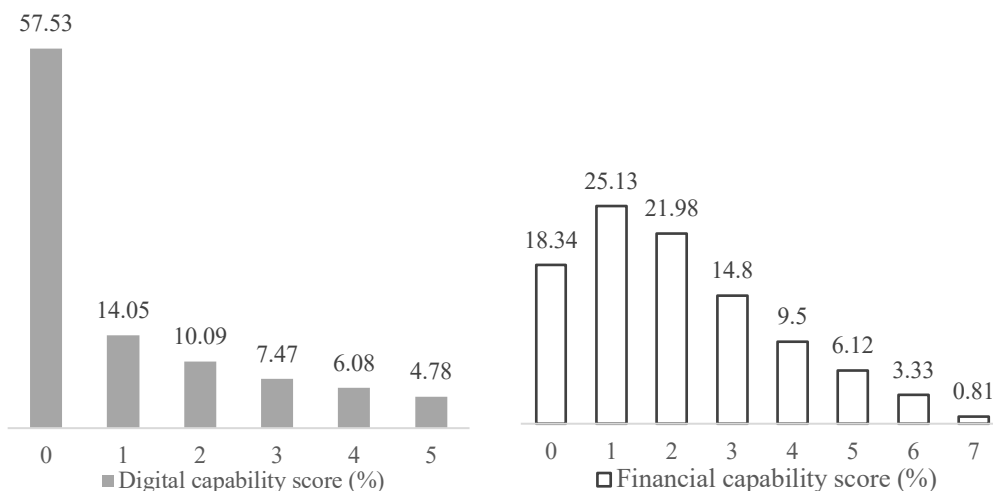
Figure 1. Distribution of digital and financial capabilities scores (%)

Digital financial capabilities and household business innovation

Table 6 first presents the Probit results on the relationship between digital financial capabilities and household business innovation from estimation of model (4), showing business owners with more digital financial capabilities were more likely to be innovation executors. The controlled individual, household and business characteristics show expected relationships with household business ownership. Younger, male, married, risk tolerant individuals were more likely to be the respondents of innovation-undertaking households. Apart from that, households with more relational expenditure were also more likely to be innovation executors. With regard to business characteristics, businesses, which had shorter history, used computer-based or mobile-based accounting, were operated online or both online and offline, received tax deduction, were more likely to undertake innovative activities. Besides, motivations, like making more money, or starting businesses for ambition (ideal job/entrepreneurial drive), also have significant and positive marginal effect on business innovation.

When it comes to the IV probit part, the results become insignificant. As discussed in the method section, we suspect the endogeneity of model (4). Since the Kleibergen-Paap statistics and Multivariate F-tests show that instrumental variables are not weak, we turn to analyse the endogeneity of independent variables. To examine our analysis, we conduct Durbin-Wu-Hausman test on the endogeneity of explanatory variables of model (4). The bottom two rows of Table 6 show that we cannot reject the hypothesis that the explanatory variables are exogenous. Therefore, there is no significant endogeneity problem and we just need to base our following analysis around business innovation on the probit model in Table 6.

According to probit result in Table 6, both digital and financial capabilities improves the probability of household business innovation significantly. While other variables are at mean

values, each one-unit increase in digital capability score from its mean, results in a 1.4% increase in the probability of a business owner undertaking innovative activities at 1% confidence level. Similarly, while other variables are at mean values, each one-unit increase in financial capability score from its mean, results in a 1.4% increase in the probability of a business owner undertaking innovative activities at 1% confidence level.

Table 6. Digital financial capabilities and household business innovation.

Business innovation	Probit	IV Probit
Digital capability score	0.0135***	0.0128
	(0.0029)	(0.0444)
Financial capability score	0.0140***	0.0198
	(0.0029)	(0.0445)
N	4,825	4,825
Kleibergen-Paap rk LM statistic		19.370
Kleibergen-Paap rk Wald F statistic		9.722
- Stock-Yogo weak ID test critical values: 10%		7.03
Multivariate F-test for Digital capability		169.93
Multivariate F-test for Financial capability		111.39
Durbin (score) chi2(2)		0 .0173 (p = 0.9914)
Wu-Hausman F (2,4767)		0 .0086 (p = 0.9915)

To illustrate the driving forces of business innovation, we put all the componential variables of digital financial capabilities into model (5), and conduct probit regression shown as Table 7.

