Effects of Renminbi (RMB) Internationalization on State-owned Enterprises Balance-sheet and Sovereign Debt: Evidence with a DSGE Model of RMB Trade Settlement and RMB-led Financial Instruments

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Abstract

This paper examines the effects of China's renminbi internationalization on state-owned corporate balance sheets and sovereign debt. This research adds three core dimensions to the nascent literature : (i) Sovereign debt analysis by distinguishing between state-owned corporations and private-sector corporations' balance-sheet. (ii) international financial market segmentation, in which we differentiate between public and private capital-backed collateral. (ii) Assessment of renminbi internationalization effects. Specifically, we developed a monetary Dynamic Stochastic General Equilibrium model to successfully conduct this topical experiment. We start by modeling China-Africa's past experiences with capital inflows into Africa from China due to trade, investment, and large sovereign debt. Subsequently, we model future prospects of renminbi internationalization as the reversal of capital flows out of Africa due to Chinese economic rebalancing, the reduction of the People's Bank of China's balance sheet, the invoicing of China's exports to Africa in renminbi, the currency swap operations between China and African central banks, and the purchase of renminbi-denominated bonds by African economic agents. Our analysis reveals how differentiated types of corporates in Africa may segment financial markets and create international financial frictions. It demonstrates how China's renminbi internationalization affects these differentiated types of corporate vulnerabilities. It highlights how international financial frictions emphasize the dynamic between rebalancing strategies in China and corporate activities in Africa. The analysis reveals how the contingent liabilities can transmit the adverse effects of renminbi internationalization from the state-owned corporate sector to an entire economy and expand sovereign debt.

JEL Codes: E13, E32, E44, E52, E58, F34, F44, 016, L32

Keywords: China, Renminbi, Sovereign Debt, RMB Trade Settlement, DSGE Model, Africa, State-owned Enterprises Balance-sheet, RMB-led Bond, RMB Currency Swaps, RMB-led Investment.

1 Introduction

China, as Africa's first trade partner, played a prominent role in African economies during these past decades, and it seems obvious that the future prospect of China's currency role in African trade and financial transactions, as well as debt sustainability, will be significant.The wider use of the renminbi in international trade and financial transactions can be understood as a response to the growing weight of China's trade and investment flows in the world economy. So, the more China continues to trade with Africa, the more popular the use of the renminbi by African countries will be. China is thus promoting the use of renminbi for settlement and offshore operations with Africa, as the demand for its currency is increasing at a time when the continent's economy is expanding (Frankel, 2012; Bowles and Wang, 2013; Eichengreen and Masahiro Kawai, 2015; Hyo-sung Park, 2016; Alfaro and Kanczuk, 2019; Agarwal et al., 2020; Horn et al., 2021).

In practice, China promotes renminbi internationalization in two broad dimensions: on the one hand, the renminbi settlement in trade and investment; on the other hand, the development of renminbi offshore markets or renminbi-denominated financial instrument markets (Chen and Hu, 2013; Prasad, 2016; Zhang, 2015; Eichengreen, 2015; Amstad et al., 2020; Bon and Cheng, 2021).

In the first step in the process of renminbi internationalization, China focused on promoting the use of the currency for trade-related purposes. Since the inspection of the pilot scheme, authorization to settle trade in renminbi has been extended, so that essentially all trade by China can now be settled in renminbi. A number of countries in Africa, among them Ghana, are using the renminbi as part of their settlement and reserve currency. Zambia has recently increased its use of renminbi for trade settlement with China. In addition, both the use of the renminbi for outward foreign direct investment by Chinese enterprises and the use of the renminbi for inward foreign direct investment in China have been strengthened with the launch of the renminbi Outward Direct Investment Scheme and the creation of the Renminbi Inward Direct Investment Scheme. Renminbi-denominated and settled foreign direct investment has thus risen rapidly, including in Africa. A growing demand for the Chinese currency has been reported in one country after another. Kenya hosts a renminbi clearing house. Renminbi internationalization has achieved progress not only in trade and investment settlement but also in the offshore renminbi markets (Yin, 2011; Cheung et al., 2012; Li et al., 2013; Li, 2013; Xu and He, 2015; Meyer et al., 2019; Bahaj and Reis, 2020; Gelpern et al., 2021).

In the second step in the process of renminbi internationalization, Chinese authorities have fostered the growth of offshore renminbi-denominated bond markets. The Renminbi Qualified Foreign Institutional Investor Scheme was introduced to allow prequalified offshore institutions to invest in China's onshore interbank bond market and equity markets. China has also promoted direct trading of the renminbi with non-USD currencies to eliminate the need for foreign counterparties to first buy and sell dollars in order to move between third currencies and the renminbi. Hence, the People's Bank of China negotiated

bilateral currency swap lines with foreign central banks to provide them with renminbi liquidity in order to encourage them to permit their banks and enterprises to conduct businesses in renminbi. Hence, as Sino-Africa ties continue to expand, a number of African central banks are applying to the People's Bank of China for currency swaps.[1] The Nigeria central bank announced that it is shifting more of its foreign reserves into renminbi from dollars. In addition, the Bank Al-Maghrib of Morocco, the Central Bank of Egypt, the South African Reserve Bank and the Central Bank of Lesotho have outstanding swap line agreements with the People's Bank of China. Zimbabwe also joined the growing list of countries in Africa using the Chinese Renminbi, but specifically as one of their official currencies. When China signed an agreement with African countries on direct currency trading, it also agreed to allow the African central banks to hold renminbi-denominated sovereign debt as foreign reserves and to promote the purchase of renminbi-denominated bonds by the African enterprises. The South African reserve bank has signed an agreement with the People's Bank of China to invest in China's bond market (He et al., 2011; Zhang and He, 2012; Yang and Han, 2013; Prasad, 2014; Liao and McDowell, 2014; Lin et al., 2016; Ilzetzki et al., 2019; Mitchener and Trebesch, 2020; Bandiera and Tsiropoulos, 2020).

Against this background, the renminbi trade settlement has become a major channel for offshore renminbi to flow back to China. Renminbi internationalization appears thus as a mechanism for encouraging the process of China's rebalancing from goods to services, notably financial services, and from investment to consumption. Nevertheless, the main uncertainty around this virtuous Chinese currency internationalization is whether these mechanisms will trigger reverse capital flows from Africa back to China, with potential adverse effects on corporate balance-sheets, which have benefited heavily in the past from cheap capital flows from China (Obstfeld et al., 2005; Henning, 2009; Dobson and Masson, 2009; Huang and Lynch, 2013; He, 2015; Schlegl et al., 2019; Brautigam et al., 2020).

The importance of international collateral constraints for less-developed countries was first identified by Eaton and Gersovitz (1981) and Bulow and Rogoff (1989), focusing on sovereign debt issues. This is one core respect in which we should recognize that financial markets can not be frictionless in the sense of Arrow and Debreu in less-developed countries, and this is important for the consequences of Chinese renminbi internationalization. Basically, much of the recent literature on less-developed countries highlights their limited financial development and the severe financing constraints experienced by local corporates (Rajan and Zingales, 2003; Gourinchas and Jeanne, 2013; Piotroski, 2014; Bowman et al.,2014; Hamilton and Wu, 2015; Glick and Leduc, 2018). From this structural feature, how international collateral constraints matter for the effects of renminbi internationalization on corporates in Africa and sovereign debt is policy relevant. Empirically, the collateral constraint grounds its micro-foundation in the incomplete market framework of

[1]The Renminbi swap lines allow, say, the bank of Ghana to sell its domestic currency (Cedi) to China for Renminbi and, at the same time, agree to reverse the transaction at a pre-specified exchange rate and date in the future. Then the Renminbi can be lent to the banking sector in Ghana to facilitate trading financing.

Hart and Moore (1994). This version of financial frictions has been introduced by the innovative paper by Kiyotaki and Moore (1997), where a model is constructed to capture how credit constraints interact with aggregate economic activity over the business cycle. The strand of literature following Kiyotaki and Moore (1997) has stressed the relevance of the link between the value of borrower collateral and their access to funds in amplifying the economy's response to shocks within the framework of Dynamic Stochastic General Equilibrium (DSGE) Models (Iacoviello, 2005; Iacoviello and Neri, 2010; Brunnermeier and Sannikov, 2011; Justiniano et al., 2013; Guerrieri and Iacoviello, 2015; Cerutti et al., 2020). However, these models are silent on the effect of sovereign default because they have been formulated for economies with perfect financial markets, where default risk is not a primary concern.

By contrast, following Calvo (1988), the significance of sovereign default for the economic outcomes of less-developed economies is certain (Aguiar and Gopinath, 2006; Arellano, 2008; Hatchondo et al., 2009; Reinhart and Rogoff, 2009; Chatterjee and Eyigungor, 2012; Aguiar et al., 2019; Miranda-Agrippino and Rey, 2020). Indeed, literature on African economies reveals the high probability of sovereign debt default. Given this feature, the magnitude of sovereign debt default matters for the effects of the renminbi's internationalization in African economies.This feature has been recently captured in the empirical literature by the topical works of Aoki et al. (2016), Na et al. (2018), Bianchi and Mondragon (2018), and Devereux et al. (2019), where models are built to capture environments with defaultable sovereign debt. Arellano et al. (2019) advance this strand of literature by developing a DSGE model that combines the workhorse model of Gali and Monacelli (2005) with a standard sovereign default model to demonstrate that, on the one hand, default risk shapes monetary distortions and affects monetary policy; on the other hand, monetary policy also affects default risk because the added monetary distortions curb government borrowing and lower sovereign spreads. Nevertheless, none of the previous studies considered the interactions between these two different strands of literature in any fundamental way.

This paper integrates international financial constraints and sovereign default to evaluate the impacts of the internationalization of the Chinese renminbi on state-owned corporate balance-sheets and sovereign debt in Africa. Specifically, we start by modeling China-Africa's past experience with capital inflows into Africa from China due to trade, investment, and large public debt. Subsequently, we model future prospects of renminbi internationalization as the reversal of capital flows in Africa due to the rebalancing of Chinese economies, the reduction of the People's Bank of China's balance sheet, the invoicing of Chinese exports to Africa in renminbi, the currency swap operations between China and African central banks, and the purchase of Renminbi-denominated bonds by African economic agents. Fifth, the government uses fiscal revenue to fund the realization of contingent liabilities when state-owned corporations default.

The remainder is as follows: in section 2, we analyze the state of China Africa economic engagement before and renminbi internationalization. In section 3, we dissect the struc-

tural DSGE model. In section 4, we estimate the model and conduct analysis before and after the exceptional event. Section 5 presents the robustness check analysis. In Section 6, we conduct discussion around the findings of the research. Section 7 describes the counterfactual analyses. in Section 8, we perform welfare analysis before and after renminbi internationalization. Section 9 draws conclusions.

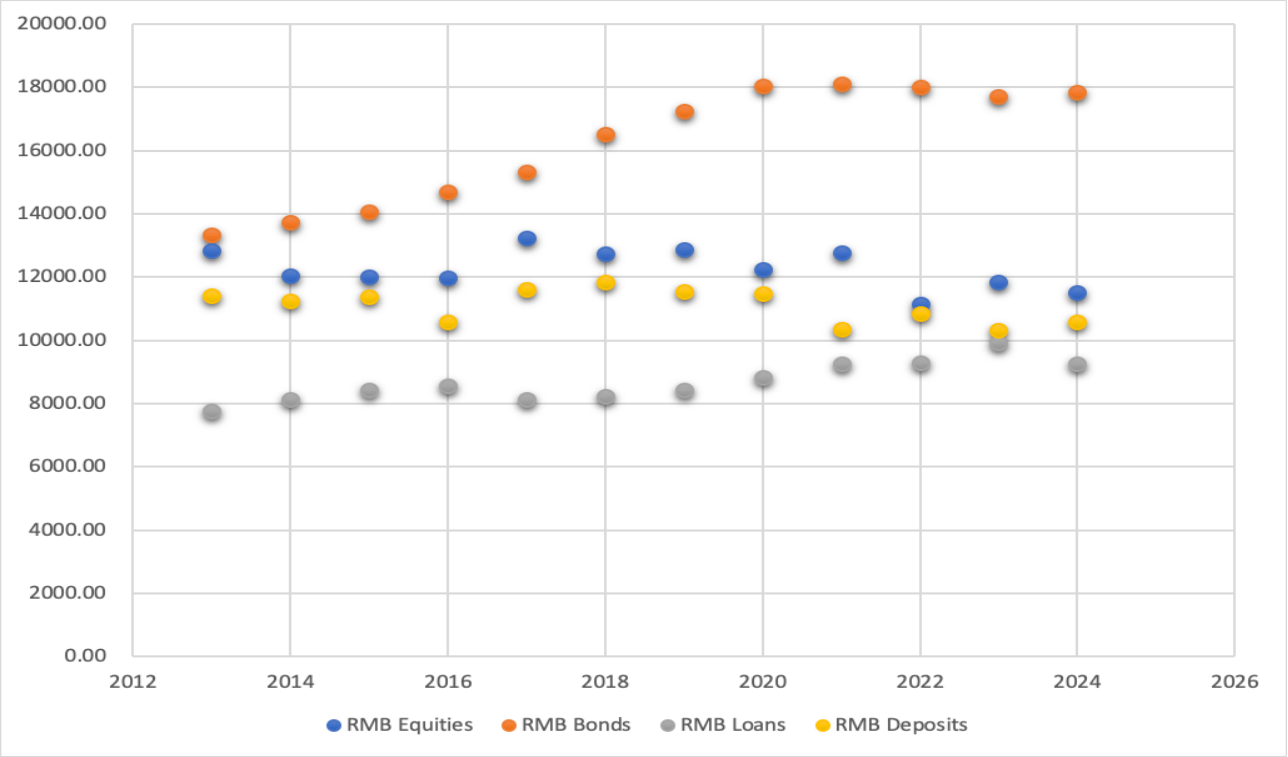
2 The Renminbi Internationalization and The State of Africa-China Financial and Trade Engagement

China's progress in reforming its monetary and financial system and the integration of the Chinese economy into the African market, set the stage for a greater role for the renminbi in the economic partnership between China and Africa.

2.1 The Renminbi Internationalization and China loans to Africa

The internationalization of the RMB has advanced substantially over the past decade. The RMB is now widely used as a payment currency for settling China's cross-border trade and direct investment transactions worldwide, and even in Africa. The People's Bank of China estimates the total offshore holding of bonds, stocks, deposits, and other RMB assets by foreign central banks and monetary authorities amounted to more than RMB 666.7 billion. As shown in Figure 1, all the RMB assets increases from the onset in 2012 until 2024. The Renminbi-led bonds outperformed the other three RMB assets, moving from RMB 13.3 billion to RMB 17.8 billion in 2024. This increasing trend is closely followed by the renminbi-led equities, which howe on average around from RMB 12 between in 2012 to 2024.

Figure 1. Renminbi Assets Held by Overseas Entities (100 Million RMB)



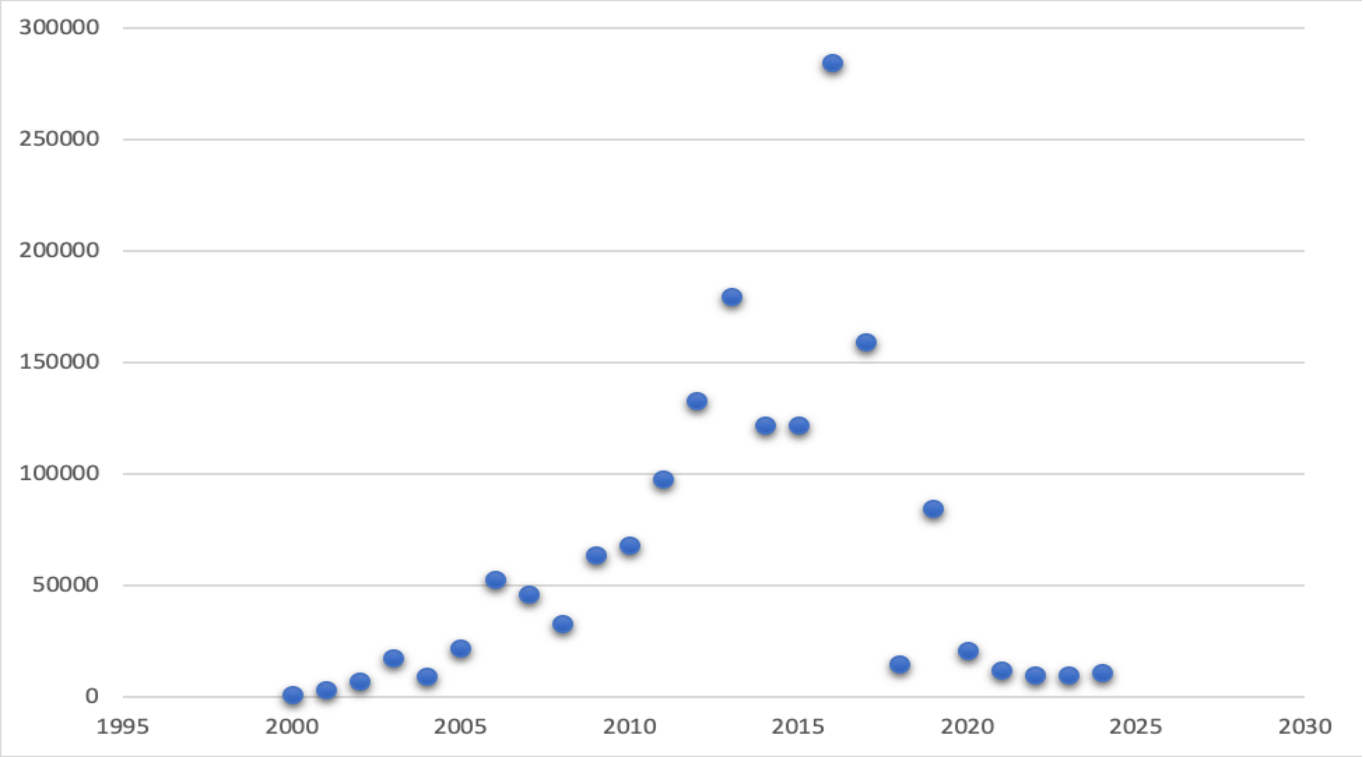
Note: The figure shows the total offshore holding of RMB equities, RMB bonds,RMB loans, and RMB deposits, by foreign central banks and monetary authorities. Source: People Bank of China (2024)

This movement reflects the growth and increasing interconnectedness of the Chinese economy with African economies, which has resulted in a growing interest and willingness among nonresidents to settle cross-border trade and direct investment payments in RMB, to invest in RMB-denominated securities, and to obtain funding in the currency.

Indeed, China has become a major funding source for African governments. Chinese loans, (mostly directed at financing public infrastructure projects), have risen rapidly in Africa in the late 2000s to peak at 2016, and there after at the onset the COVID-19 crisis in 2019. This has provided African countries with a new source of infrastructure financing, and China becomes the largest bilateral official lender to countries in Africa. China's share of total African external public debt rose thus substantially during the period. With the implementation of renminbi internationalization that follows, Chinese official total loan disbursements to Africa have fallen precipitously. Between 2020 to 2024, it represents on average one-eighth of their peak value of 2016 (Figure 2). This is because, with renminbi internationalization, China is revising its lending strategy in Africa. Hence, as Africa still has huge demand and potential for development financing, the destinations, sectors, and modality of Chinese loans to Africa has been modified to fit the evolving framework of

renminbi internationalization.

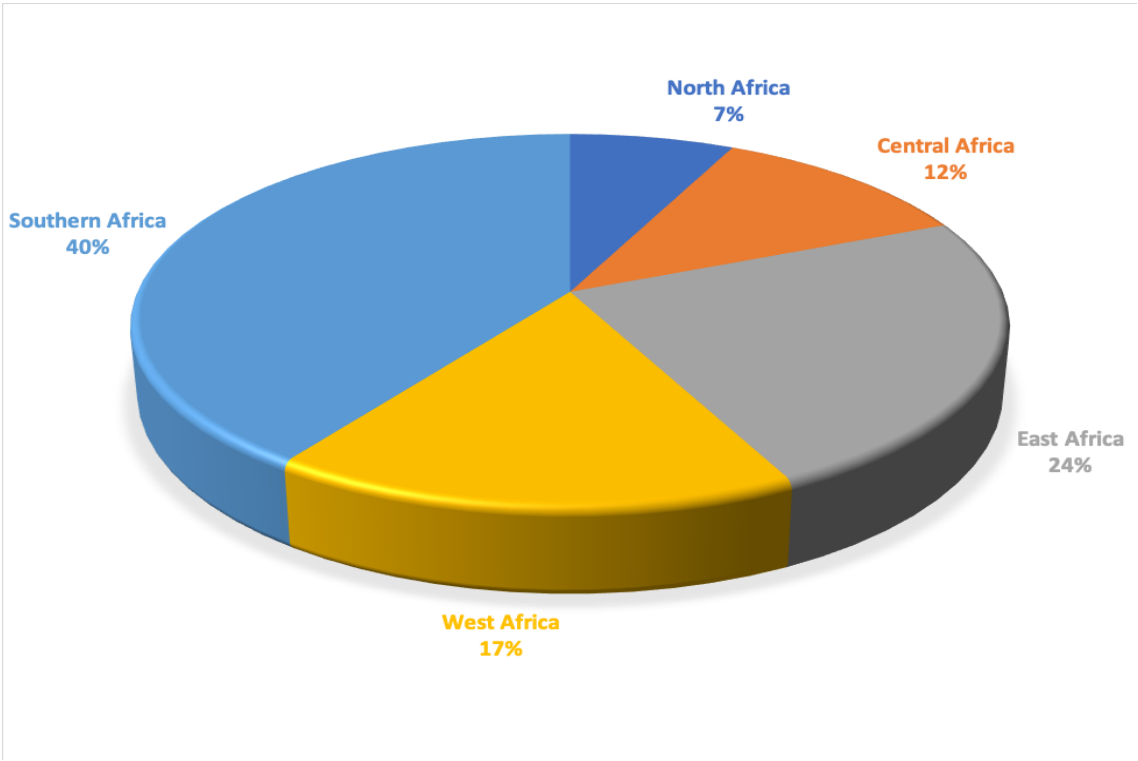
Figure 2. Chinese Loans to Africa (US Billion Dollar)



Note: The figure shows the amount of sovereign debt borrowed by African governments from China since 2000. Source: China-Africa Research Initiative (2024).

However, Africa's official debt to China is highly concentrated. At the regional level, the Southern Africa is the region in Africa that receive substantial disbursement of Chinese loans, with a total of loans amounting 40 % between 2000 to 2024. The East Africa region follows the lead with an amount representing 24 % in the same period. The west Africa, central Africa, and the North Africa regions are in the queue with the amount representing 17%, 12% and 7% respectively.

Figure 3. Chinese Loans to Africa by region, 2000-2024 (US Billions Dollar)



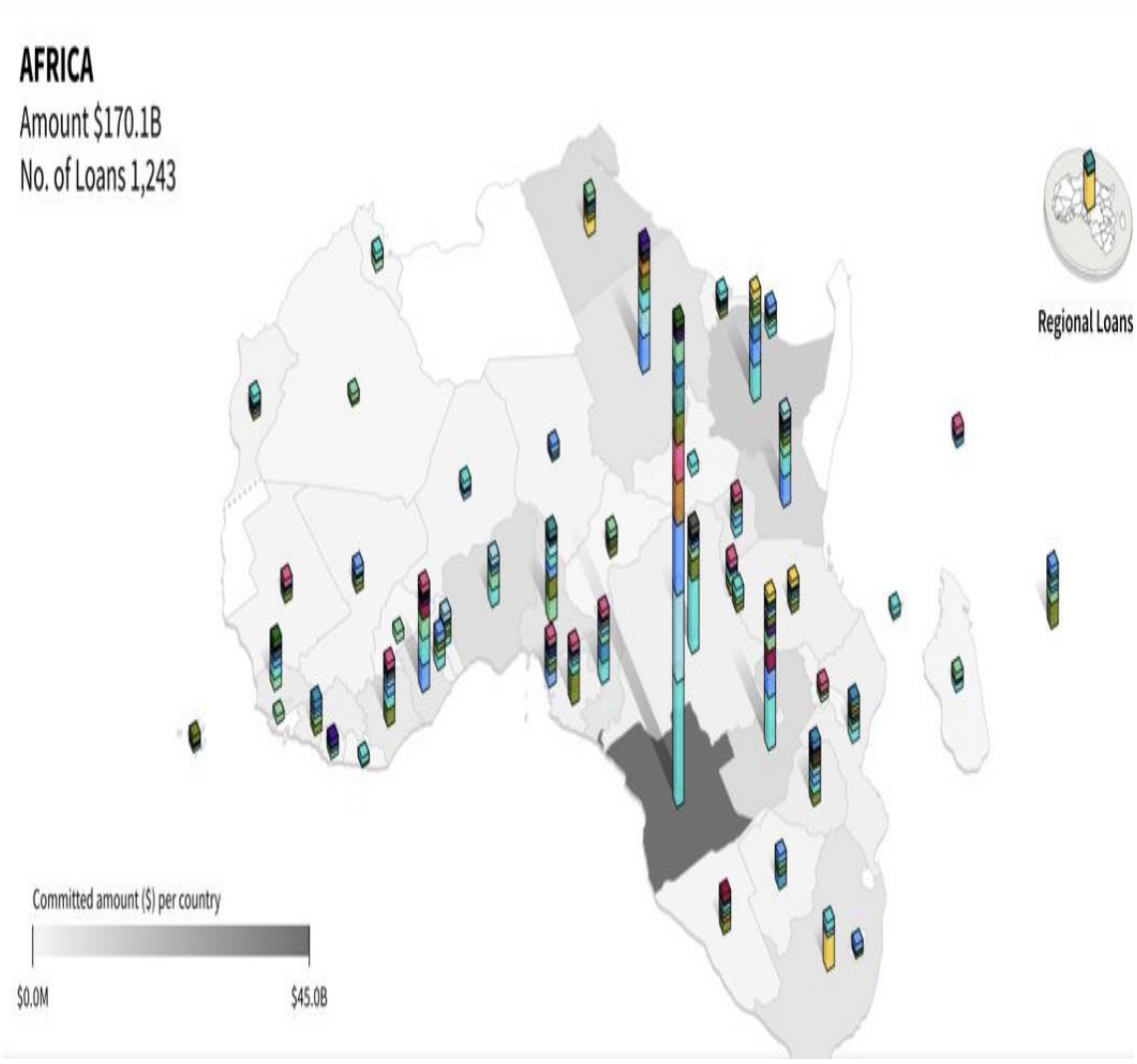
Note: The figure shows the Chinese loans disbursement to Africa per region, including, Southern Africa, East Africa, Central Africa, West Africa and North Africa. Boston University Global Development Policy Center (2024). Chinese Loans to Africa Database.

At the country level, there is a cross-region heterogeneity. Five countries namely, Angola, Kenya, Zambia, Cameroon, and Nigeria, which , account for 55 percent of official bilateral debt to China. This is especially the case because those countries are mostly resources-intensive countries. This fact demonstrates that there is a correlation between China lending disbursements and the prevalence of bilateral trade between China and the African's countries.

The main concern is is the mounting amount of sovereign debt facing several of those countries. In fact, there are currently more than twenty African countries that are facing sovereign debt distress. The good news is that, the negotiations on debt restructuring and relief between China and a some of high-sovereign debt countries, such as Angola, Ethiopia, Kenya, and Zambia, are ongoing. China is thus becoming a prominent lender of last resort by issuing rescue loans to African countries in sovereign debt distress. Overall, Chinese state-owned banks and companies provided rescue loans worth $77 billion to thirteen low- and middle-income economies in debt distress between 2000 and 2024. In

total, seven African countries have received such bailout loans. Those bailout loans allow African countries to service external debt, increase reserves, or finance general budgetary expenditures.

Figure 4. Chinese Loans to Africa by Countries, 2000-2024 (US Billions Dollar)

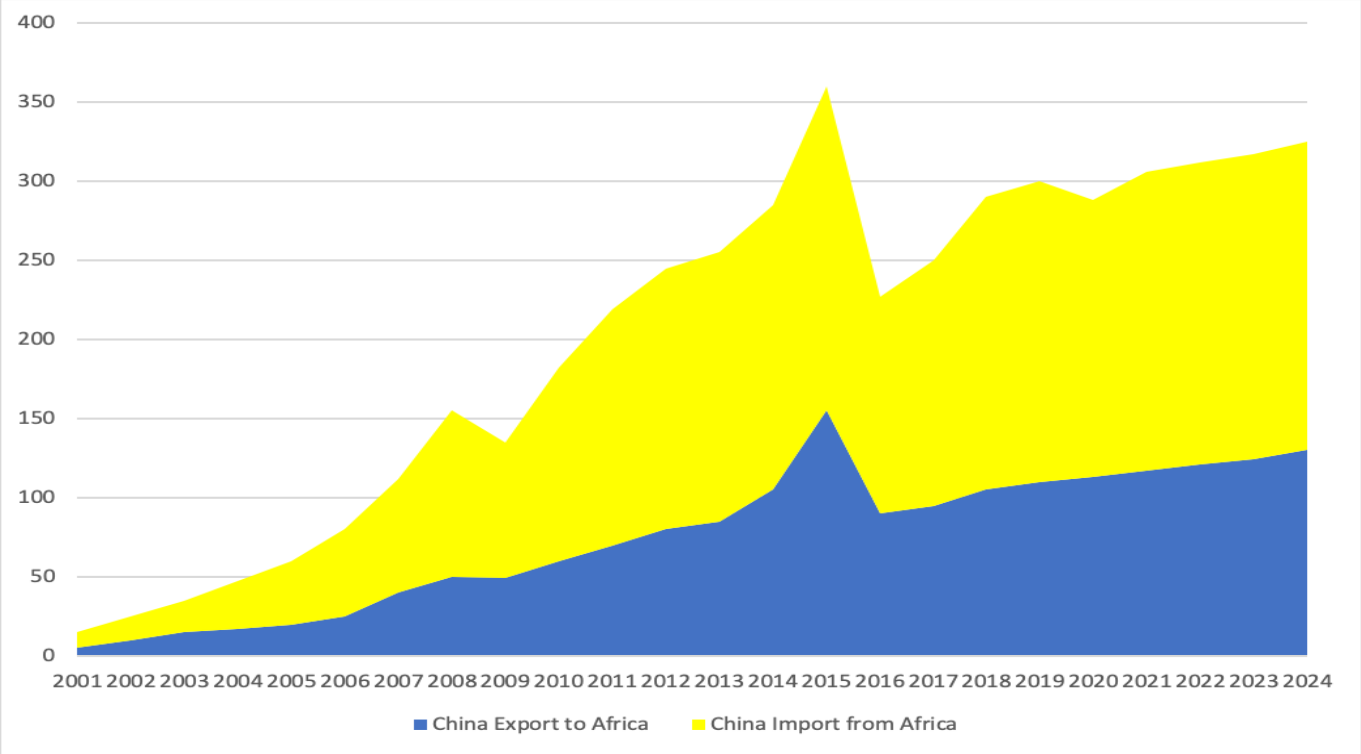


Note: The figure shows the disbursement of Chinese loans to Africa per each of the 55 countries of the continent. Boston University Global Development Policy Center (2024). Chinese Loans to Africa Database.

2.2 The Renminbi Internationalization and Bilateral Trade between China and Africa (ie and China loans to Africa via RMB TRADE...)

Growth in the international use of the RMB, particularly in Africa, has traced several of the features or instrument of RMB internationalization. Particularly, the use of renminbi for cross-border trade invoicing and payment has grown rapidly since its introduction in 2009. In 2014 close to 20 percent of China's goods trade was settled in RMB. In 2015 the RMB settlement portion of China's goods trade rose nearly 10.5 percent over the previous year. Since then, the share of the RMB has been growing in China's cross-border trade, reaching 49 percent in the second quarter of 2023. Africa is more and more relying heavily on both the RMB for its bilateral trade with China. As several other countries, Africa countries are setting up mechanisms to facilitate use of the RMB in cross- border trade payments involving China.

Figure 5. China Africa Trade (US Billions Dollar)

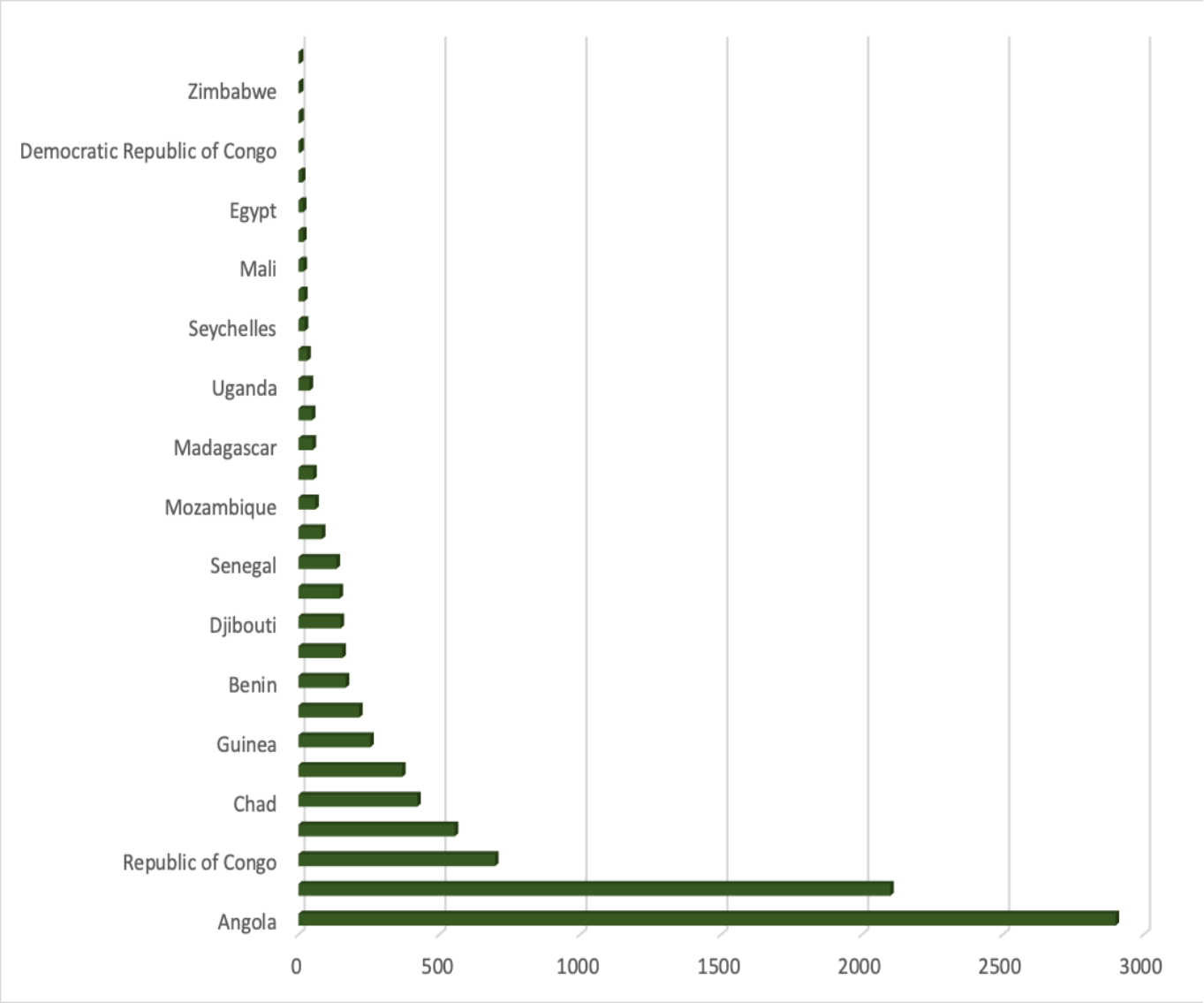


Note: The figure shows China-Africa bilateral trade. The blue bar represents the total amount of Chinese exports to African countries. The yellow bar denotes the total amount of Chinese imports from African countries. Source: United Nations Comtrade (2024)

Basically, China has emerged Africa's largest individual country trading partner in the last tow decades. China's large appetite for raw materials have spurred African exports of

goods, which more than quadrupled in nominal US dollar terms between 2000 and 2024. Nowadays, the bilateral trade volumes between China and Africa are on a rising trend, reaching a historic high of $282 billion in 2023. But, there is a massive imbalance in this bilateral trade between China and Africa. In 2024, China exported more $173 billion to Africa, while it imports only $109 billion from Africa (Figure 5). As the Chinese economy recalibrates to adapt to renminbi internationalization, several trends in China-Africa trade relations are worth-mentioning. Today, one-fifth of Africa's total goods exports go to China. While African exports to China remain largely composed of unprocessed commodities, the exact composition of this export basket is changing with renminbi internationalization. Metals, mineral products, and fuel represent about three fifths of the region's exports to China.