Looking at the componential variables of digital capability whose margins are significant, *'Social network with a smartphone'* is eye attracting, especially concerning that, we have already applied "household relational expenditure" as one control variable for household social network. Hence, we suppose there is extra digital empowerment from online social network for innovative activities to happen. The argument is that, while there is endless information available on the internet, pretty much of which even free to acquire, business innovation seems to be more influenced by information received from business owners' social network. In principle, this might well go along with the open innovation practice adopted by some global giants, such as IBM and P&G. Compared with spending bulk of investment on internal R&D processes, they partially transformed to circulating problem-defining briefs throughout their global networks to find whether there had already been ready-made solutions in the world. Such open innovation practice helped reduce costs and increase R&D productivity tremendously (Huston and Sakkab, 2006). When it comes to small business owners like those in 2015 CHFS, we can expect there could be very limited intentionally spared resources for innovative activities. Luckily, the popularity of social network based on smartphones gives rise to the opportunity for small business owners to gain learning capability (Alegre and Chiva, 2013) and innovate through connecting and learning. In the much flatter internet world nowadays, information received from digital social network is not only news or words, but also views incorporated with the values and nudge of disseminators, some of whom could probably be well-known professionals. What's more, such connections are much more efficient and frequent, compared to traditional channels. Those may be the reasons why *'Social network with a smartphone'* has significant and positive marginal impact on business innovation, while *'Information search with a smartphone'* does not. Apart from that, we can also observe that the marginal effect of online shopping on business innovation is still very significant. Similar to the explanation in the business ownership model, we think the usage of online shopping opens a door to countless business ideas, especially

during such a period as the transaction volume of e-commerce mushroomed in China.

With respect to componential variables of financial capability, we can also find different patterns compared to the business ownership model. While we might regard *"Use credit cards"* and *"Have outstanding bank loans"* as sources of financial support for business innovation, these two variables have the common character of improving status quo by taking some degree of risk. Since there would always be the possibility that one cannot pay back debt or bill in full, which is similar to the case of business innovation, where changes would not always increase returns. As a result, taking credit, no matter by a credit card or a bank loan, not only provides actual financial resources for business innovation, but also implicates the attitudinal and behavioural traits to embrace risk for change. As for *'Financial knowledge & skills'* and *'Economic & Financial information awareness'*, they may function as the literate and attitudinal boosters for business innovation to happen.

Table 7. Componential variables of digital financial capabilities and household business innovation.

Business innovation

Digital capability score		Financial capability score	
Online shopping	0.0252*** (0.0087)	Financial knowledge & skills	0.0318*** (0.0098)
Online banking	0.0059 (0.0101)	Economic & Financial information	0.0180** (0.0079)
Mobile banking	0.0067 (0.0104)	Use credit card	0.0310*** (0.0086)
Social network with a	0.0263*** (0.0099)	Have outstanding bank loans	0.0310*** (0.0083)
Information search with a	0.0041 (0.0087)	Invest: liquidity	-0.0036 (0.0079)
		Invest: risk management	-0.0074 (0.0084)
N	4,825	Invest: growth	-0.0021
R-squared	0.168		(0.0091)

Like in the business ownership model, we introduce the interaction term of digital and financial capabilities scores to examine their mutual impact on each other's marginal effect on business innovation. Shown by Table 8, the coefficient of the interaction term is significant, which means it improves the goodness of fit of model (6), and digital and financial capabilities have significant impact on each other's marginal effect on business innovation.

Table 8. Digital financial capabilities and household business innovation with the interaction term.