Figure 6. China Loans to Trade and Industry Sector, 2000-2024, $ Billions

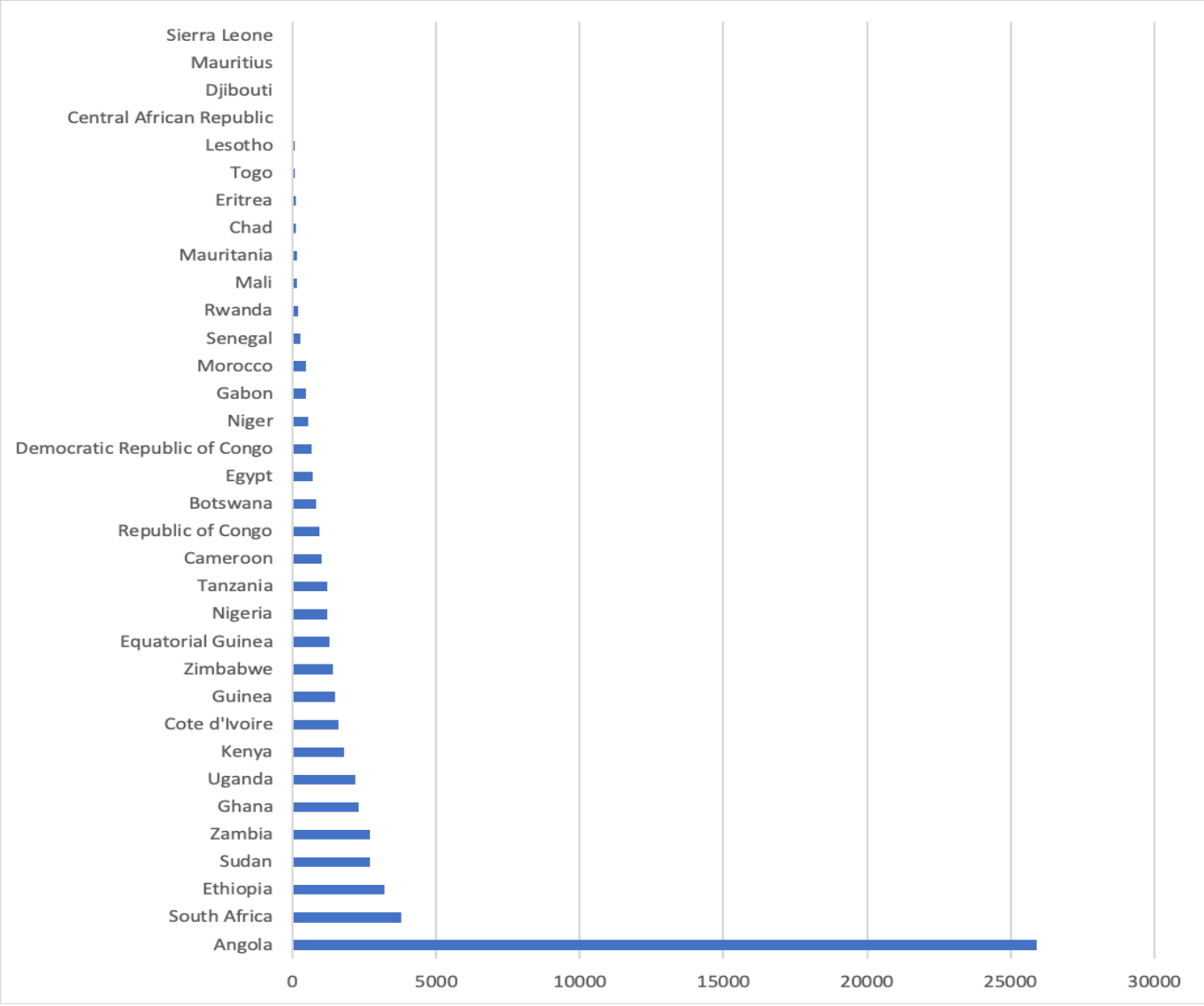


Note: The figure shows the .Boston University Global Development Policy Center. 2024. Chinese Loans to Africa Database.

Specifically, oil imports from Africa are declining as China increasingly sources crude oil from countries with RMB trade settlement mechanism, such as, Russia and Saudi Arabia. So, China is buying and consuming less crude oil from Africa. With the exception of Chad, which saw a 81-percent increase in the value of its oil exports to China between 2019 and 2024, all of the other eight major African oil producers have exported less than they did before the COVID-19 crisis. By 2024, Angola, formerly the world's second-largest exporter of oil to China, had been down-graded to the number eight position. In addition,

South Sudan, Sudan, and Nigeria, which have all seen serious declines of 77 percent, 67 percent, and 61 percent, respectively, in their hydrocarbons export to China. By contrast, in mineral and metal trade, African exports to China are on a rapid ascent, reaching more than $65 billion in 2024 from $15 billion in 2010. Meanwhile, China has also emerged as the single largest source of imports for African countries. China mainly supplies manufactured goods and machinery to households and corporates in Africa.

Figure 7. China Loans in Africa in Energy Sector, 2000-2024, US Billions Dollar



Note: The figure shows the .Boston University Global Development Policy Center. 2024. Chinese Loans to Africa Database.

This scale-down of some aspects of china Africa trade is muted by the ongoing expansion of semi-processed agriculture exports from African countries to China under renminbi internationalization. Between august 2022 to 2024, around 30 percent of Kenya's avocados are exported to China. From 2019 to 2024, Namibia beef exports to China has grow considerably. Ethiopian and Rwandan coffee is now being directly retail in China by the means of the e-commerce platforms, sometime by the help of Renminbi trade settlement mechanism.

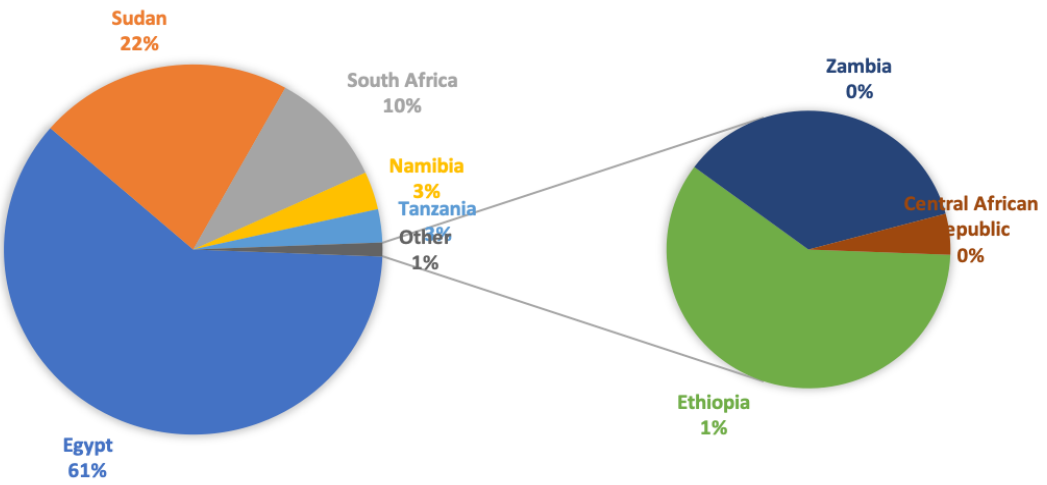
2.3 The Renminbi Internationalization and Renminbi-led Bonds in Africa

China over the last two decades. China has become Africa's major credit provider over the last two decades. In fact, to foster the use of renminbi worldwide, China tries to provide foreign investors with a deep and liquid pool of high-quality RMB-led bonds. China's offshore Renminbi-led bonds was first issued in July 2007 and was initially restricted to mainland policy and commercial banks. From 2007 to 2014, nearly 25 percent of current account transactions–services, income, and dividend payments was settled in RMB. From 2015 to 2024, the RMB-led current account transactions–services, income, and dividend payments rose around 39 percent.[2]

In Africa, several countries issuers have tapped RMB funds in the offshore market. Subsidiaries of foreign multinational firms operating in Africa have also been active in tapping offshore RMB funds. Practically, Chinese loans to financial services sector in Africa grew considerably from 2000 to 2024. Financial services sector in Egypt receive the largest share in Africa, amounted to 61% of total Chinese loans to financial services sector. Sudan and South-Africa follows the lead with respectively 22% and 10%. The Chinese loans to financial services sector in Namibia and Tanzania represent respectively 3% and 2% of the total share. Ethiopia, Zambia and Central Africa Republic, close the lead with less than 1% of the total share.

[2]The first auction took place in September 2009 with China's own sovereign issuance in Hong Kong SAR.

Figure 8. China Loans to Financial Services Sector, 2000-2024, Billions USD



Note: The figure shows the .Boston University Global Development Policy Center. 2024. Chinese Loans to Africa Database.

This means that China ambition is to scale-up Africa uptake of services provided by the financial and payments infrastructure it has been shaping over decades within the framework of renminbi internationalization. Indeed, Table 1 shows the Chinese holdings of foreign sovereign bonds in percent of African country's GDP. On average 20 Africans' government owe share of their GDP to China in the form of tradable debt securities. Specifically, Morocco, Tunisia, Liberia, Egypt, Senegal, Liberia, Cote d'Ivoire, Ghana, Nigeria, Gabon, Uganda, Kenya, Tanzania, Angola, Zambia, Mozambique, Namibia and South Africa, owe around 1% of their GDP to China in the form of renminbi-led tradable debt securities.

Table A 1—Table 4: External debt owed to China through portfolio holdings (incl. sovereign bond holdings of PBoC)

0%	[0%1%]	[1%3%]	[3%5%]	[5%10%]	> 10%
Libya	Morocco				
Algeria	Tunisia				
Mauritania	Liberia				
Mali	Egypt				
Niger	Senegal				
Chad	Liberia				
Sudan	Cote D'Ivoire				
Eritrea	Ghana				
Burkina Faso	Nigeria				
Guinea	Cameroon				
Sierra Leone	Ethiopia				
Togo	Gabon				
Benin	Uganda				
Central Afri Rep	Kenya				
South Sudan	Tanzania				
Djibouti	Angola				
Somalia	Zambia				
Equatorial Guinea	Mozambique				
Congo, Republic of	Namibia				
Congo, Dem Republic of	South Africa				
Rwanda					
Burundi					
Malawi					
Botswana					
Zimbabwe					
Lesotho					
Eswatini					
Madagascar					
Guinea-Bissau					
Gambia					

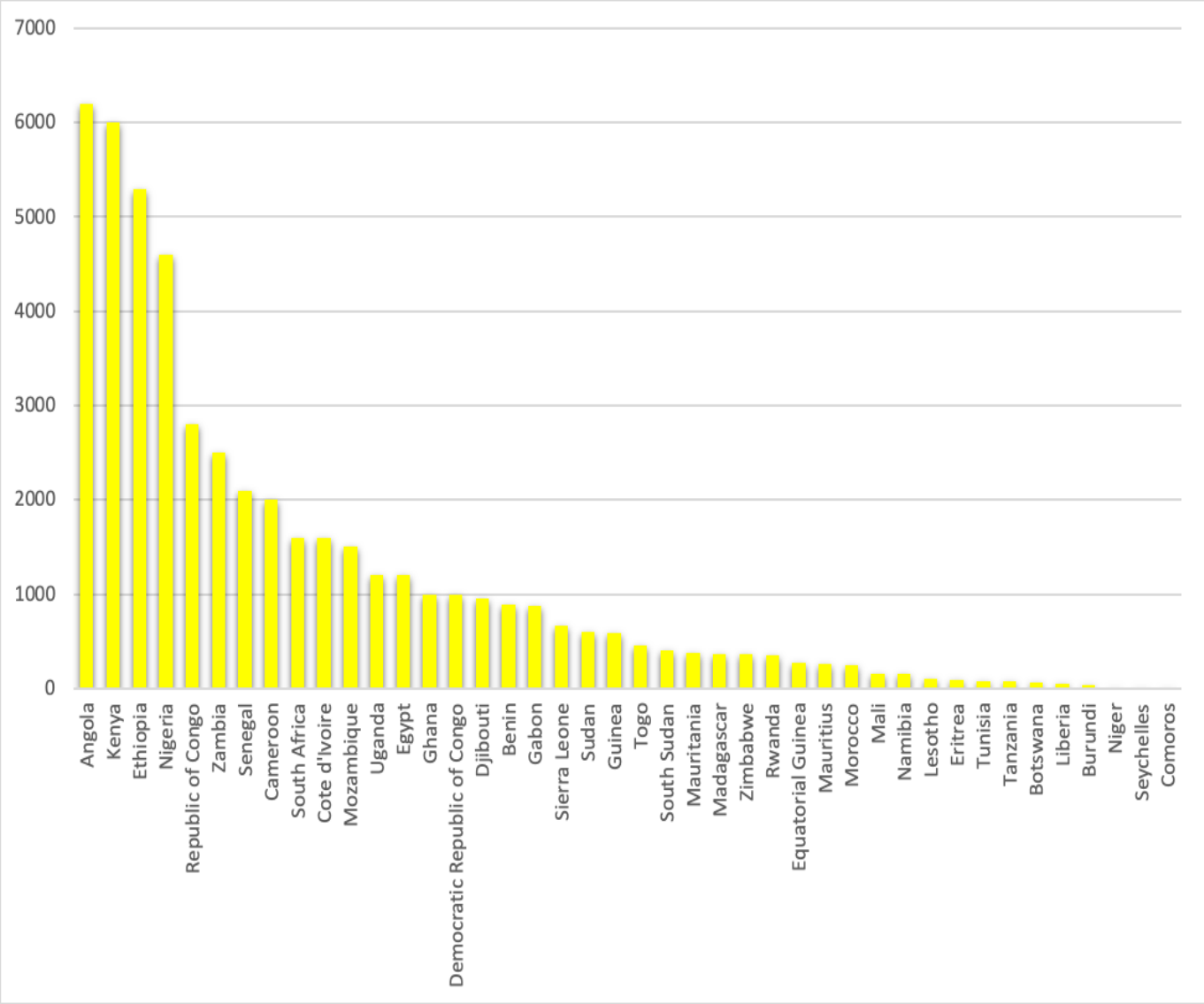
Note: This table shows Chinese holdings of foreign sovereign bonds in percent of African country (debtor country) GDP. A share of 5% means that the government of the respective African country owes 5% of its GDP to China in the form of tradable debt securities.Sources: Horn, Reinhart and Tredesch (2021), and China-Africa Research Initiative (2024).

This is due to the fact that, China is denominating in Renminbi policy loans issued by Chineses' international institutions, such as, the Belt-and-road initiative or the New

Development Bank. Hence, in 2023 the first South African rand-led bond was issued by the New Development bank. In addition China Development Bank, signed RMB-denominated loan contracts with Egypt's central bank, to support Belt and Road Initiative projects. This strategic move by China aim to encourage the international use of Renminbi-led loans. As a result, to increases the number of sovereign loans to African countries from Chinese policy banks denominated in Renminbi, China set-up three RMB clearing houses in Africa. More importantly, to respond to the growing global demand of Renminbi-led bond, China establishes more deeper and liquid capital markets in Hong Kong and Shanghai.

So, the Belt-and-road initiative, helped by the New Development Bank, and the China Development Bank, positions china as a key financier for the transportation sector in Africa. While all African benefit from this Chinese financial assistance, only ten African countries benefit the most. This include Angola, Kenya, Ethiopia, Nigeria, Republic of Congo, Zambia, Senegal, Cameroon, South-Africa and Cote d'Ivoire, with respectively, $6.2 billion, $6 billion, $5.3 billion, $4.6 billion, $2.8 billion, $2.5 billion, $2.1 billion, $2 billion, $1.6 billion, $1.6 billion of China loans to the transport sector on average between 2000-2024. However, the vast majority of African countries do not benefit the most, because recently, China has retrenched its financing activities in Africa amid renminbi internationalization. The future deceleration in China's credit supply is likely to affect many African countries negatively over the medium term, mainly through the transport sector.

Figure 9.China Loans to Transport Sector, 2000-2024, Billions USD

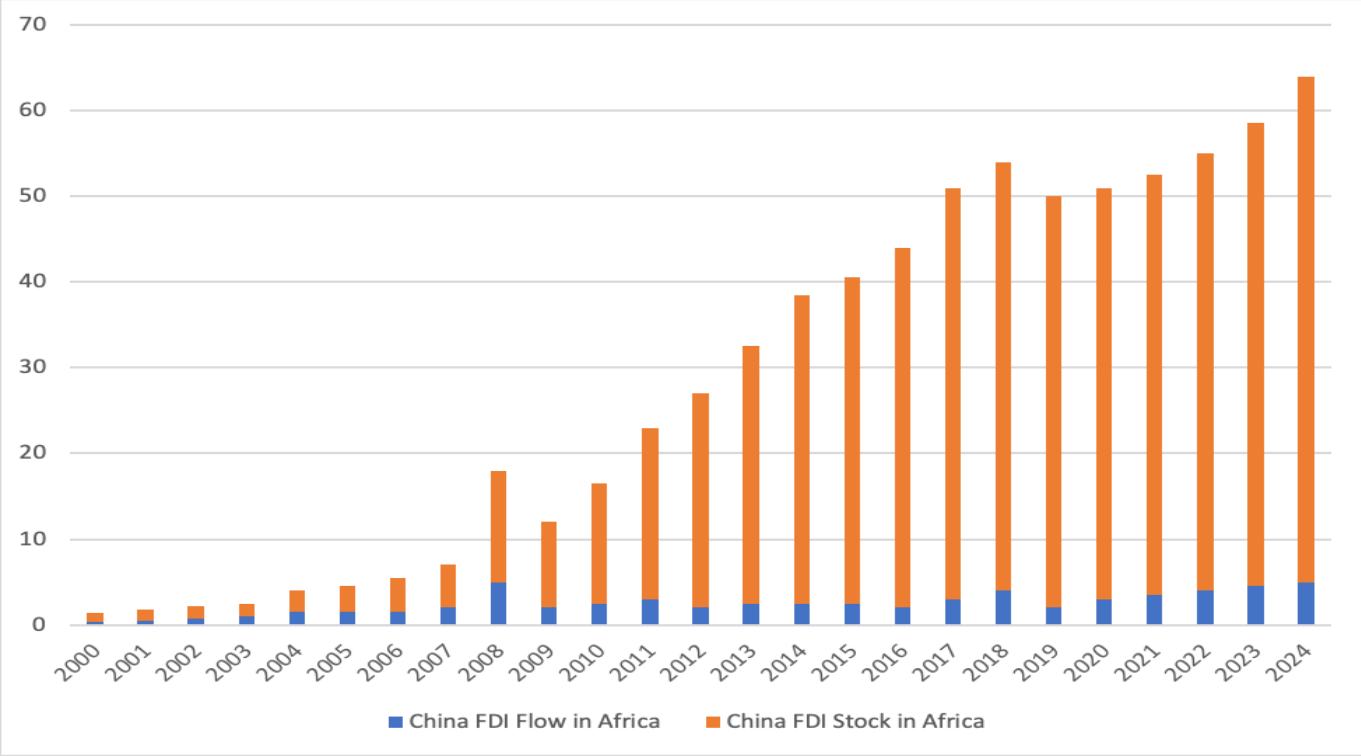


Note: The figure shows the .Boston University Global Development Policy Center (2024). Chinese Loans to Africa Database.