Business innovation (N=4,825)	Probit Coefficients
Digital capability score	0.2151*** (0.0400)
Financial capability score	0.1839*** (0.0313)
The interaction term	-0.0339*** (0.0098)
Margins of	**Margins of**

	digital capability		**financial capability**
Financial capability score=0	0.0235*** (0.0053)	Digital capability score =0	0.0234*** (0.0045)
Financial capability score=1	0.0227*** (0.0045)	Digital capability score =1	0.0218*** (0.0039)
Financial capability score=2	0.0212*** (0.0039)	Digital capability score =2	0.0193*** (0.0035)
Financial capability score=3	0.0187*** (0.0036)	Digital capability score =3	0.0155*** (0.0038)
Financial capability score=4	0.0150*** (0.0039)	Digital capability score =4	0.0103** (0.0052)
Financial capability score=5	0.0098* (0.0052)	Digital capability score =5	0.0034 (0.0077)
Financial capability score=6	0.0028 (0.0077)		
Financial capability score=7	-0.0060 (0.0111)		

Table 8 also illustrates the different marginal effects of one capability at each level of the other. Regarding digital capability, its impact on household business innovation keeps positive and decreasing when financial capability score ranges from 0 to 5, but turns insignificant when the household's financial capability is as high as 6 or 7. Likewise, financial capability's impact on household business innovation keeps significant and positive and decreasing when digital capability ranges from 0 to 4, but turns insignificant when the household's digital capability score is 5. In general, the changing trend holds with the negative sign of the interaction term in model (6) that, the larger one capability score is, the smaller the marginal effect the other will have on household business innovation. To understand the reason why the interaction effect of digital and financial capabilities scores is still negative concerning innovative activities among business owners, we propose to reflect on and compare the roots of entrepreneurship and the functionings corresponding to digital financial capabilities. As pointed out by Astebro, Herz, Nanda, and Weber (2014), standard theories of risk and return cannot provide a complete basis for entrepreneurship, because the risk-adjusted returns of entering and persistence in entrepreneurship are actually low (Hamilton, 2000). Behavioural factors, such as risk preferences, do matter. Similarly, undertaking business innovation can always be a bold step toward changes. While an excellent innovation executor may have better skills in seizing opportunities, he/she does not objectively know the distribution of returns (Knight, 1921). Comparatively, no matter for policy makers or multilateral NGOs, the improvement of digital financial capabilities is aimed at enabling households to make informed decisions, from a rational standpoint. Thus, we suppose, while digital financial capabilities bring business owners innovative inspiration and resources, or even higher risk tolerance (Okičić, and Selimović, 2017), the accumulation of capabilities also make them more rationally think of innovation from the standpoint of risk-adjusted returns. So, one capability's marginal impact on business innovation decreases as the other rises to higher levels, while those of both stay significant and positive within ranges as discussed above.

Robustness checks by socioeconomic groups

Since the empowerment from digital financial capabilities can be an important lever to increase households' well-beings and especially benefit vulnerable populations (Aker, 2008; Jensen, 2007; Kempson, Perotti, and Scott, 2013), we look further at their diversified effects among different socioeconomic groups, which also acts as a robustness check with regard to model (3) and (6), with the interaction term included.

Table 9 presents the probit margins of digital financial capabilities on household business ownership by groups classified regarding gender, age cohorts, rural/ urban residence, and relative poverty. In line with the result from model (3), marginal effects are significant and positive across all groups, mostly at 1% confidence level, showing strong robustness. What's more, there are distinct patterns of trend concerning marginal effects of digital and financial capabilities, which should not be overlooked. Specifically, digital capability's marginal effect on household business ownership is more pronounced for male respondents and rural, relatively poor households. In comparison, financial capability's marginal effect on household business ownership is more standout for female respondents and urban, non-relatively poor households. When it comes to age cohorts, the largest marginal effects are those for middle-aged groups, regarding both digital and financial capabilities, while that of financial capability is also larger for young groups.