2.4 The Renminbi Internationalization and China FDI in Africa

The Renminbi is quickly evolving as the currency of choice for settling direct investment payments. Since the earliest of 2010 decade, both inward foreign direct investment and outward direct investment have been permitted in Renminbi. This rapid advancement reflects a growing willingness of nonresident counterparties to accept RMB in settlement of Foreign Direct Investment (FDI). The share of inward foreign direct investment settled in Renminbi evolves from less than 10% in 2010, to 65% in 2015, and reach 89% in 2024. More so, The share of outward foreign direct investment settled in Renminbi rose from less than 5% in 2010, to 228% in 2015, and reach 253% in 2024.

Figure 10. China Foreign Direct Investment (FDI) Stock and Flow in Africa (US Billions Dollar)



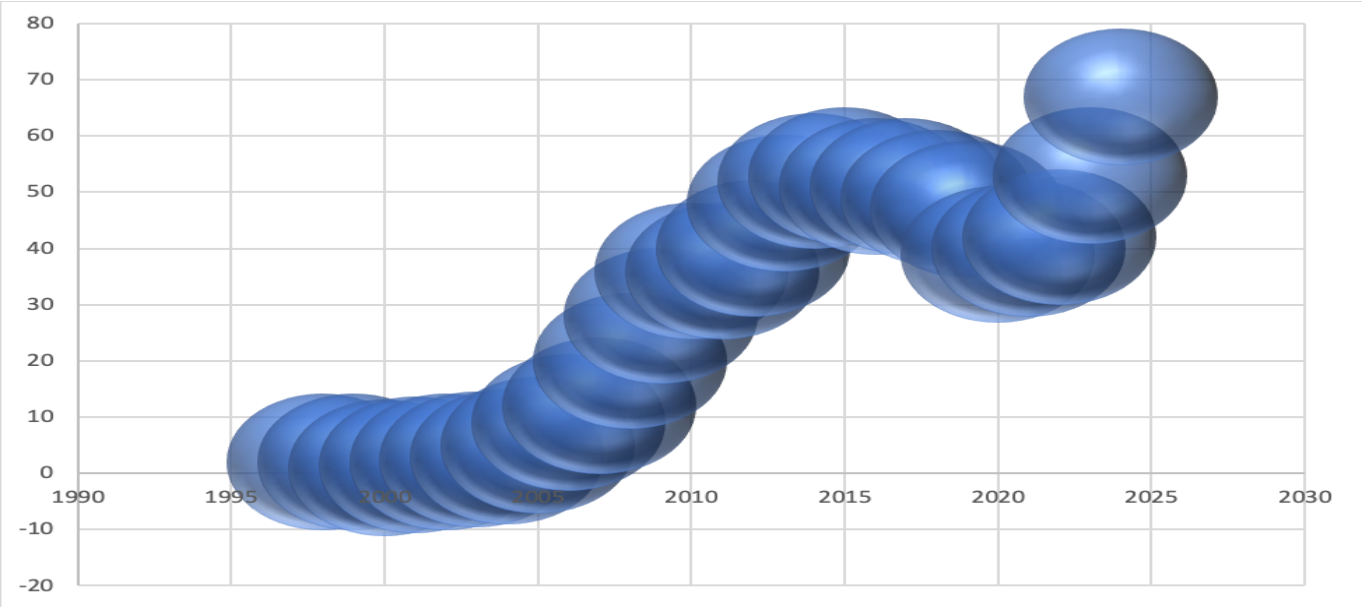
Note: The figure shows China Foreign Direct Investment in Africa. The green dotted light- blue line is the China FDI Flow in African countries. The yellow dotted dark-blue line is the China FDI Stock in African countries. Source: China Statistical Yearbook (2024).

In Africa, China's Foreign Direct Investment has also increased significantly since the 2000 decade (Figure). The China's Foreign Direct Investment flow rose from $0.3 billion in

2000 to $2.5 billion in 2010, with a peak of $5 billion in 2008. This flow expansion steadily continues from 2011 amounting $3 billion and reach another peak in 2018 amounting $3 billion. Afterward, the flow receded in 2019 and 2020. Since 2021, the flow rebounded to reach $4.5 billion and $5 billion in 2023 and 2024. More so, the China's Foreign Direct Investment stock increased from $1.1 billion in 2000 to $14 billion in 2010. This stock expansion steadily continues from 2011 amounting $20 billion and reach a peak in 2018 amounting $50 billion. Afterward, the stock of FDI receded and stagnated from 2019 to 2021. Since 2022, the stock of FDI rebounded to reach $54 billion and $59 billion in 2023 and 2024. This impressive rise of China FDI can be explained by the fact that some resource-rich countries in Africa have seen relatively large inflows of Chinese FDI directed primarily toward construction and mining.

Mounting evidence points to broadly positive effects of Chinese foreign direct investments in Africa on the China's economic outcomes (Figure). The expansion is clearly evident in Chinese companies' African construction gross revenues, which rose from $2 billion in 1998 to $20 billion a decade later. The Chine Companies gross revenue continue it increases in 2009 amounting $28 billion to reach $49 billion in 2018, with a peak of peak of $53 billion in 2015. From 2019 and 2022, the revenue declines substantially. It rebounded in 2023 with an amount of $53 billion and settled around $67 billion in 2024.

Figure 11.Gross Annual Revenue of Chinese Infrastructures Enterprises in Africa (US Billions Dollar)



Note: The figure shows the gross annual revenues of Chinese corporations in infrastructures projects in African countries. Source: National Bureau of Statistic of China (2024).

This decline, since 2019, of the gross annual revenues of Chinese companies operating in Africa, may be explained by the fall of the China's Foreign Direct Investment in Africa during the same period. In fact, this scaling-down of Foreign Direct Investment mainly corresponds to China shifts in focus from infrastructure to industrialization in Africa. Nonetheless, this Africa's industrialization approach by China will be somewhat distinct from the infrastructure one, as most Chinese industrial investments in Africa will come from private companies. As a result, Chinese investments are beginning to cover not only the extraction of raw material but also the refining and processing of those raw material directly in Africa. That is why in 2023, the Chinese Prospect Lithium Zimbabwe invested $300 million in a lithium processing plant in Zimbabwe in June. In addition, in october, the Ganfeng Lithium Industry Limited invested a $250 million in lithium processing plant in Nigeria. So, the reduced flows of Chinese public investments in African infrastructure over the last years will be offset by increased flows in private investments mostly in industrialization projects.

Table A 2—Table 5: China's overseas equity investments

No data	[0%1%]	[1%3%]	[3%5%]	[5%10%]	> 10%
	Morocco	Nigeria	Ghana	Zambia	Guinea-Bisau
	Tunisia	Egypt	Togo	Tanzania	Guinea
	Algeria	Madagascar	Cameroon	Djibouti	Sierra Leone
	Libya	Rwanda	Angola		Niger
	Mauritania		South Africa		Chad
	Mali		Lesotho		Congo, Rep of
	Senegal				Congo Dem Rep
	Cote d'Ivoire				Uganda
	Burkina Faso				Namibia
	Benin				Zimbabwe
	Gabon				Mozambique
	Central Afri Rep				
	Sudan				
	South Sudan				
	Ethiopia				
	Eritrea				
	Somalia				
	Kenya				
	Malawi				
	Burundi				
	Botswana				
	Equatorial Guinea				
	Gambia, The				

Note: This table shows the geographic allocation of Chinese equity investments, consisting of foreign

direct investment and Chinese portfolio holdings of equity instruments issued by non-residents, across Africa. Sources: American Enterprise Institute (2024), for FDI stocks, and IMF's Coordinated Portfolio Investment Survey (2024), for portfolio equity investments.

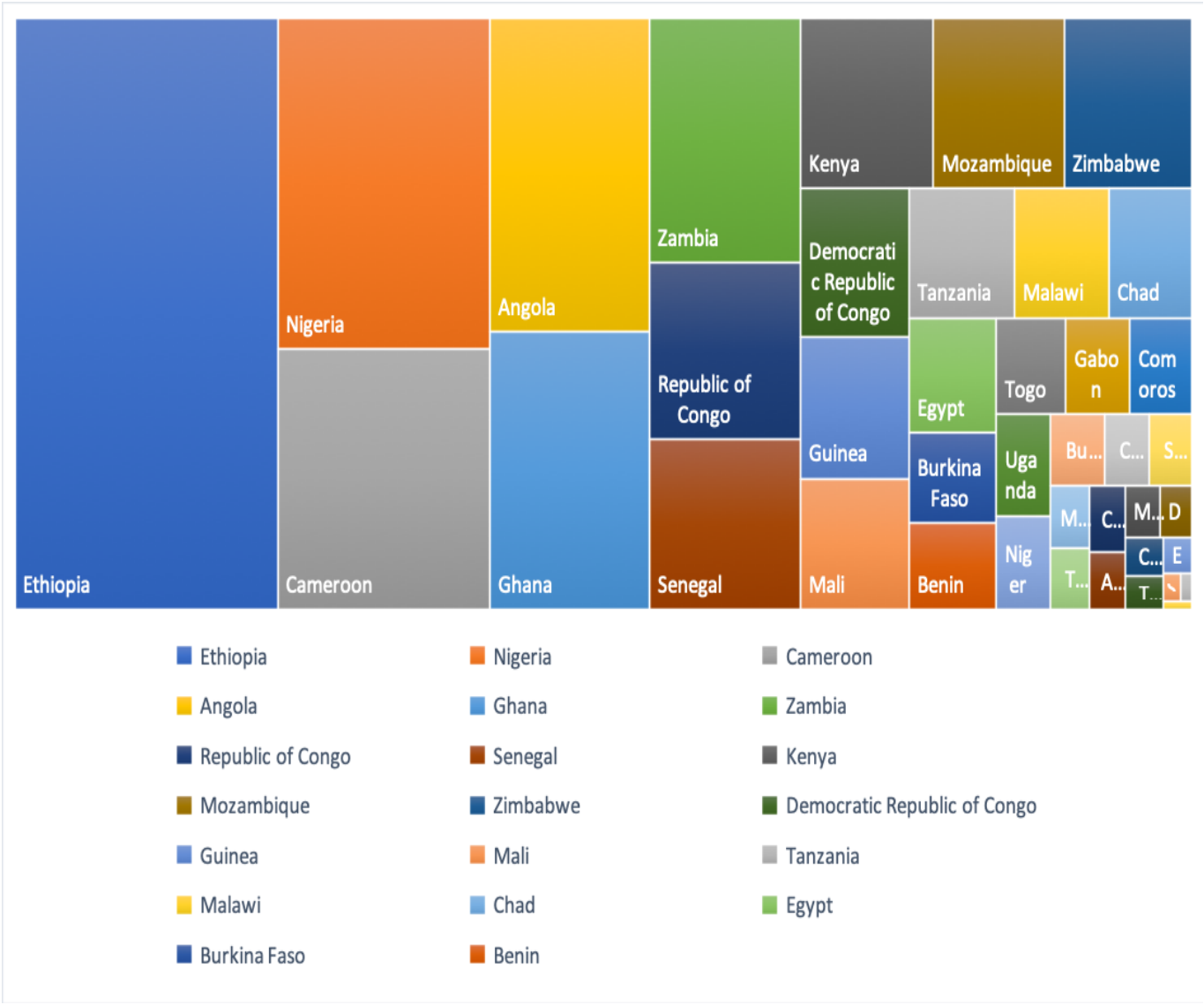
China is thus increasing funding for industrial projects via equity investment platforms such as the China-Africa Development Fund and the China-Africa Industrial Capacity Cooperation Fund (Table). On average 1% of China's overseas equity investments in Africa goes to Morocco, Tunisia, Algeria, Libya, Mauritania, Mali, Senegal, Cote d'Ivoire, Burkina Faso, Benin, Gabon, Central Africa Rep, Sudan, South Sudan, Ethiopia, Eritrea, Somalia, Kenya, Malawi, Burundi, Botswana, Equatorial Guinea, The Gambia. Between 1% to 3% of China's overseas equity investments in Africa are allocated to Nigeria, Egypt, Madagascar, and Rwanda. Between 3% to 5% of China's overseas equity investments in Africa goes to Ghana, Togo, Cameroon, Angola, South Africa, and Lesotho. Between 5% to 10% of China's overseas equity investments in Africa is allocated to Zambia, Tanzania, Djibouti. The huge share of of China's overseas equity investments in Africa (more than 10%) belongs to Guinea-Bisau, Guinea, Sierra Leone, Niger, Chad, Rep of Congo Congo Dem Rep, Uganda, Namibia, Zimbabwe, and Mozambique.

2.5 The Renminbi Internationalization and Currency Swaps Agreements between People Bank of China and Africa's Central Banks

The renminbi internationalization has led the large volumes in cross-currency swaps involving offshore RMB. This gives rise to the emergence of the cross-currency swap curve as a key offshore RMB benchmark interest rate curve. In fact, financial instruments that allow hedging of both currency risk and interest rate risk have accompanied the growth of the offshore debt market. Licensed banks in Hong Kong Special Administrative Region (SAR) began accepting RMB deposits in February 2004. Because of corporate deposit growth, the pace of accumulation began to accelerate after cross-border trade settlement in RMB was permitted in 2009. In one decade, offshore Renminbi double from RMB 2.4 trillion in 2014 to settle around RMB 2.1 trillion in 2024.

Consequently, the bilateral currency swaps between China and Africa is another avenue through which international use of the Renminbi is increasing. Indeed, since 2008, the People's Bank of China (PBOC) has signed bilateral currency swap agreements with central banks across at least thirty-nine countries, including four African countries. These currency swap lines aim to supply trade credit to African's commercial banks, allowing direct trade settlement using the RMB and reducing the negative effects of exchange rate volatility. Indeed, in 2018, the Central Bank of Nigeria signed its first bilateral currency swap agreement with the PBOC worth about $2.4 billion. The swap line was renewed in April 2021 and also revived in 2024. Nowadays, more than a dozen African countries experiencing foreign exchange shortages are attempting to follow Nigeria's steps.

Figure 12. China Loans to Africa inInformation and Communication Technology (ICT) Sector, 2000-2024, Billions USD



Note: The figure shows the .Boston University Global Development Policy Center. 2024. Chinese Loans to Africa Database.

Practically, the role of currency swaps in renminbi internationalization is more visible via the e-commerce platforms in China and Africa. Platforms such as Alibaba Group's Tmall, JD.com, Kilimall, and Kikuu are providing a virtual doorway for African suppliers into the China market, which represent the world's largest e-commerce market. Kilimall, a Kenyan e-commerce platform started a decade ago (in 2014), has most of its supply chain

located in China. It provides thus e-commerce transaction, mobile payment, and cross-border logistics services for over 10 million African users, mainly from Kenya, Nigeria, and Uganda, towards China market. After Covid-19 in 2021, the sales of Ethiopian coffee rose from143% to more than 200% in 2024, due live-streaming events on these e-commerce platforms during shopping festivals in China. Similarly, the sales of Kenyan black tea surged above 500% in 2024 compared to 409% in 2022. That is why the top 10 African countries recipients of China loans to Information and Communication Technology (ICT) are Ethiopia, Nigeria, Cameroon, Angola, Ghana, Zambia, Republic of Congo, Senegal, Kenya, Mozambique and Malawi.

Table A 3—Table 3: China External Debt to Africa (direct loans only)

No data	[0%1%]	[1%5%]	[5%10%]	[10%25%]	[25%100%]
Libya	Morocco	Algeria	Mauritania	Sierra Leone	Niger
Somalia	Tunisia	Egypt	Guinea	Cote d'Ivoire	Congo, Rep of
Eswatini	Liberia	Burkina Faso	Senegal	Cameroon	Djibouti
	Madagascar	Nigeria	Togo	Chad	
		Ghana	Benin	South-Sudan	
		Cent Afric Rep	Mali	Ethiopia	
		Gabon	Equatorial Guinea	Uganda	
		Congo, Dem Rep	Tanzania	Kenya	
		Malawi		Angola	
		Namibia		Zambia	
		Botswana		Zimbabwe	
		South Africa		Mozambique	
		Lesotho			
		Rwanda			
		Burundi			
		Sudan			
		Eritrea			

Note: This table shows the geographic distribution of total external debt owed to China through direct loans by countries across Africa. Sources: Horn, Reinhart and Tredesch (2021), and IMF WEO Database(2024).

In this context, China provides some official loans on concessional terms, accounting for less than 11% of total bilateral loans received by Africa from China at the end of 2024. The share of the region's total external debt-service cost attributable to China's official bilateral loans is 15% as of 2024. Moreover, African countries that are either in debt distress or at high risk of debt distress account for more than 42% of the total public debt stock to China at the end of 2024. China has been a key player in recent debt restructuring and negotiations. It also contributed to the Debt Service Suspension Initiative, providing 65% of suspensions between 2020 and 2024, though owning just 32%. Overall, Chinese

state-owned banks and companies provided rescue loans worth more than $79 billion to thirteen low- and middle-income economies in debt distress between 2000 and 2024. When taking into consideration, the drawdowns of central bank currency swap lines, that worth around $251 billion, are included in the total amount, this total bailout lending becomes even higher ($251 billion).