Such distinct patterns leave us inspirations for future policy emphasis. On one hand, digital capability is especially pro-rural and pro-poor regarding business ownership. Since the beginning of China's Rural Vitalization Strategy and Targeted Poverty Alleviation Policy, much attention and numerous efforts have been paid to such areas, yet effective methods are still under exploration. Shown by our analysis, improvement of digital capability would have significantly larger influence on probability of rural and relatively poor households being business owners. The rationality is embedded in the characteristics of both human capital and digital technologies. Generally, populations, who live in rural areas and are relatively poor, may find it harder to meet formal employment requirement, especially for jobs with such satisfactory income as to help change a whole family's economic status. The widely connected, efficient and low-cost features of digital commerce and finance in China helped create a well-functioning ecosystem to benefit them in starting and running their own businesses. This gives us confirmation to promote the utilization of digital technologies among those vulnerable populations. On the other hand, both digital and financial capabilities have significantly larger influence on probability of middle-aged respondents being business owners, compared to other two age cohorts. The argument is that, middle-aged group might well face heavier life burdens, as well as implicit age discrimination, especially for jobs without high technical requirement. Thus, with the empowerment of digital financial capabilities, middle-aged group have greater tendency to become entrepreneurs. Concerning it is also the group with largest population, and considerable proportion of whom would enter elder group in the near future, the improvement of their digital financial capabilities has important implication for policies dealing with aging problems.

Table 10 presents the probit margins of digital financial capabilities on household business innovation by gender, age cohorts, rural/ urban residence, and relative poverty. While results are still robust across almost all socioeconomic groups, patterns of trend are quite different from those around business ownership. Prominently, both digital and financial capabilities' marginal effects on business innovation are larger for male, young and non-relatively poor groups. With regard to rural/ urban residence, marginal impact of digital capability is larger for urban group, while that of financial capability is larger for rural group. Concerning the componential dimensions of digital financial capabilities, which have significant and positive marginal effects on business innovation, we suppose larger influence might be the result of greater peer network regarding both capabilities and innovative activities. Detailed examination can rely on future studies regarding different populations.

In summary, results by different socioeconomic groups demonstrate strong robustness of our models, implicating improvement of digital financial capabilities can promote household entrepreneurship widely across different populations. Concerning problems like rural vitalization, poverty alleviation, and society aging, special emphasis can be targeting improving digital capability of rural and relatively poor households, as well as both digital and financial capabilities of middle-aged group.

Table 9. Probit margins on business ownership by socioeconomic groups.

Business Ownership	(1) Female	(2) Male	(3) Age 16~35	(4) Age 36~59
Digital	0.0109*	0.0110**	0.0092*	0.0101***
	(0.0028)	(0.0028)	(0.0053)	(0.0030)
Financial	0.0131*	0.0137**	0.0130**	0.0170***
	(0.0023)	(0.0024)	(0.0054)	(0.0026)
N	16568	18304	5287	18021
R-squared	0.125	0.139	0.075	0.094

Business Ownership	(5) Age 60~max	(6) Rural	(7) Urban	(8) Relatively poor	(9) Non-relatively poor
Digital	0.0068*	0.0154***	0.0062**	0.0119**	0.0078***
	(0.0038)	(0.0037)	(0.0023)	(0.0043)	(0.0023)
Financial	0.0042**	0.0138***	0.0135**	0.0127**	0.0128***
	(0.0018)	(0.0025)	(0.0021)	(0.0027)	(0.0020)
N	11564	10752	24120	9157	25715
R-squared	0.138	0.158	0.124	0.107	0.133

Note: 1. The interaction terms is included in the regressions.

2. Numbers of sample in different sub groups do not add up to 34,872, because of drops caused by some missing control variables after splitting the entire sample into different groups.

3. Based on Chen and Ravallion (2012), we define a household as being "relatively poor", if its total consumption per capita was less than 50% of per capita consumption at provincial level.

Table 10. Probit margins on business innovation by socioeconomic groups.

Business Innovation	(1) Female	(2) Male	(3) Age 16~35	(4) Age 36~59	(5) Age 60~max
Digital	0.0117*	0.0246**	0.0244**	0.0152**	0.0187**
	(0.0044)	(0.0048)	(0.0082)	(0.0040)	(0.0065)
Financial	0.0146*	0.0210**	0.0197**	0.0169**	0.0010
	(0.0046)	(0.0045)	(0.0086)	(0.0038)	(0.0043)
N	2,101	2,641	1,173	2,943	455
R-squared	0.170	0.176	0.156	0.154	0.277

Business Innovation	(6) Rural	(7) Urban	(8) Relativ	(9) Non-relativ

			ely poor	ely poor
Digital	0.0113**	0.0185**	-0.0036	0.0208***
	(0.0055)	(0.0038)	(0.0062	(0.0038)
Financial	0.0187**	0.0169**	0.0091*	0.0194***
	(0.0051)	(0.0037)	(0.0050	(0.0037)
N	896	3,781	570	4,036
R-squared	0.263	0.158	0.207	0.152

Note: 1. The interaction terms is included in the regressions.