Table A 4—Table 6: Total Chinese claims (total debt plus equity)

No data	[0%1%]	[1%5%]	[5%10%]	[10%20%]	> 20%
Eswatini	Tunisia	Morocco	Senegal	Mauritania	Guinea
	Libya	Algeria	Gambia, The	Cote D'Ivoire	Sierra Leone
		Egypt	Guinea-Bissau	Cameroon	Togo
		Burkina Faso	Ghana	Sudan	Congo, Rep of
		Nigeria	Benin	South Sudan	Congo Dem Rep
		Central Africa Rep	Eritrea	Ethiopia	Uganda
		Gabon	Malawi	Kenya	Zambia
		Somalia	South Africa	Tanzania	Zibambwe
		Rwanda	Lesotho	Angola	Mozambique
		Burundi		Namibia	
		Botswana			
		Madagascar			

Note: This table shows the geographic distribution of China's foreign assets, including debt claims from direct lending, trade advances, FDI debt instruments and portfolio holdings of foreign bonds and equity claims from foreign direct investment and portfolio holdings of foreign equity instruments, across Africa. Source: China-Africa Research Initiative (2024).

These swap lines are officially meant to increase bilateral trade and facilitate trade settlement in local currencies. So, trade invoicing and settlement between African countries and China is one domain where the Renminbi-led currency swaps' role is expanding. In this regards, the Pan-African Payment and Settlement System (PAPSS) is a platform that partners with African central bank systems to provide a payment and settlement service to facilitate cross-border financial transactions using local currencies within the African continent. The PAPSS aims to bypass the dominant-currency paradigm by allowing more than forty African currencies to be convertible for transactions among commercial banks and payment service providers within the continent without relying on the dominant currency (US dollar). It puts a notable effort to reduce the acute demand for foreign exchange by increasing the convertibility of local currencies in intra-African trade. The Renminbi-led currency swaps offer thus a Chance to Africa to use the PAPSS in order to ease cross-border financial payments between China and Africa, and provides a receptive environment for Chinese efforts to internationalize the Renminbi.

3 The Model

This research develops a stochastic monetary business cycle model which features international collateral constraints to assess the effects of China's renminbi internationalization on state-owned corporates balance-sheets and sovereign debt in Africa. We model a framework that consists of two economies, China and Africa. We focus on the home economy in presenting our model, with the understanding that analogous equations hold for foreign economy.

3.1 Households

Households allocate their labor to the two corporates sectors of the economy: the composite labor index, n_t, thus consists of hours worked in the state-owned corporate, n_{gt} , and in the private sector corporate,n_{pt} , following the CES aggregator:

$$n_t = \left[(1-\theta_h)^{\frac{1}{\tau}} (n_t^g)^{\tau-\frac{1}{\tau}} + (\theta_h)^{\frac{1}{\tau}} (n_t^p)^{\tau-\frac{1}{\tau}}\right]^{\frac{\tau}{\tau-1}} \tag{1}$$

where θ_h stands for the share of labor in the private sector corporate over total labor and $1-\theta_h$ the share of labor in the state-owned corporate over total labor. In addition, τ is the elasticity of substitution between the two corporates sectors for labor supply.[3]

A continuum of infinitely-lived households obtain thus utility from consumption c_t^H and labor supply n_t. Their intertemporal optimization problem is to maximize lifetime utility:

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta_t^H \left(\varpi_t log\left(c_t^H - hc_{t-1}^H\right) + \vartheta_t log\left(1-n_t\right)\right) \tag{2}$$

Here, c_t^H is the consumption basket that aggregates domestic and imported goods, ϖ_t stands for a preference shock affecting the marginal utility of household, β^H denotes the household's discount factor and θ_t represents a preference shock affecting the marginal utility of the labor supply.[4]

[3]This form of labor market specification is justified by the way we capture the concept of representative agent in the model. The assumption of representative agent does not literally means that one unique household divides its work time in both sectors; rather it is meant to represent a situation where a continuum of agents coexist but these different agents are sufficiently similar that treating them as one introduce no first-order problems. In such a context, equation (1) is simply interpreted as reflecting the presence of heterogeneity, mainly related to skills or education in the case of emerging markets, that makes the substitution of labor from one sector to another imperfect. As result, skilled or educated households mostly supply labor hours to private sector corporate, by contrast, unskilled or uneducated households mostly supply their labor hours to state-owned corporates.

[4]Households have a discount factor β^H higher than both types of corporates. They are therefore more patient and are the model's economy natural lenders.

The representative household maximizes (2) subject to the intertemporal budget constraint:

$$c_t^H + D_t = w_t^g n_t^g + w_t^p n_t^P + R_{D,t-1} D_{t-1} + \Xi_t - T_t, \tag{3}$$

The right hand side of (3) describes the household's resources and the left hand side rep-resents the uses of these resources. The household financial resources come from real wages received from state-owned corporate, $w_t^g n_t^g$, and the private sector corporate,$w_t^p n_t^p$, interest on the renminbi-denominated bonds, $R_{D,t-1} D_{t-1}$, and revenue from renminbi trade and investment settlement between China and Africa,Ξ_t.[5] The households financial resources are used for consumption, c_t^H , purchase of renminbi-denominated bonds, D_t, and lump sum taxes paid to government, T_t.[6]

3.2 Corporates in African Economies

There is a continuum of infinitely lived corporations involved in the production process. Some are state-owned corporates and some are private-sector corporates. Both state-owned and private-sector corporations manufacture intermediate goods, consume final goods, accumulate physical capital, and pay wages to their employees, who are households. State-owned and private sector corporates are both financially constrained but evolve in two parallel production sectors that produce two imperfectly substitutable intermediate goods. In equilibrium, some of he goods varieties are exported, while other are sold domestically.

3.2.1 State-owned Corporate and Contingent Liabilities

The state-owned corporations begin the period with public capital holdings, which they purchased in the preceding period using bank loans. During this time, they use that public capital, along with hired labor, to produce intermediate goods; the proceeds will be used to pay labor, consume, repay bank loans, and purchase new public capital for tomorrow, subject to a financing constraint. Since state-owned corporates are credit constrained, they discount the future more heavily than households and private sector corporations, and this behavior guarantees that the credit constraints will bind in the neighborhood of the steady state we analyze.

In that context, the representative state-owned corporate maximizes expected utility as follows:

[5]Households revenue from renminbi trade and investment settlement between China and Africa arises in two differents manners. On the one hand, domestic households who offer their labor services to Chinese state-owned enterprises that execute domestic African countries public investment infrastructural projects funded by Chinese debts. On the other hand, domestic households that produce goods or raw materials that are exported to China by African countries.

[6]The Lagrangian and the first-order conditions of this household optimization problem can be found at the Technical Appendix upon request.

$$U_0 = E_0 \sum_{t=0}^{\infty} (\beta_g)^t log\left(c_t^g - h_g c_{t-1}^g\right), \tag{4}$$

where β^g stands for the state-owned corporate's inter-temporal discount factor and c_t^g is his individual consumption.

This state-owned corporate maximizes (4) subject to the budget constraint:

$$c_t^g + w_t^g n_t^g + R_{L,t-1}^g L_{t-1}^g + q_t k_t^g = p_t^g y_t^g + L_t^g + q_t \left(1 - \delta^g\right) k_{t-1}^g, \tag{5}$$

The right hand side of (5) describes the state-owned corporate's resources and the left hand side the uses of these resources. Financial resources come from sales of intermediated goods produced, $p_t^g y_t^g$, new bank loans, L_t^g , and the value of underpreciated physical capital he owns, $q_t(1-\delta^g)k_{t-1}^g$. These resources are used to consume, c_t^g , to pay wage to workers, $w_g n_g$, pay back bank loans from last period, $R_{L,t-1}^g L_{t-1}^g$, and buy new public capital for tomorrow, $q_t k_t^g$.

Each state-owned corporate has access to the following production function that takes labor and public capital inputs and turns them into goods:

$$y_t^g = \alpha_t^g \left(n_t^g\right)^{1-\alpha^g} \left(k_{t-1}^g\right)^{\alpha^g}, \tag{6}$$

where α_g represents the labor share in the production sector and α_t^g measures the total productivity factor (TPF) specific to the sector.

The law of motion for the stock of physical public capital owned by the representative state-owned corporate is given by:

$$k_t^g = \left(1 - \delta^g\right) k_{t-1}^g + i_t^g, \tag{7}$$

where i_t^g represents investment in physical public capital and δ^g is the depreciation rate of public capital.

The international financial frictions arise as follows. We assume that the amount of loans one corporate can obtain is constrained by the value of the collateral he can pledge. Collateral is materialized by public physical capital holdings and loans are provided by foreign advanced economies banks. The process implies that how much physical capital a state-owned corporate can accumulate depends on the minimum loan return required by banks, which in turn depends on three mains components: the LTV ratio, the contingent liabilities $[E_t q_{t+1}^g]$, and the real interest rate $R_{L,t}^g$ on loans. The contingent liabilities is

$t+1$ directed linked to the expected future price on public capital pledge as collateral.[7] If the expected future price on public capital pledge as collateral exceeds the real interest rate $[E_t q^g_{t+1}] > R^g_{L,t}$ on loans, state-owned corporates fulfill their financial engagement via-vis the lenders. By contrast, if the expected future price on public capital pledge as collateral is less than the real interest rate $[E_t q^g_{t+1}] < R^g_{L,t}$ on loans, there is a realization of contingent liabilities and the entire economy bears the cost of financing. Consequently, variations in the quantity and in the value of collateral modify the transmission of shocks and can amplify their effects.

Written in equation term, this friction reads like:

$$R^g_{L,t} L^g_t \leq V^g_t \left(\left(1-\delta^g\right) k^g_t \right) E_t \left[q^g_{t+1} \right] \tag{8}$$

given the following conditions:

$$\begin{cases} \text{State-owned corporate Repayment} & \text{if } \left[E_t q^g_{t+1}\right] > R^g_{L,t} \\ \\ \text{Default, contingent liabilities realization} & \text{if } \left[E_t q^g_{t+1}\right] < R^g_{L,t} \end{cases} \tag{9}$$

where V^g_t stands for the maximum loan to value (LTV) ratio available to a given state-owned corporate.

The amount of loans borrowed by the state-owned enterprise is given by:

$$L^g_t = \left[\left(1-\vartheta_{L^g}\right)^{\frac{1}{\eta}} \left(L^g_{h,t}\right)^{\frac{\eta-1}{\eta}} + \left(\vartheta_{L^g}\right)^{\frac{1}{\eta}} \left(L^g_{f,t}\right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{10}$$

η is the elasticity of substitution between Chinese loans and domestic loans, ϑ_{L^g} denotes the percentage of Chinese loan flows in state-owned corporates in Africa, $L^g_{h,t}$ the amount of domestic loans demanded by state-owned corporates in Africa, and $L^g_{f,t}$ reperesents the amount of Chinese loans demanded by by state-owned corporates in Africa.

The total cost of loans supported by state-owned corporates in Africa is defined as :

$$R^g_{L,t} = \left[\left(1-\vartheta_{L^g}\right) \left(R^g_{h,L,t}\right)^{1-\eta} + \left(\vartheta_{L^g}\right) \left(R^g_{f,L,t}\right)^{1-\eta} \right]^{\frac{1}{1-\eta}} \tag{11}$$

here $R^g_{h,L,t}$ denotes the cost of loans obtained from the domestic financial sector, and $R^g_{f,L,t}$ represents the cost of Chinese loans supplied to state-owned corporates in Africa.

[7] Contingent liabilities are government guarantee of financial repayment in the case the state-owned corporate would be insolvable.This type of government provisions are recurrent in emerging markets.

3.2.2 Private Sector Corporate

The private sector corporate's problem is very similar to that of the state-owned one (the major difference is that in this case there is no government guarantee), so this sub-section will be written in a more concise manner. Within this production sector, the representative private sector corporate maximizes its expected utility described as follows:

$$U_0 = E_0 \sum_{t=0}^{\infty} (\beta_p)^t log\left(c_t^p - h_p c_{t-1}^p\right), \tag{12}$$

where β_p stands for the private sector corporate's discount factor and c_t^p his consumption. Since private sector corporate are also credit constrained (but less so than state-owned corporate) they also discount the future more heavily than households ($\beta_p < \beta_H$).

The representative private sector corporate solves (9) subject to the intertemporal budget constraint:

$$c_t^p + w_t^p n_t^p + R_{L,t-1}^p L_{t-1}^p + q_t k_t^p = p_t^p y_t^p + L_t^p + q_t \left(1 - \delta^p\right) k_{t-1}^p, \tag{13}$$

He also has access to a production function that takes labor and private capital inputs and turns them into goods:

$$y_t^p = \alpha_t^p \left(n_t^p\right)^{1-\alpha^p} \left(k_{t-1}^p\right)^{\alpha^p}, \tag{14}$$

The law of motion for the stock of physical private capital k_{t-1}^p is given by :

$$k_t^p = \left(1 - \delta^p\right) k_{t-1}^p + i_t^p, \tag{15}$$

Contrast to their state-owned corporates counterpart, government is not involved in private sector corporates financial agreement. The international financial frictions are thus quite different in this case. Collateral is materialized by private physical capital holdings and loans are provided by foreign advanced banks.We assume that the amount of loans one private sector corporate can obtain is constrained by the value of the collateral he can pledge. As in this model, collateral is materialized by physical capital holdings, the process implies that how much physical private capital a private sector corporate can accumulate depends on the minimum loan return required by banks, which in turn depends on three mains components: the LTV ratio, the expected future price $[E_t q_{t+1}^p$ of private capital pledged as collateral and the real interest rate $R_{L,t}^p$ on loans. Consequently, variations in the quantity and in the value of collateral modify the transmission of shocks and can amplify their effects.

while the equation for the financial friction reads like:

$$R_{L,t}^{p} L_{t}^{p} \leq V_{t}^{p} \left(\left(1 - \delta^{p} \right) k_{t}^{p} \right) E_{t} \left[q_{t+1}^{p} \right] \tag{16}$$

The borrowing constraint (13) shows that private sector corporates cannot borrow more than a fraction V_t^p of the expected future value of the stock of private capital they pledged.

The amount of loans borrowed by the private sector enterprise is given by:

$$L_{t}^{p} = \left[\left(1 - \vartheta_{L^{p}} \right)^{\frac{1}{\eta}} \left(L_{h,t}^{p} \right)^{\frac{\eta-1}{\eta}} + \left(\vartheta_{L^{p}} \right)^{\frac{1}{\eta}} \left(L_{f,t}^{p} \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{17}$$

η is the elasticity of substitution between Chinese loans and domestic loans, ϑ_{L^p} denotes the percentage of Chinese loan flows in the private sector enterprises in Africa, $L_{h,t}^p$ the amount of domestic loans demanded by the private sector corporates in Africa, and $L_{f,t}^p$ represents the amount of Chinese loans demanded by private sector corporates in Africa.

The total cost of loans supported by private sector enterprises in Africa is defined as :

$$R_{L,t}^{p} = \left[\left(1 - \vartheta_{L^{p}} \right) \left(R_{h,L,t}^{p} \right)^{1-\eta} + \left(\vartheta_{L^{p}} \right) \left(R_{f,L,t}^{p} \right)^{1-\eta} \right]^{\frac{1}{1-\eta}} \tag{18}$$

here $R_{h,L,t}^p$ is the cost of loans obtained from the domestic financial sector, and $R_{f,L,t}^p$ stands for the cost of Chinese loans supplied to private sector enterprises in Africa.

The takeaways from this sub-section are the two key differences between state-owned and private sector corporates. First, the discount factor of state-owned corporate β_g is lower than its counterpart private sector corporate β_p. This feature implies that the ability of state-owned corporate to save pledgeable capital is reduced. Second, the state-owned corporates' maximal LTV ratio in their borrowing constraint V_t^g is lower than its counterpart V_t^p for private sector corporates. This second feature means that state-owned corporate can not pledge their accumulated capital as efficiently as private sector corporates. This may explain the reason why government is always involved in state-owned corporate financial contract.

3.3 Final Goods Production Sector

Firms use the intermediate goods supplied by state-owned corporates y_t^g and private sector corporates y_t^p, to produce a differentiated bundle of final goods y_t sold to home and foreign consumers, by the means of the following CES production function:

$$y_{t} = \left[\left(1 - \theta_{y} \right)^{\frac{1}{\mu}} \left(y_{t}^{g} \right)^{\mu - \frac{1}{\mu}} + \left(\theta_{y} \right)^{\frac{1}{\mu}} \left(y_{t}^{p} \right)^{\mu - \frac{1}{\mu}} \right]^{\frac{\mu}{\mu-1}} \tag{19}$$

Final good producers choose y_t^g and y_t^p to maximize profits, given the production function (14) and input prices p_t^g and p_t^p :

$$Max_{y_t^g y_t^p} \left[y_t - (p_t^g y_t^g + p_t^p y_t^p) \right], \tag{20}$$

The first order conditions for this problem imply the following demand for the output of state-owned corporates:

$$y_t^g = (1 - \theta_y) \left(p_t^g \right)^{-\mu} y_t, \tag{21}$$

and its counterpart for the private sector corporates:

$$y_t^p = (\theta_y) \left(p_t^p \right)^{-\mu} y_t, \tag{22}$$

Further, inserting the demand functions, (16) and (17), into the profit function reveals that the price P_t is given by:

$$P_t = \left[(1 - \theta_p) \left(p_t^g \right)^{1-\gamma} + (\theta_p) \left(p_t^p \right)^{1-\gamma} \right]^{\frac{1}{\gamma}}, \tag{23}$$

Hence, P_t the price of final goods serves to set inputs price p_t^g of state-owned corporates intermediate goods, and p_t^p price of private sector corporates intermediate goods. With, θ_p represents the price rigidity while γ is the price indexation.

Further, the composite wage index, w_t, thus consists of wages supplied to households by the state-owned corporate, w_t^g , and wages supplied to households by the private sector corporate,w_t^p , following the CES aggregator:

$$w_t = \left[(1 - \theta_w) \left(w_t^g \right)^{1-\nu} + (\theta_w) \left(w_t^p \right)^{1-\nu} \right]^{\frac{1}{\nu}}, \tag{24}$$

Here, θ_w represents the wage rigidity whereas ν denotes the wage indexation.