2. Numbers of sample in different sub groups do not add up to 4,825, because of drops caused by some missing control variables after splitting the entire sample into different groups.

Concluding remarks

Using the China Household Finance Survey (CHFS) 2015 data, this paper provides evidence on the impact of digital financial capabilities on household entrepreneurship from a relatively comprehensive view. First, we construct robust scores to measure both digital and financial capabilities. Second, we illustrate consistent and strong evidence that digital financial capabilities have significant and positive impact on household business ownership and innovation, based on both probit and IV probit analysis. Third, we compare the varying impact of different componental dimensions of digital financial capabilities on household entrepreneurship, and highlight differential driving forces regarding their impact on business ownership and innovation. In particular, we adopt the interaction term of digital and financial capabilities scores to analyse their interacted impact on household entrepreneurship. As shown by the result, the interaction term improves the goodness of fit of the model, and digital and financial capabilities have significant influence on each other's impact on household entrepreneurship. By comparing the varying influences across different socioeconomic populations, we prove the robustness of our empirical result, and explore policy implications for vulnerable groups.

Compared with previous studies, this paper extends the literature by three major contributions. Primarily, the examination we conduct is considerably comprehensive around the association between digital financial capabilities and household entrepreneurship, taking into account more dimensions of capabilities simultaneously. In addition, we illustrate and compare how digital financial capabilities are affecting business ownership and business innovation through different function channels. Further, for the first time, we point out the interacted impact of digital and financial capabilities, and rigorously examine both the general interaction effect and derivative effects of one capability at each level of the other, on household entrepreneurship. All in all, this paper provides new methods and insights for better understanding the relationship between digital financial capabilities and household entrepreneurship, as well as policy implications to benefit strategic development interventions.

While this paper addresses households' entrepreneurial decisions and business innovation, other entrepreneurial activities could also be affected by digital financial capabilities. Thus, there is the potential for a new breed of studies. Given the limits of CHFS 2015 data, we do not include such phenomenal service as mobile payment in China. In future research, the role of mobile payment, or any other influential new service in a specific market, should be explored and compared with other componental dimensions.

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Appendix 1. Factor analysis results of digital financial capabilities scores

Table 1. Digital capability score - Factor analysis

Factor	Eigenvalue	Difference	Proportion	Cumulative	Variable	KMO
Factor1	2.46389	2.07758	0.8390	0.8390	Online shopping	0.8493
Factor2	0.38632	0.30593	0.1315	0.9705	Online banking	0.7596
Factor3	0.08039	0.07394	0.0274	0.9979	Mobile banking	0.7808
Factor4	0.00645	0.00662	0.0022	1.0001	Social networking with smartphone	0.7873
Factor5	-0.00017	.	-0.0001	1.0000	Information search with smartphone	0.7962
Method	Iterated principal factors				Overall	0.7916
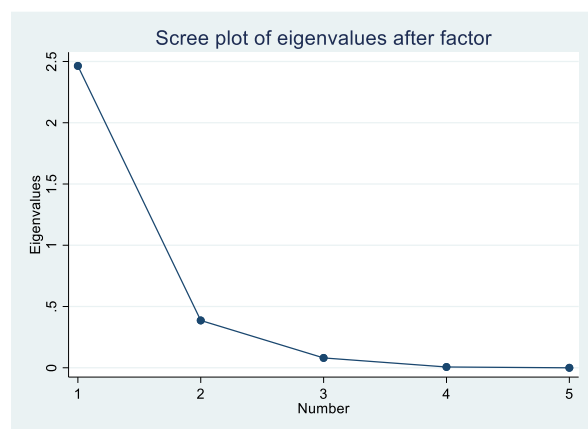


Figure 1. Scree plot of digital capability factors.

Table 2. Financial capability score - Factor analysis

Factor	Eigenvalue	Difference	Proportion	Cumulative	Variable	KMO
Factor1	1.68989	1.44453	0.7556	0.7556	Financial knowledge & skills	0.8002
Factor2	0.24536	0.07130	0.1097	0.8654	Economic &	0.7978

					Financial information awareness	
Factor3	0.17406	0.06943	0.0778	0.9432	Use credit card	0.7504
Factor4	0.10463	0.08619	0.0468	0.9900	Have outstanding bank loans	0.7447
Factor5	0.01844	0.01425	0.0082	0.9982	Invest: liquidity	0.7955
Factor6	0.00419	0.00440	0.0019	1.0001	Invest: risk management	0.8205
Factor7	-0.00020	.	-0.0001	1.0000	Invest: growth	0.7564
Method	Iterated principal factors				Overall	0.7772
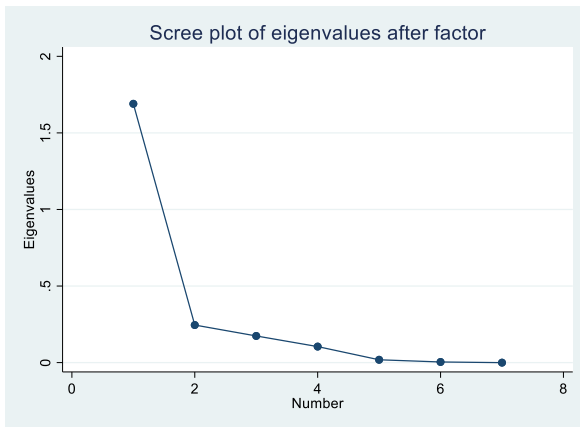
Figure 2. Scree plot of financial capability factors.

Appendix 2. Complete regression results
Table 3. Digital financial capabilities and household business ownership.

	(1) Probit	(2) IV probit
Digital capability score	0.0043**	-.----
	(0.0017)	(-.----)
Financial capability score	0.0098***	-.----
	(0.0015)	(-.----)
Digital capability score (instrumented)	-.----	0.0520**
	(-.----)	(0.0254)
Financial capability score (instrumented)	-.----	0.0505**
	(-.----)	(0.0229)
Age	-0.0027***	0.0001
	(0.0002)	(0.0007)
Female	-0.0208***	-0.0172***
	(0.0036)	(0.0050)
Married	0.0036	-0.0053
	(0.0058)	(0.0102)
Education: Junior high or below	0.0588***	0.1253***

	(0.0047)	(0.0096)
Risk tolerant	0.0126***	-0.0249***
	(0.0043)	(0.0085)
Happiness	0.0129***	0.0134***
	(0.0037)	(0.0041)
Family size	0.0308***	0.0331***
	(0.0015)	(0.0018)
Rural	-0.0533***	-0.0322***
	(0.0048)	(0.0057)
Poor health	-0.0275***	-0.0156***
	(0.0045)	(0.0045)
Has child	-0.0042	-0.0086
	(0.0044)	(0.0058)
Has elder	-0.0437***	-0.0396***
	(0.0044)	(0.0053)
Own home	-0.0681***	-0.0307***
	(0.0080)	(0.0096)
ln (Household asset)	0.0295***	0.0066
	(0.0020)	(0.0043)
ln (Household income per capita)	0.0034***	-0.0027*
	(0.0012)	(0.0016)
ln (Household relational expenditure)	0.0022***	-0.0011
	(0.0006)	(0.0007)
Providence dummies and constant	Not listed for brevity	
N	34872	34872
pseudo R^2	0.129	-.---

Standard errors in parentheses, * p<.1, ** p<0.05, *** p<0.01

Table 4. Componential variables of digital financial capabilities and household business ownership

Business ownership (Probit)