3.4 Capital Producing Sector

Capital producers purchase final goods as investment goods It and transform them into physical capital that they sell to both state-owned corporates and private sector corporates. These producers choose the quantity of investment to maximize profits as follows:

$$Max_{x_{I_t}} E_t \left[q_t I_t - I_t - \frac{\Psi}{2} \left(\frac{I_t}{k_t} - \delta \right)^2 k_t \right] \tag{25}$$

The first order condition (relative to investment It) is given by:

$$E_t\left[q_t - 1 - \Psi\left(I - \frac{t}{k_t} - \delta\right)\right] = 0 \tag{26}$$

Since capital producers face an adjustment cost $(\Psi/2(I_t/k_t - \delta)^2 k_t)$ relation (20) highlights the relationship between the price of physical capital q_t and the marginal cost of adjustment. Note however that, at the stationary state, those adjustment costs are not active and the price of capital therefore equals one.

3.5 Chinese State-owned Banks

China capital outflows to Africa are controlled by the government, and the mains creditors are the Chinese state-owned banks. Hence the representative Chinese state-owned bank intervenes in the model as supplier of loans to both state-owned corporates and private sector corporates in Africa, for renminbi-led assets management, as well as for trade and investment settlement with African economies. It solves the following problem:

$$MaxE_0 \sum_{t=0}^{\infty} \beta_h^t \left(\frac{\lambda_t}{\lambda_{t-1}}\right) \xi_R DIV_t, \tag{27}$$

where DIV_t represents the dividends paid to the government, which is the ultimate owner of bank shares. In this model, we assume that Chinese government uses these banks dividends for renminbi-led assets management, trade and investment settlement with Africa countries. Note that as a result, the discount factor in problem (21) is the same as in the household program, λ_t therefore represents the marginal utility of wealth for households and ξ_R denotes the portfolio adjustment cost. State-owned banks optimize subject to the flow of funds constraint

$$DIV_t + R_{D,t-1}D_{t-1} + L_t^g + L_t^p = D_t + R_{L,t-1}^g L_{t-1}^g + R_{L,t-1}^p L_{t-1}^p, \tag{28}$$

The right hand side of (22) describes the Chinese state-owned bank's resources and the left hand side represents the uses of these resources. The Chinese state-owned bank financial resources come from the renminbi-denominated bonds, D_t, debt service from the state-owned corporates in Africa $R_{L,t-1}^g L_{t-1}^g$, and debt service from the private sector $R_{L,t-1}^p L_{t-1}^p$. The Chinese state-owned bank financial resources are used for trade and investment settlement with Africa DIV_t, to pay interest on the renminbi-denominated bonds, $R_{D,t-1}D_{t-1}$, and extend loans L_t^g to the state-owned corporates as well as loans to private sector corporates L_t^p in Africa.

The total amount of Chinese loans supplied to both state-owned corporates and private sector enterprises in Africa is defined as:

$$L_t^* = \left[(1-\varrho_L)^{\frac{1}{\zeta}} \left(L_{g,t}^*\right)^{\frac{\zeta-1}{\zeta}} + (\varrho_L)^{\frac{1}{\zeta}} \left(L_{p,t}^*\right)^{\frac{\zeta-1}{\zeta}} \right]^{\frac{\zeta}{\zeta-1}} \tag{29}$$

ζ is the elasticity of substitution between Chinese loans supplied to state-owned corporate and Chinese loans supplied to private sector corporates in Africa, ϱ_L denotes the percentage of Chinese loan flows in Africa, $L_{g,t}^*$ the amount of Chinese loans supplied to the state-owned corporates in Africa, and $L_{p,t}^*$ represents the amount of Chinese loans supplied to private sector corporates in Africa.

The total cost supported by China to fund Chinese loans to Africa is defined as:

$$R_{L,t}^* = \left[(1-\varrho_L) \left(R_{g,L,t}^*\right)^{1-\zeta} + (\varrho_L) \left(R_{p,L,t}^*\right)^{1-\zeta} \right]^{\frac{1}{1-\zeta}} \tag{30}$$

here $R_{g,L,t}^p$ is the cost of Chinese loans supplied to state-owned corporates in Africa, and $R_{p,L,t}^*$ stands for the cost of Chinese loans supplied to private sector enterprises in Africa.

3.6 Monetary Policy

This section examines the conduct of monetary policy in African economies and in China, before and after the renminbi internationalization.

3.6.1 Monetary Policy in African Economies

Following large capital flows from China, Central banks in African economies will attempt to use their main monetary policy instrument (policy rate in this case) to channel those liquidities to the real sector via the banking sector.

$$R_t = (1-r_R)\left[(1+r_\pi)\,\pi_{t-1} + r_y Y_{t-1}\right] + r_R R_{t-1} + \varepsilon_{R,t}, \tag{31}$$

where rr and Y are steady-state real rate and output, respectively. Here, monetary policy responds systematically to past inflation r_π and past output r_y . A backward-looking Taylor rule has the advantage of isolating the exogenous component of monetary policy from its endogenous counterpart and fit for exit strategies. If $r_R > 0$, the rule allows for interest rate inertia. $\varepsilon_{R,t}$ is a white noise shock process with zero mean and variance σ_ε. Central banks in African economies may depart from this accommodative monetary policy stance when the People Bank of China moves towards the full normalization of renminbi.

3.6.2 Monetary Policy in China

This section describes the process of monetary policy in China. We start by discussing the past experience of large capital flows from china to Africa. We then depart from this policy to discuss the future prospect of monetary policy within the framework of renminbi normalization.

3.6.2.1 Capital Outflows from China and Monetary Policy in China

The People's Bank of China conducts monetary policy by taking into account capital flows from China towards African economies, which can be explained either by monetary expansion or the purchase of foreign assets by China. In line with the core objective of our research, we assume that those foreign assets are essentially claims to state-owned corporates and private sector corporates in African economies.

In each period,t, the People Bank of China decides on three types of assets: base money (M_t), claims to private sector corporates in emerging markets L_t^{p*}, and claims to the state-owned corporates in emerging markets L_t^{g*}.

The People Bank of China resource constraint in any given period is given by :

$$(M_t - M_{t-1}) = \left(L_t^{p*} - L_{t-1}^{p*}\right) + \left(L_t^{g*} - L_{t-1}^{g*}\right) \tag{32}$$

Following Reynard and Schabert (2009) and Garcia-Cicco (2011), this monetary policy stance formulation implies that the central bank changes the position of an asset on its balance sheet, compensated by a change in another asset, such that the bank's total net worth is kept constant in nominal terms.

3.6.2.2 Renminbi Internationalization and Monetary Policy in China

The Chinese renminbi internationalization proceeds by the undoing of accommodative monetary policy initially implemented under large capital outflows from China to Africa. The internationalization strategy adopted thus far in this paper is the reversal of capital flows back to China. The People's Bank of China sustains the renminbi internationalization by tightening the monetary policy stance. Practically, the People's Bank of China sells the equivalent amount of foreign assets accumulated for years under the past monetary policy stance, against the renminbi.

The People Bank of China aim would be to increase their stock (M_t) of money by refunding their holdings of both, claims to African's private sector corporates L_t^{p*}, and L_t^{g*} claims to state-owned corporates in Africa. By diminishing the People Bank of China stock of foreign financial assets holding, the internationalization of the renminbi would in turn shrink liquidity in foreign financial markets, including African economies.

4 Estimation Findings

The structural model is estimated using Bayesian estimations on quarterly data over the sample period 1980Q1 to 2024Q1. The dataset includes 8 time series as presented: real GDP, real consumption, real investment, the inflation, the real exchange rate, the term of trade, the Chinese loans to Africa, and the PBoC policy rate. Data are seasonally adjusted using Hedrick-Prescott filter. Figure X plots the transformed data. The tables (1-14) report the prior and posterior marginal densities of the parameters of the model, as well as the standard deviation of the shocks and the parameters driving the shocks processes.

4.1 China-Africa Engagement Before Renminbi Internationalization

Table 1 represents the state of African economy when both state-owned corporates and private sector corporates benefit from large capital inflows from China. The discount factor posterior parameter is estimated to be 0.999 greater than its prior parameter of 0.997. The total depreciation of capital is estimated to be 0.02 lower than its prior value of 0.25. the total share of capital into the production process is estimated to be 0.32, higher than its prior value of 0.3. The portfolio adjustment cost is estimated to 0.000001 much lower than its prior parameter of 0.0005. These results indicate that, under past experience, financing constraints are loosened in Africa under the Sino-Africa partnership. The household consumption habit is estimated to be 0.32, much lower than its prior value of 0.7. this results show that before RMB internationalization, households were saving more in Africa. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 0.59, lower than its prior value of 1. This results indicates that, African economies become less labor-intensive before renminbi internationalization.

The price rigidity is estimated to be 0.5 exactly as its prior value of 0.5. But, the price indexation is estimated to be 0.07 lower than its prior value of 0.5. By contrast, the wage rigidity is estimated to be 0.67 greater than its prior value of 0.5. But, the wage indexation is estimated to be 0.46 lower than its prior value of 0.5. These findings show that wages are more rigid than prices under past experience of Sino-Africa partnership. The Chinese loan supply rigidity is estimated to 0.29, lower than its prior value of 0.5. Likewise, the Chinese loan supply indexation is estimated to 0.12, lower than its prior value of 0.5. This results indicate that, before renminbi internationalization, more China loans are supplied to Africa.

The investment adjustment cost is estimated to 0.63, lower than its prior value of 4. This results indicate that, before renminbi internationalization, corporates in Africa turn Chinese loans into higher investments because of lower investment costs. This is because, the loosening of the financial constraints affecting state-owned corporates increases their in- vestment capabilities. With more capital inflows from China to Africa, before renminbi internationalization, state-owned corporates become less financially constrained, and become more capital intensive. The depreciation rate of public capital is estimated

to be 0.4, lower than its prior value of 0.5. By contrast, the depreciation rate of private capital is estimated to be 0.6, greater than its prior value of 0.5.

The loan-to-value ratio is estimated to 0.00001 lower than its prior value of 0.1. This results demonstrate that, corporates in Africa are less financially constrained before the renminbi internationalization. Moreover, the results shows that state-owned corporates are saving more before renminbi internationalization relative to private sector enterprises. The consumption habit of private sector enterprises corporates is estimated to 0.9 more higher that its prior value of 0.5. By contrast, the consumption habit of state-owned corporates is estimated to 0.2 lower than its prior value of 0.5.

The price stability parameter is estimated to 1.9 lower than its prior value of 2. Likewise, the output stabilization parameter is estimated to 0.16 greater than its prior value 0.12. The monetary policy persistence parameter is estimated to 0.86 greater than its prior value of 0.85. These finding demonstrate that, before renminbi internationalization, monetary policy effectively stimulate economic activity while spurring low and stable inflation. The easier availability of resources facilitates the production of intermediate goods by the state-owned corporations. As long as the demand for those goods remains relatively unchanged and their supply is increasing, their prices decline and their value added becomes close to that of their private sector counterpart. In addition, in the private sector corporates are becoming labor intensive. The more the financial constraints are relaxed for state-owned corporations, the more private sector enterprises become labor-intensive as their counterpart.

The consumption good openness is estimated to 0.18 greater than its prior value 0.1. The investment good openness is estimated to 0.07, greater than its prior value of 0.5. These results show, before renminbi internationalization, African economies trade more with China. Likewise, the state-owned corporates loans openness is estimated to 0.1 greater that its prior value of 0.08.Also, the private sector corporate loans openness is estimated to 0.3 greater than its value 0f 0.2. This finding show that African's corporates benefit more Sino-Africa financial intensification before renminbi internationalization.

The elasticity of substitution of final goods is estimated to 4.5 greater than its prior value of 1. This results confirm trade intensification between China and Africa before renminbi internationalization. The elasticity state-owned corporates Chinese loans is estimated to 2.5 greater than its prior value of 1. Likewise, the elasticity of private sector corporates Chinese loans is estimated to be 0.9, near the prior value of 1. These findings demonstrate high capital inflow from China towards Africa corporates, mainly state-owned corporates.

Table 1— Parameter Priors and Posteriors Before RMB Internationalization

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
β	0.997	0.9990	0.9990	0.9990	Normal	0.10
δ	0.25	0.02	0.01	0.12	Beta	0.02
α	0.30	0.3261	0.3260	0.3261	Beta	0.05
ξ_R	0.0005	0.000001	0.000001	0.000002	Gamma	0.00013
h	0.7	0.32	0.21	0.42	Beta	0.20
τ	1	0.59	0.30	0.88	Gamma	10.30
θ_p	0.5	0.56	0.47	0.65	Beta	0.10
γ_p	0.5	0.07	0.01	0.14	Beta	0.2
θ_w	0.5	0.67	0.56	0.78	Beta	0.10
ν_w	0.5	0.46	0.16	0.76	Beta	0.10
ϱ_L	0.5	0.29	0.20	0.38	Beta	0.10
ζ	0.5	0.12	0.01	0.22	Beta	0.15
Ψ	4	0.63	0.38	0.86	Normal	1.5
δ_g	0.5	0.48	0.28	0.68	Normal	0.2
δ_p	0.5	0.66	0.47	0.85	Beta	0.15
V	0.1	0.00001	0.01	0.00002	Beta	0.05
h_p	0.5	0.96	0.93	0.99	Beta	0.18
h_g	0.5	0.20	0.05	0.34	Beta	0.2
r_π	2	1.9988	1.9986	1.9989	Normal	0.15
r_y	0.12	0.1637	0.1637	0.1637	Normal	0.05
ρ_r	0.85	0.8696	0.8696	0.8696	Beta	0.10
θ_y	0.10	0.18	0.0011	0.18002	Beta	0.04
θ_I	0.05	0.07	0.0001	0.08002	Beta	0.04
ϑ_{L^p}	0.08	0.1	0.0003	0.10003	Beta	0.04
ϑ_{L^g}	0.2	0.3	0.0005	0.30002	Beta	0.07
μ_y	1	4.5	0.0009	4.67002	Gamma	0.75
η_g	1	2.5	0.0003	2.70002	Gamma	0.75
η_p	1	0.9	0.0001	1.00002	Gamma	0.75

Note: Results based on 100 chains, each with 2,000,000 draws from the Metropolis algorithm.

The standard deviation of the productivity shock, the public spending shock, the preference shock, the wage markup shock and the contingent liabilities shock are estimated to be respectively, 0.82, 0.71, 2.07, 0.80, 2.27, and 0.026, lower than their prior value of, 0.88, 0.76, 2.12, 0.92, 2.28, and 0.09 respectively. By contrast, the balance-sheet shock, the external finance premium shock, and the China loans supply shock, are estimated to be respectively, 0.14, 0.46, and 0.27, exactly as their prior values. This results demonstrate that financial shocks are less volatile before renminbi internationalization than both supply and

demand shock. This imply that both state-owned corporate and private sector corporate are less financially constrained before the renminbi internationalization.

Likewise, the productivity shock, the public spending shock, the balance-sheet shock, the china loans supply shock, the contingent liability shock and the wage markup shocks are estimated to be respectively, 0.99, 0.93, 0.96, 0.99, 0.90, and 0.99, greater than its prior value of 0.85. This results imply that there is more willingness for African economies to face the realization of contingent liabilities before renminbi internationalization. By contrast, the preference shock, the external finance premium shock and the spillover shock are estimated to be 0.81, 0.45, and 0.84, lower than its prior value of 0.85. These findings show that spillover shocks are less persistent before renminbi internationalization.

Table 2—Shocks Priors and Posteriors Before RMB Internationalization

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
σ_α	0.880	0.8274	0.3134	1.3860	Inverted Gamma	0.7000
σ_g	0.760	0.7147	0.2543	1.1851	Inverted Gamma	0.6000
σ_ϖ	2.120	2.0726	0.8299	3.4023	Inverted Gamma	1.3000
σ_η	0.140	0.1432	0.0519	0.2375	Inverted Gamma	0.0900
σ_{R_L}	0.460	0.4606	0.3942	0.5241	Inverted Gamma	0.0400
σ_L	0.270	0.2700	0.2209	0.3203	Inverted Gamma	0.0310
σ_w	0.920	0.8027	0.2332	1.4461	Inverted Gamma	1.8000
σ_ζ	2.280	2.2710	1.3911	3.0820	Inverted Gamma	0.6000
σ_r	0.090	0.0263	0.0263	0.0263	Inverted Gamma	0.0800
ρ_α	0.85	0.99	0.98	1.00	Beta	0.08
ρ_g	0.85	0.93	0.88	0.98	Beta	0.10
ρ_ϖ	0.85	0.81	0.72	0.91	Beta	0.10
ρ_η	0.85	0.96	0.92	0.99	Beta	0.10
ρ_{R_L}	0.85	0.47	0.35	0.59	Beta	0.10
ρ_L	0.85	0.99	0.98	1.00	Beta	0.08
ρ_ζ	0.85	0.90	0.83	0.97	Beta	0.10
ρ_w	0.85	0.99	0.99	1.00	Beta	0.08
$\rho_{\alpha*g}$	0.85	0.84	0.69	0.99	Beta	0.10

Note: Results based on 100 chains, each with 2000, 000 draws from the Metropolis algorithm.

4.2 Sino-Africa Economic Partnership After RMB Internationalization

Tables 3-10 represents the state African economy when both state-owned corporates and private sector corporates face Chinese renminbi internationalization. The data used for the Bayesian estimations of the structural DSGE model were very informative regarding the effects of renminbi internationalization on Africa.

4.2.1 China-Africa Economic Partnership under RMB Trade Settlement

The findings in Table 3 reveal that renminbi internationalization leads to tighter financing constraints in African economies. Indeed, renminbi trade settlement instrument disrupts trade intensification between china and Africa due to tighter financings constraints facing both state-owned corporates and private sector enterprises. The discount factor posterior parameter is estimated to be 0.991 lower to its prior parameter of 0.997. The total depreciation of capital is estimated to be 0.023 lower than its prior value of 0.25. The total share of capital into the production process is estimated to be 0.25, lower than its prior value of 0.3. The portfolio adjustment cost is estimated to 0.0007 higher than its prior parameter of 0.0005.

The household consumption habit is estimated to be 0.73, higher than its prior value of 0.7. This results show that with renminbi internationalization under renminbi trade settlement instrument, households were save less in Africa. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 0.9, close to its prior value of 1. This results indicates that, African economies become more labor-intensive with renminbi internationalization under renminbi trade settlement instrument.