Digital capability score		Financial capability score	
Online shopping	0.0120** (0.0049)	Financial knowledge & skills	0.0077* (0.0042)
Online banking	-0.0010 (0.0060)	Economic & Financial information	0.0067* (0.0040)
Mobile banking	0.0211*** (0.0063)	Use credit card	0.0086 (0.0052)
Social network with	0.0005 (0.0051)	Have outstanding bank loans	0.0401*** (0.0050)
Information search with	0.0029 (0.0050)	Invest: liquidity	0.0104** (0.0040)
		Invest: risk management	0.0335*** (0.0047)
		Invest: growth	-0.0351*** (0.0056)
Age	-0.0026** (0.0002)	Has child	-0.0066 (0.0044)
Female	-0.0206** (0.0036)	Has elder	-0.0419*** (0.0044)
Married	0.0008 (0.0057)	Own home	-0.0720*** (0.0080)
Education: Junior high or	0.0554*** (0.0046)	ln (Household asset)	0.0295*** (0.0020)
Risk tolerant	0.0161*** (0.0043)	ln (Household income per capita)	0.0033*** (0.0012)
Happiness	0.0136*** (0.0037)	ln (Household relational expenditure)	0.0021*** (0.0006)
Family size	0.0300*** (0.0015)	Providence dummies and constant	Not listed For brevity
Rural	-0.0550** (0.0048)	N	34872
Poor health	-0.0276** (0.0045)	R-squared	0.134

Table 5. Digital financial capabilities and household business ownership with the interaction term.

	Probit Coefficients	IV Probit Coefficients
Digital capability score	0.1004***	-.----
	(0.0142)	(-.----)
Financial capability score	0.0888***	-.----
	(0.0096)	(-.----)
The interaction term	-0.0234***	-.----

	(0.0034)	(-.----)
Digital capability score (instrumented)	-.----	0.4419***
	(-.----)	(0.1245)
Financial capability score (instrumented)	-.----	0.1846*
	(-.----)	(0.1041)
The interaction term (instrumented)	-.----	-0.0164***
	(-.----)	(0.0035)
Age	-0.0124***	0.0031
	(0.0009)	(0.0034)
Female	-0.1002***	-0.0946***
	(0.0179)	(0.0228)
Married	0.0168	0.0896*
	(0.0287)	(0.0501)
Education: Junior high or below	0.2952***	0.6293***
	(0.0231)	(0.0463)
Risk tolerant	0.0674***	-0.1730***
	(0.0210)	(0.0380)
Happiness	0.0612***	0.0261
	(0.0186)	(0.0197)
Family size	0.1524***	0.1790***
	(0.0073)	(0.0080)
Rural	-0.2529***	-0.1443***
	(0.0243)	(0.0299)
Poor health	-0.1280***	-0.0914***
	(0.0223)	(0.0239)
Has child	-0.0140	-0.0848***
	(0.0221)	(0.0240)
Has elder	-0.2175***	-0.2556***
	(0.0219)	(0.0235)
Own home	-0.3266***	-0.1411***
	(0.0402)	(0.0467)
ln (Household asset)	0.1440***	0.0511***
	(0.0103)	(0.0206)
ln (Household income per capita)	0.0168***	-0.0122

	(0.0060)	(0.0078)
ln (Household relational expenditure)	0.0098***	-0.0028
	(0.0029)	(0.0035)
Providence dummies and constant	Not listed for brevity	
N	34872	34872
pseudo R^2	0.131	-.---

Table 6. Digital financial capabilities and household business innovation.

Business innovation	(1) Probit	(2) IV Probit
Digital capability score	0.0135***	-.----
	(0.0029)	(-.----)
Financial capability score	0.0140***	-.----
	(0.0029)	(-.----)
Digital capability score (instrumented)	-.----	0.0128
	(-.----)	(0.0444)
Financial capability score (instrumented)	-.----	0.0198
	(-.----)	(0.0445)
Age (years)	-0.0012***	-0.0010
	(0.0004)	(0.0012)
Female (%)	-0.0237***	-0.0262**
	(0.0073)	(0.0111)
Married (%)	0.0346***	0.0254
	(0.0122)	(0.0280)
Education: Junior high or below (%)	-0.0053	-0.0055
	(0.0087)	(0.0164)
Risk tolerant (%)	0.0233***	0.0316**
	(0.0079)	(0.0151)
Happiness (%)	0.0035	0.0018
	(0.0079)	(0.0089)
Family size (#)	-0.0037	-0.0040
	(0.0027)	(0.0034)
Rural (%)	0.0101	0.0076
	(0.0102)	(0.0114)
Household relational expenditure (CNY)	0.0028**	0.0027*
	(0.0013)	(0.0016)
Business history (years)	-0.0010**	-0.0011*
	(0.0005)	(0.0007)
Business for more money (%)	0.0196**	0.0228**
	(0.0085)	(0.0110)
Business for ambition (%)	0.0316***	0.0413**
	(0.0102)	(0.0163)
Business with e-accounting (%)	0.0347***	0.0639***
	(0.0112)	(0.0220)
Business online only (%)	0.0379**	0.0743*
	(0.0179)	(0.0409)
Business online & offline (%)	0.0705***	0.1466***

	(0.0157)	(0.0379)
Received business tax deductions (%)	0.0314**	0.0464**
	(0.0123)	(0.0204)
Province, industry dummies and constant	Not listed for brevity	
N	4825	4825
pseudo R^2	0.157	-.---

Table 7. Componential variables of digital financial capabilities and household business innovation.

Business innovation (Probit)			
Digital capability score		**Financial capability score**	
Online shopping	0.0252***	Financial knowledge & skills	0.0318***
	(0.0087)		(0.0098)
Online banking	0.0059	Economic & Financial information	0.0180**
	(0.0101)		(0.0079)
Mobile banking	0.0067	Use credit card	0.0310***
	(0.0104)		(0.0086)
Social network with	0.0263***	Have outstanding bank loans	0.0310***
	(0.0099)		(0.0083)
Information search with	0.0041	Invest: liquidity	-0.0036
	(0.0087)		(0.0079)
		Invest: risk management	-0.0074
			(0.0084)
		Invest: growth	-0.0021
			(0.0091)
Age (years)	-0.0009**	Business history (years)	-0.0009*
	(0.0004)		(0.0004)
Female (%)	-0.0229**	Business for more money (%)	0.0198**
	(0.0073)		(0.0083)
Married (%)	0.0305**	Business for ambition (%)	0.0332***
	(0.0119)		(0.0100)
Education: Junior high or	-0.0041	Business with e-accounting (%)	0.0318***
	(0.0085)		(0.0109)
Risk tolerant (%)	0.0207***	Business online only (%)	0.0355**
	(0.0078)		(0.0173)
Happiness (%)	0.0045	Business online & offline (%)	0.0694***
	(0.0077)		(0.0155)
Family size (#)	0.0115	Received business tax deductions (%)	0.0285**
	(0.0101)		(0.0118)
Rural (%)	-0.0039	Province, industry dummies and	Not listed For brevity
	(0.0026)		
Household relational	0.0030**	**N**	4825
	(0.0013)	R-squared	0.168

Table 8. Digital financial capabilities and household business innovation with the interaction term.

Business innovation	**Probit Coefficients**

Digital capability score	0.2151***
	(0.0400)
Financial capability score	0.1839***
	(0.0313)
The interaction term	-0.0339***
	(0.0098)
Age (years)	-0.0079***
	(0.0028)
Female (%)	-0.1651***
	(0.0541)
Married (%)	0.2527***
	(0.0891)
Education: Junior high or below (%)	-0.0400
	(0.0634)
Risk tolerant (%)	0.1724***
	(0.0579)
Happiness (%)	0.0156
	(0.0581)
Family size (#)	-0.0274
	(0.0197)
Rural (%)	0.0911
	(0.0759)
Household relational expenditure (CNY)	0.0193**
	(0.0098)
Business history (years)	-0.0077**
	(0.0034)
Business for more money (%)	0.1398**
	(0.0628)
Business for ambition (%)	0.2275***
	(0.0752)
Business with e-accounting (%)	0.2493***
	(0.0808)
Business online only (%)	0.2817**
	(0.1298)
Business online & offline (%)	0.5244***
	(0.1136)
Received business tax deductions (%)	0.2258**
	(0.0895)
Province, industry dummies and constant	Not listed for brevity
N	4825
pseudo R^2	0.161

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