The price rigidity is estimated to be 0.56 greater than its prior value of 0.5. The price indexation is estimated to be 0.47 lower than its prior value of 0.5. By contrast, the wage rigidity is estimated to be 0.57 greater than its prior value of 0.5. The wage indexation is estimated to be 0.46 lower than its prior value of 0.5. These findings show that prices are rigid as wages with renminbi internationalization under renminbi trade settlement instrument.

The Chinese loan supply rigidity is estimated to 0.62, greater than its prior value of 0.5. Likewise, the Chinese loan supply indexation is estimated to 0.48, lower than its prior value of 0.5. This results indicate that, with renminbi internationalization under renminbi trade settlement instrument, less Chinese loans are supplied to Africa.

The investment adjustment cost is estimated to 0.25, lower than its prior value of 4. This results indicate that, with renminbi internationalization under renminbi trade settlement instrument, corporates in Africa continue to benefit from lower investment costs. This is because, the tightening of the financial constraints evenly affects state-owned corporates relatively to private sector corporates. The depreciation rate of public capital is estimated to be 0.66, lower than its prior value of 0.5. By contrast, the depreciation rate of private capital is estimated to be 0.5, exactly as its prior value of 0.5. Hence, under

renminbi trade settlement instrument, state-owned enterprises become relatively less financially constrained as private sector enterprises. As a result, state-owned corporates are becoming relatively capital-intensive as private sector enterprises.

The loan-to-value ratio is estimated to 0.12 greater than its prior value of 0.1. This results demonstrate that, corporates in Africa are more financially constrained with renminbi internationalization under renminbi trade settlement instrument. Moreover, the results shows that both state-owned corporates and private sector enterprises save less with renminbi internationalization under renminbi trade settlement instrument. The consumption habit of private sector enterprises corporates is estimated to 0.73 more higher that its prior value of 0.5. Likewise, the consumption habit of state-owned corporates is estimated to 0.65 greater than its prior value of 0.5. Indeed, because they face tight financing conditions, the table goes on to show that state-owned corporates save less. Private sector corporates, by contrast, relatively save more, because they are less affected relative to their counterparts. Private sector corporates therefore accumulate more pledgeable collateral and can undertake more investment projects than state-owned corporates.

The price stability parameter is estimated to 1.8 lower than its prior value of 2. By contrast, the output stabilization parameter is estimated to 0.10 lower than its prior value 0.12. The monetary policy persistence parameter is estimated to 0.74 lower than its prior value of 0.85. These finding demonstrate that, with renminbi internationalization under renminbi trade settlement instrument, monetary policy as ineffective in stimulating economic activity. Inflation remains low and stable, but economic activity contracts.The findings reveal that renminbi internationalization leads to tighter financing constraints in African economies. In fact, because state-owned corporates are the most financially constrained, their costs are higher, and it is relatively expensive to produce in this sector; goods in this sector thus become scarce. As the demand for those goods decreases with renminbi led trade settlement, this shift in supply implies that their prices decreases as well, leading to a decrease in the value-added of state-owned corporates. For private sector corporates, by contrast, it is easier to produce because the financial constraints are less severe; goods from this sector thus become abundant. This increase in private sector corporate supply leads to a price decrease, and the value added of the sector therefore declines. In both cases, one the one hand price decreases and reinforcing price stability, on the other hand, the value-added declines contracting the economic activity.

The consumption good openness is estimated to 0.001 lower than its prior value 0.1. The investment good openness is estimated to 0.001, greater than its prior value of 0.8. These results demonstrate that renminbi internationalization under renminbi trade settlement contravene bilateral trade between African economies and China. Likewise, the state-owned corporates loans openness is estimated to 0.001 lower that its prior value of 0.2. Also, the private sector corporate loans openness is estimated to 0.001 lower than its value of 0.08. These findings demonstrate that China loans to Africa shrink with renminbi internationalization under renminbi trade settlement, more so for state-owned corporates than private sector corporates.

Table 3— Parameters Priors and Posteriors under RMB Trade Settlement

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
β	0.997	0.991	0.997	1.3	Normal	0.10
δ	0.25	0.023	0.01	0.12	Beta	0.02
α	0.30	0.25	0.15	0.35	Beta	0.05
ξ_R	0.0005	0.0007	0.0001	0.0011	Gamma	0.00013
h	0.7	0.7349	0.7344	0.7354	Beta	0.20
τ	1	0.9210	0.9193	0.9230	Gamma	10.30
θ_p	0.5	0.5649	0.5646	0.5654	Beta	0.10
γ_p	0.5	0.4762	0.4757	0.4767	Beta	0.2
θ_w	0.5	0.5780	0.5776	0.5784	Beta	0.10
ν_w	0.5	0.4817	0.4813	0.4823	Beta	0.10
ϱ_L	0.5	0.6229	0.6227	0.6231	Beta	0.10
ζ	0.5	0.4846	0.4840	0.4852	Beta	0.15
Ψ	4	0.2545	0.2543	0.2547	Normal	1.5
δ_g	0.5	0.6636	0.4626	0.7642	Normal	0.2
δ_p	0.5	0.5097	0.5092	0.5104	Beta	0.15
V	0.1	0.1213	0.1210	0.1215	Beta	0.05
h_g	0.5	0.7306	0.7297	0.7311	Beta	0.18
h_p	0.5	0.6592	0.6581	0.6607	Beta	0.2
r_π	2	1.85	1.60	2.10	Normal	0.15
r_y	0.12	0.10	0.08	0.13	Normal	0.05
ρ_r	0.85	0.74	0.81	0.78	Beta	0.10
θ_y	0.10	0.001	0.0011	0.002	Beta	0.04
θ_I	0.08	0.001	0.0001	0.002	Beta	0.04
ϑ_{L^p}	0.08	0.001	0.0003	0.003	Beta	0.04
ϑ_{L^g}	0.2	0.001	0.0005	0.002	Beta	0.07
μ_y	1	0.001	0.0009	0.002	Gamma	0.75
η_g	1	0.001	0.0003	0.002	Gamma	0.75
η_p	1	0.001	0.0001	0.002	Gamma	0.75

Note: Results based on 100 chains, each with 2000, 000 draws from the Metropolis algorithm.

The elasticity of substitution of final goods is estimated to 0.001 lower than its prior value of 1. This results confirm that bilateral trade contracts between China and Africa with renminbi internationalization under renminbi trade settlement. The elasticity state-owned corporates Chinese loans is estimated to 0.001 lower than its prior value of 1. Likewise, the elasticity of private sector corporates Chinese loans is estimated to be 0.001, lower than its prior value of 1. These findings demonstrate deep financial constraints for both state-owned corporates and private sector enterprises with renminbi internationalization

under renminbi trade settlement.

Table 4— Shocks Priors and Posteriors under RMB Trade Settlement

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
σ_α	0.880	0.9271	0.3134	1.3860	Inverted Gamma	0.7000
σ_g	0.760	0.8742	0.2543	1.1851	Inverted Gamma	0.6000
σ_ϖ	2.120	2.267	0.8299	3.4023	Inverted Gamma	1.3000
σ_η	0.140	0.1321	0.0519	0.2375	Inverted Gamma	0.0900
σ_{R_L}	0.460	0.443	0.3942	0.5241	Inverted Gamma	0.0400
σ_L	0.270	0.2462	0.2209	0.3203	Inverted Gamma	0.0310
σ_w	0.920	0.934	0.2332	1.4461	Inverted Gamma	1.8000
σ_ζ	2.280	2.109	1.3911	3.0820	Inverted Gamma	0.6000
σ_r	0.090	0.137	0.0263	0.0263	Inverted Gamma	0.0800
ρ_α	0.85	0.89	0.98	1.00	Beta	0.08
ρ_g	0.85	0.81	0.88	0.98	Beta	0.10
ρ_ϖ	0.85	0.80	0.72	0.91	Beta	0.10
ρ_η	0.85	0.87	0.92	0.99	Beta	0.10
ρ_{R_L}	0.85	0.65	0.35	0.59	Beta	0.10
ρ_L	0.85	0.88	0.98	1.00	Beta	0.08
ρ_ζ	0.85	0.85	0.83	0.97	Beta	0.10
ρ_w	0.85	0.89	0.99	1.00	Beta	0.08
$\rho_{\alpha*g}$	0.85	0.91	0.69	0.99	Beta	0.10

Note: Results based on 100 chains, each with 2000, 000 draws from the Metropolis algorithm.

In Table 4, The standard deviation of the productivity shock, the public spending shock, the preference shock, the wage markup shock and the monetary policy shock are estimated to be respectively, 0.92, 0.87, 2.2, 0.93, and 0.13, greater than their prior value of, 0.88, 0.76, 2.12, 0.92, and 0.09 respectively. By contrast, the balance-sheet shock, the external finance premium shock, the China loans supply shock, and the contingent liabilities shock, are estimated to be respectively, 0.13, 0.44, 0.24, and 2.1 lower than their prior value of 0.14, 0.46, 0.27 and 2.2. This results demonstrate that there is less willingness for African economies to face continent liabilities realization and high sovereign debt with renminbi internationalization under renminbi trade settlement instrument.

Likewise, the productivity shock, the balance-sheet shock, the china loans supply shock, the wage markup, and the spillover shocks are estimated to be respectively, 0.89, 0.87, 0.88, 0.89, and 0.91 respectively, greater than their prior value of 0.85. By contrast, the public spending shock, the preference shock, the external finance premium shock and the contingent liabilities shock are estimated to be 0.81, 0.80, 0.65, and 0.85, respectively, lower than their prior value of 0.85. These findings show that the effects of Chinese loans

contraction on both state-owned-corporates and private sectors' balance-sheets are more persistent with renminbi internationalization under renminbi trade settlement instrument.

Overall, the estimations reveal that renminbi internationalization under renminbi trade settlement worsens the balance sheets and the productive capacities of both state-owned corporates and private sector corporates. However, due to their different levels of financing constraints, state-owned corporations appear to be more affected by Chinese renminbi internationalization than private sector corporations. As a response, private sector corporates seem to accumulate pledge- able private capital collateral more efficiently than state-owned corporates with pledge- able public capital collateral. Hence, private sector corporates are thus capital-intensive, whereas state-owned corporates are labor-intensive. The Chinese renminbi internationalization would contravene the progress realized by state-owned corporates during years of large capital flows from China, which made them more economically close to their private sector counterparts due to financing constraints.

4.3 Sino-Africa Partnership under RMB-led Bond Internationalization

Table 5 displays the effects of renminbi internationalization under the renminbi-led bond instrument. The discount factor posterior parameter is estimated to be 0.995 close to its prior parameter of 0.997. The total depreciation of capital is estimated to be 0.02 lower than its prior value of 0.25. The total share of capital into the production process is estimated to be 0.28, lower than its prior value of 0.3. The portfolio adjustment cost is estimated to 0.0005 exactly as its prior value. These results indicate that, with renminbi internationalization under renminbi-led bond instrument, Africa economies face financing constraints.

The household consumption habit is estimated to be 0.68, lower than its prior value of 0.7. This results show that with with renminbi internationalization under renminbi-led bond instrument, households were save relatively more in Africa. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 0.87, lower than its prior value of 1. This results indicates that, African economies become more labor-intensive with renminbi internationalization under renminbi-led bond instrument.

The price rigidity is estimated to be 0.61 greater than its prior value of 0.5. The price indexation is estimated to be 0.38 lower than its prior value of 0.5. By contrast, the wage rigidity is estimated to be 0.50 exactly as its prior value. The wage indexation is estimated to be 0.42 lower than its prior value of 0.5. These findings show that prices and wages are relatively less rigid with renminbi internationalization under renminbi-led bond instrument.

The Chinese loan supply rigidity is estimated to 0.46, lower than its prior value of 0.5. Likewise, the Chinese loan supply indexation is estimated to 0.45, lower than its prior value of 0.5. This results indicate that, financing constraints is relatively loosened with renminbi internationalization under renminbi-led bond instrument. This is because under under renminbi-led bond instrument, corporates still benefit from china loans supply.

The investment adjustment cost is estimated to 0.004, lower than its prior value of 4. This results indicate that, with renminbi internationalization under renminbi-led bond instrument, corporates in Africa continue to benefit from lower investment costs. The depreciation rate of public capital is estimated to be 0.46, lower than its prior value of 0.5. By contrast, the depreciation rate of private capital is estimated to be 0.49, lower than its prior value of 0.5. So with renminbi internationalization under renminbi-led bond instrument, private-sector corporations, face always less severe financing constraints. Private-sector corporates become highly capital intensive. Consequently, private sector corporates employ a relatively small portion of the economy's workforce but equip each worker with significantly more private capital.

The loan-to-value ratio is estimated to 0.1 exactly as its prior value of 0.1. This results demonstrate that, corporates in Africa are less financially constrained with renminbi internationalization under renminbi-led bond instrument. Moreover, the results shows that both state-owned corporates and private sector enterprises save relatively less with ren-

minbi internationalization under renminbi-led bond instrument. The consumption habit of private sector enterprises corporates is estimated to 0.57 higher that its prior value of 0.5. Likewise, the consumption habit of state-owned corporates is estimated to 0.56 greater than its prior value of 0.5. Indeed, both corporates relatively save less, because they are less affected under renminbi-led bond instrument. Therefore they accumulate some pledgeable collateral and can undertake some investment projects.

The price stability parameter is estimated to 1.85 lower than its prior value of 2. Similarly, the output stabilization parameter is estimated to 0.15 greater than its prior value 0.12. The monetary policy persistence parameter is estimated to 0.84 lower than its prior value of 0.85. These finding demonstrate that, under renminbi-led bond instrument renminbi internationalization help monetary policy to anchor inflation around the target wile expanding economic growth.

The consumption good openness is estimated to 0.17 greater than its prior value 0.1. The investment good openness is estimated to 0.06, lower than its prior value of 0.08. These results demonstrate that under renminbi-led bond, renminbi internationalization support more bilateral trade between African economies and China relatively than investment. Likewise, the state-owned corporates loans openness is estimated to 0.11 lower that its prior value of 0.2. Also, the private sector corporate loans openness is estimated to 0.09 higher than its value of 0.08. These findings demonstrate that China loans supply to Africa remains steady with renminbi internationalization under renminbi-led bond, for private sector enterprises, contrast to state-owned corporates.

The elasticity of substitution of final goods is estimated to 2.5 higher than its prior value of 1. This results confirm that renminbi-led bond instrument supports bilateral trade between China and Africa. The elasticity state-owned corporates Chinese loans is estimated to 0.7 lower than its prior value of 1. By contrast, the elasticity of private sector corporates Chinese loans is estimated to be 1.5, greater than its prior value of 1. These findings demonstrate more loose financial constraints private sector enterprises with renminbi internationalization under renminbi-led bond instrument, relatively to the state-owned corporates.

Table 5—MCMC Priors and Posteriors Parameters under RMB-led Bond

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
β	0.997	0.995	0.995	1.01	Normal	0.10
δ	0.25	0.02	0.01	0.11	Beta	0.02
α	0.30	0.28	0.15	0.33	Beta	0.05
ξ_R	0.0005	0.0005	0.0001	0.0010	Gamma	0.00011
h	0.7	0.6895	0.6893	0.6897	Beta	0.20
τ	1	0.8754	0.8110	0.9951	Gamma	10.30
θ_p	0.5	0.6199	0.6193	0.6207	Beta	0.10
γ_p	0.5	0.3893	0.3887	0.3899	Beta	0.2
θ_w	0.5	0.5075	0.5780	0.5281	Beta	0.10
ν_w	0.5	0.4241	0.3236	0.5247	Beta	0.10
ϱ_L	0.5	0.4670	0.3967	0.5974	Beta	0.10
ζ	0.5	0.4562	0.3856	0.4869	Beta	0.15
Ψ	4	0.0044	0.0042	0.0046	Normal	1.5
δ_g	0.5	0.4615	0.4301	0.5329	Normal	0.2
δ_p	0.5	0.4994	0.4988	0.4999	Beta	0.15
V	0.1	0.1086	0.1085	0.1088	Beta	0.05
h_p	0.5	0.5762	0.4743	0.5974	Beta	0.18
h_g	0.5	0.5634	0.4721	0.5741	Beta	0.2
r_π	2	1.85	1.60	2.10	Normal	0.15
r_y	0.12	0.15	0.08	0.23	Normal	0.05
ρ_r	0.85	0.84	0.81	0.88	Beta	0.10
θ_y	0.10	0.17	0.11	0.23	Beta	0.04
θ_I	0.08	0.06	0.01	0.10	Beta	0.04
ϑ_{L^p}	0.08	0.09	0.03	0.15	Beta	0.04
ϑ_{L^g}	0.2	0.11	0.05	0.17	Beta	0.07
μ_y	1	2.54	1.98	3.517	Gamma	0.75
η_p	1	1.50	1.02	2.745	Gamma	0.75
η_g	1	0.714	0.542	1.985	Gamma	0.75

Note: Results based on 100 chains, each with 2000, 000 draws from the Metropolis algorithm.

In Table 6, the standard deviation of the productivity shock, the public spending shock, the preference shock, the external finance premium shock, the China loans supply shock, the wage markup shock, and the contingent liabilities shock, are estimated to be respectively, 0.16, 0.041, 2.07, 0.01, 0.09, 0.01, and 2.27 greater than their prior value of, 0.88, 0.76, 2.12, 0.46, 0.27, 0.92, and 2.28 respectively. By contrast, the balance-sheet shock and the monetary policy shock are estimated to be respectively, 0.16 and 0.096 greater than their prior value of 0.14 and 0.090. This results demonstrate that there is less willingness for African economies to face continent liabilities realization and high sovereign debt with

renminbi internationalization under renminbi-led bond instrument.

On the contrary all the shocks a exhibit lower persistence with renminbi internationalization under renminbi-led bond instrument, less so for the contingent liabilities shock and the spillover shock.

Table 6—Shocks Priors and Posteriors under RMB-led Bond

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
σ_α	0.880	0.1653	0.1603	0.1727	Inverted Gamma	0.7000
σ_g	0.760	0.0413	0.0413	0.0414	Inverted Gamma	0.6000
σ_ϖ	2.120	2.0726	0.8299	3.4023	Inverted Gamma	1.3000
σ_η	0.140	0.1663	0.1644	0.1680	Inverted Gamma	0.0900
σ_{R_L}	0.460	0.0121	0.0118	0.0124	Inverted Gamma	0.0400
σ_L	0.270	0.0962	0.0878	0.1056	Inverted Gamma	0.0310
σ_w	0.920	0.0199	0.0162	0.0231	Inverted Gamma	1.8000
σ_ζ	2.280	2.2710	1.3911	3.0820	Inverted Gamma	0.6000
σ_r	0.090	0.0964	0.0283	0.1650	Inverted Gamma	0.0800
ρ_α	0.85	0.0915	0.0911	0.0920	Beta	0.08
ρ_g	0.85	0.0962	0.0959	0.0964	Beta	0.10
ρ_ϖ	0.85	0.0846	0.0841	0.0851	Beta	0.10
ρ_η	0.85	0.0832	0.0827	0.0838	Beta	0.10
ρ_{R_L}	0.85	0.0779	0.0775	0.0782	Beta	0.10
ρ_L	0.85	0.0880	0.0875	0.0887	Beta	0.08
ρ_ζ	0.85	0.1383	0.1380	0.1386	Beta	0.10
ρ_w	0.85	0.0677	0.0672	0.0681	Beta	0.08
$\rho_{\alpha*g}$	0.85	0.1363	0.1356	0.1370	Beta	0.10

Note: Results based on 100 chains, each with 2000, 000 draws from the Metropolis algorithm.

4.4 Sino-Africa Economic Partnership under RMB-led Investment Internationalization

Table 7 displays the effects of renminbi internationalization under the renminbi-led investment instrument. The discount factor posterior parameter is estimated to be 0.997 identical to its prior value. The total depreciation of capital is estimated to be 0.018 lower than its prior value of 0.25. The total share of capital into the production process is estimated to be 0.29, lower than its prior value of 0.3. The portfolio adjustment cost is estimated to 0.0002 lower than its prior value of 0.0005. These results indicate that, with renminbi internationalization under renminbi-led investment instrument, the magnitude of financing constraints face by African economies diminishes.

The household consumption habit is estimated to be 0.65, lower than its prior value of 0.7. This results show that with with renminbi internationalization under renminbi-led investment instrument, households were save relatively more in Africa. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 0.87, lower than its prior value of 1. This results indicates that, African economies become more labor-intensive with renminbi internationalization under renminbi-led investment instrument.

The price rigidity is estimated to be 0.55 greater than its prior value of 0.5. The price indexation is estimated to be 0.35 lower than its prior value of 0.5. By contrast, the wage rigidity is estimated to be 0.54 greater as its prior value. The wage indexation is estimated to be 0.51 greater than its prior value of 0.5. These findings show that prices and wages are relatively less rigid with renminbi internationalization under renminbi-led investment instrument.

The Chinese loan supply rigidity is estimated to 0.55, greater than its prior value of 0.5. Likewise, the Chinese loan supply indexation is estimated to 0.49, lower than its prior value of 0.5. This results indicate that, financing constraints is relatively loosened with renminbi internationalization under renminbi-led investment instrument. Hence, under renminbi-led investment instrument, corporates still benefit from china loans supply.

The investment adjustment cost is estimated to 0.0002, lower than its prior value of 4. This results indicate that, renminbi-led investment instrument helps corporates in Africa to maintain lower investment costs under renminbi internationalization. The depreciation rate of public capital is estimated to be 0.48, lower than its prior value of 0.5. By contrast, the depreciation rate of private capital is estimated to be 0.51, higher than its prior value of 0.5. So with renminbi internationalization under renminbi-led investment instrument, state-owned corporates maintain loosening financing constraints. State-owned corporates remains capital intensive. So, they employ a relatively small portion of the economy's workforce but equip each worker with significantly more public capital.

The loan-to-value ratio is estimated to 0.11 close to its prior value of 0.1. This results demonstrate that, corporates in Africa are less financially constrained with renminbi internationalization under renminbi-led investment instrument. Moreover, the results shows

that both state-owned corporates and private sector enterprises save relatively less with renminbi internationalization under renminbi-led investment instrument. The consumption habit of private sector enterprises corporates is estimated to 0.53 higher that its prior value of 0.5. Likewise, the consumption habit of state-owned corporates is estimated to 0.51 greater than its prior value of 0.5. Indeed, with renminbi-led investment instrument, both corporates relatively smooth their saving under renminbi internationalization. As are result they steadily accumulate both public-backed and private-backed pledgeable collateral and continue to growth their investments.

The price stability parameter is estimated to 2.01 exactly as its prior value of 2. Similarly, the output stabilization parameter is estimated to 0.2 greater than its prior value 0.12. The monetary policy persistence parameter is estimated to 0.87 greater than its prior value of 0.85. These finding demonstrate that, renminbi-led investment instrument induces monetary policy in Africa to achieve inflation objective and maintain economic expansion under renminbi internationalization.

The consumption good openness is estimated to 0.11 close to its its prior value of 0.1. The investment good openness is estimated to 0.12, greater than its prior value of 0.08. These results demonstrate that under renminbi-led investment instrument, renminbi internationalization support more investment intensification in Africa funded by Chinese loans relatively to the bilateral trade between Africa and China. Likewise, the state-owned corporates loans openness is estimated to 0.23 greater that its prior value of 0.2. Also, the private sector corporate loans openness is estimated to 0.07 lower than its value of 0.08. These findings demonstrate that China loans supply to Africa remains steady with renminbi internationalization under renminbi-led investment, for state-owned corporates, contrast to the private sector corporates.

The elasticity of substitution of final goods is estimated to 0.8 lower than its prior value of 1. This results confirm that renminbi-led investment instrument does not necessarily supports bilateral trade between China and Africa under renminbi internationalization. The elasticity state-owned corporates Chinese loans is estimated to 1.8 greater than its prior value of 1. By contrast, the elasticity of private sector corporates Chinese loans is estimated to be 0.9, lower than its prior value of 1. These findings demonstrate more loose financial constraints for state-owned corporates with renminbi internationalization under renminbi-led investment instrument, relatively to the private sector corporates.

Table 7–Priors and Posteriors Parameters under RMB-led Investment

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
β	0.997	0.997	0.995	1.2	Normal	0.10
δ	0.25	0.018	0.01	0.101	Beta	0.02
α	0.30	0.291	0.15	0.325	Beta	0.05
ξ_R	0.0005	0.0002	0.0001	0.00021	Gamma	0.00013
h	0.7	0.6521	0.6295	0.6795	Beta	0.20
τ	1	0.879	0.7621	0.9975	Gamma	10.30
θ_p	0.5	0.5514	0.5190	0.6378	Beta	0.10
γ_p	0.5	0.3581	0.3437	0.3937	Beta	0.2
θ_w	0.5	0.5478	0.5379	0.5985	Beta	0.10
ν_w	0.5	0.5141	0.5014	0.5541	Beta	0.10
ϱ_L	0.5	0.5501	0.5403	0.5994	Beta	0.10
ζ	0.5	0.4925	0.4801	0.4966	Beta	0.15
Ψ	4	0.002	0.0014	0.0064	Normal	1.5
δ_g	0.5	0.4896	0.4515	0.5815	Normal	0.2
δ_p	0.5	0.5194	0.5017	0.4391	Beta	0.15
V	0.1	0.1213	0.1113	0.1413	Beta	0.05
h_p	0.5	0.5376	0.4760	0.8896	Beta	0.18
h_g	0.5	0.5135	0.4731	0.8730	Beta	0.2
r_π	2	2.01	1.901	2.10	Normal	0.15
r_y	0.12	2.00	0.105	0.25	Normal	0.05
ρ_r	0.85	0.87	0.81	0.89	Beta	0.10
θ_y	0.10	0.11	0.11	0.23	Beta	0.04
θ_I	0.08	0.12	0.01	0.15	Beta	0.04
ϑ_{L^p}	0.08	0.07	0.03	0.14	Beta	0.04
ϑ_{L^g}	0.2	0.23	0.05	0.27	Beta	0.07
μ_y	1	0.897	0.1984	1.798	Gamma	0.75
η_p	1	0.958	1.02	1.974	Gamma	0.75
η_g	1	1.842	0.542	1.985	Gamma	0.75

Note: Results based on 30 chains, each with 300, 000 draws from the Metropolis algorithm.

In Table 8, the standard deviation of the productivity shock, the public spending shock, the preference shock, the external finance premium shock, the China loans supply shock, the wage markup shock, and the contingent liabilities shock, are estimated to be respectively, 0.53, 0.43, 1.6, 0.21, 0.16, 0.59, and 2.26 greater than their prior value of, 0.88, 0.76, 2.12, 0.46, 0.27, 0.92, and 2.28 respectively. By contrast, the balance-sheet shock and the monetary policy shock are estimated to be respectively, 0.56 and 0.099 greater than their prior value of 0.14 and 0.090. This results demonstrate that there is less willingness for African economies to face continent liabilities realization and high sovereign debt with

renminbi internationalization under renminbi-led investment instrument.

On the contrary all the shocks a exhibit lower persistence with renminbi internationalization under renminbi-led investment instrument, except for the china loans supply shock.

Table 8—MCMC Priors and Posteriors Parameters under RMB-led Investment

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
σ_α	0.880	0.531	0.1553	0.8532	Inverted Gamma	0.7000
σ_g	0.760	0.436	0.0313	0.5134	Inverted Gamma	0.6000
σ_ϖ	2.120	1.672	0.8299	3.4520	Inverted Gamma	1.3000
σ_η	0.140	0.563	0.1361	0.8345	Inverted Gamma	0.0900
σ_{R_L}	0.460	0.2178	0.1123	0.8751	Inverted Gamma	0.0400
σ_L	0.270	0.1625	0.0542	0.8332	Inverted Gamma	0.0310
σ_w	0.920	0.5907	0.0179	0.9567	Inverted Gamma	1.8000
σ_ζ	2.280	2.2618	1.3911	3.421	Inverted Gamma	0.6000
σ_r	0.090	0.0996	0.0283	0.1532	Inverted Gamma	0.0800
ρ_α	0.85	0.7512	0.0912	0.9352	Beta	0.08
ρ_g	0.85	0.7278	0.0932	0.9912	Beta	0.10
ρ_ϖ	0.85	0.8467	0.0826	0.8961	Beta	0.10
ρ_η	0.85	0.8321	0.0812	0.8522	Beta	0.10
ρ_{R_L}	0.85	0.7792	0.0759	0.8794	Beta	0.10
ρ_L	0.85	0.8875	0.0870	0.8905	Beta	0.08
ρ_ζ	0.85	0.5331	0.1283	0.8308	Beta	0.10
ρ_w	0.85	0.6757	0.0577	0.8771	Beta	0.08
$\rho_{\alpha*g}$	0.85	0.5634	0.1353	0.7632	Beta	0.10

Note: Results based on 30 chains, each with 300, 000 draws from the Metropolis algorithm.

4.5 China-Africa Engagement under RMB-led Currency Swaps Internationalization

Table 9 illustrates the effects of renminbi internationalization under the renminbi-led currency swaps instrument. The discount factor posterior parameter is estimated to be 0.994 lower to its prior parameter of 0.999. The total depreciation of capital is estimated to be 0.04 lower than its prior value of 0.25. The total share of capital into the production process is estimated to be 0.27, lower than its prior value of 0.3. The portfolio adjustment cost is estimated to 0.0008 higher than its prior parameter of 0.0005. These findings renminbi-led currency swap instrument strengthens the difficulties of African's corporates to access to Chinese loans under renminbi internationalization.

The household consumption habit is estimated to be 0.72, higher than its prior value of 0.7. This results show that with renminbi internationalization under renminbi-led currency swap instrument, households save less in Africa. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 0.8, close to its prior value of 1. This results indicates that, African economies become more labor-intensive with renminbi internationalization under renminbi-led currency swap instrument.

The price rigidity is estimated to be 0.63 greater than its prior value of 0.5. The price indexation is estimated to be 0.7 greater than its prior value of 0.5. Likewise, the wage rigidity is estimated to be 0.74 greater than its prior value of 0.5. The wage indexation is estimated to be 0.65 greater than its prior value of 0.5. These findings show that prices are rigid as wages with renminbi internationalization under renminbi-led currency swap instrument.

The Chinese loan supply rigidity is estimated to 0.48, lower than its prior value of 0.5. Likewise, the Chinese loan supply indexation is estimated to 0.55, greater than its prior value of 0.5. This results indicate that, with renminbi internationalization under renminbi-led currency swap instrument, the amount of Chinese loans supplied to Africa declines.

The investment adjustment cost is estimated to 0.63, lower than its prior value of 4. This results indicate that, with renminbi internationalization under renminbi-led currency swap instrument, corporates in Africa continue to benefit from lower investment costs. This is because, the tightening of the financial constraints evenly affects state-owned corporates relatively to private sector corporates. The depreciation rate of public capital is estimated to be 0.48, lower than its prior value of 0.5. By contrast, the depreciation rate of private capital is estimated to be 0.54, lower than its prior value of 0.5. Indeed, under renminbi-led currency swap instrument, state-owned enterprises are becoming relatively less financially constrained than private sector enterprises. As a result, state-owned corporates are becoming relatively capital-intensive than private sector enterprises.

The loan-to-value ratio is estimated to 0.15 greater than its prior value of 0.1. This results demonstrate that, corporates in Africa are more financially constrained with ren-

minbi internationalization under renminbi-led currency swap instrument. Moreover, the results shows that both state-owned corporates and private sector enterprises save less with renminbi internationalization under renminbi-led currency swap instrument. The consumption habit of private sector enterprises corporates is estimated to 0.76 more higher that its prior value of 0.5. Likewise, the consumption habit of state-owned corporates is estimated to 0.72 greater than its prior value of 0.5. Both corporates therefore accumulate less pledgeable collateral under renminbi-led currency swap instrument.

The price stability parameter is estimated to 2.3 greater than its prior value of 2. By contrast, the output stabilization parameter is estimated to 0.15 greater than its prior value 0.12. The monetary policy persistence parameter is estimated to 0.79 lower than its prior value of 0.85. These finding demonstrate that, renminbi internationalization under renminbi-led currency swap instrument expose African economies to the resurgence of inflation.

The consumption good openness is estimated to 0.003 lower than its prior value 0.1. The investment good openness is estimated to 0.04, lower than its prior value of 0.08. These results demonstrate that renminbi internationalization under renminbi-led currency swap instrument contravene both investment intensification and bilateral trade between African economies and China. Likewise, the state-owned corporates loans openness is estimated to 0.005 lower that its prior value of 0.2. Also, the private sector corporate loans openness is estimated to 0.002 lower than its value of 0.08. These findings show the reduction of Chinese loans to Africa with renminbi internationalization under renminbi currency swaps instrument, more so for the private sector corporates than for the state-owned corporates.

The elasticity of substitution of final goods is estimated to 0.06 lower than its prior value of 1. This results confirm that bilateral trade contracts between China and Africa with renminbi internationalization under renminbi currency swaps. The elasticity state-owned corporates Chinese loans is estimated to 0.6 lower than its prior value of 1. Likewise, the elasticity of private sector corporates Chinese loans is estimated to be 0.0003, lower than its prior value of 1. These findings demonstrate financial constraints deepen for both state-owned corporates and private sector enterprises with renminbi internationalization under renminbi currency swaps, more so for the private sector corporate than for the state-owned corporates.

Table 9—MCMC Priors and Posteriors under RMB-led Currency Swaps

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
β	0.999	0.9949	0.9949	0.9959	Normal	0.10
δ	0.25	0.0494	0.0494	0.0495	Beta	0.02
α	0.30	0.2722	0.2615	0.2826	Beta	0.05
ξ_R	0.0005	0.0008	0.0001	0.0009	Gamma	0.00013
h	0.7	0.72	0.21	0.82	Beta	0.20
τ	1	0.8	0.30	0.88	Gamma	10.30
θ_p	0.5	0.63	0.42	0.67	Beta	0.10
γ	0.5	0.7	0.31	0.14	Beta	0.2
θ_w	0.5	0.74	0.36	0.78	Beta	0.10
ν_w	0.5	0.65	0.15	0.79	Beta	0.10
ϱ_L	0.5	0.48	0.20	0.58	Beta	0.10
ζ	0.5	0.55	0.01	0.652	Beta	0.15
Ψ	4	0.63	0.38	0.86	Normal	1.5
δ_g	0.5	0.48	0.28	0.68	Normal	0.2
δ_p	0.5	0.54	0.47	0.85	Beta	0.15
V	0.1	0.15	0.01	0.17	Beta	0.05
h_p	0.5	0.76	0.93	0.97	Beta	0.18
h_g	0.5	0.72	0.05	0.84	Beta	0.2
r_π	2	2.358	2.350	2.366	Normal	0.15
r_y	0.12	0.1509	0.1507	0.1510	Normal	0.05
ρ_r	0.85	0.7984	0.7981	0.7988	Beta	0.10
θ_y	0.10	0.0031	0.0025	0.1267	Beta	0.04
θ_I	0.08	0.0453	0.0942	0.1617	Beta	0.04
ϑ_{L^p}	0.08	0.0027	0.0547	0.0022	Beta	0.04
ϑ_{L^g}	0.2	0.0058	0.0012	0.8301	Beta	0.07
μ_y	1	0.0668	0.0036	1.0711	Gamma	0.75
η_p	1	0.0003	0.0001	1.0003	Gamma	0.75
η_g	1	0.6141	0.1112	1.6189	Gamma	0.75

Note: Results based on 30 chains, each with 300, 000 draws from the Metropolis algorithm.

In Table 10, The standard deviation of the productivity shock, the public spending shock, the preference shock, the wage markup shock and the monetary policy shock are estimated to be respectively, 0.97, 0.77, 2.2, 0.97, and 0.89, greater than their prior value of, 0.88, 0.76, 2.12, 0.92, and 0.09 respectively. By contrast, the balance-sheet shock, the external finance premium shock, the China loans supply shock, and the contingent liabilities shock, are estimated to be respectively, 0.13, 0.44, 0.24, and 2.21 lower than their prior value of 0.14, 0.46, 0.27 and 2.2. This results demonstrate that there is less willingness for African economies to face continent liabilities realization and high sovereign

debt with renminbi internationalization under renminbi-led currency swaps instrument.

Likewise, the productivity shock, the public spending shock, the balance-sheet shock,, the china loans supply shock, the wage markup, and the contingent liabilities shock are estimated to be respectively, 0.98, 0.95, 0.92, 0.94, 0.92 and 0.98 respectively, greater than their prior value of 0.85. By contrast, the preference shock, the external finance premium shock and the spillover shocks are estimated to be 0.84, 0.73, and 0.83, respectively, lower than their prior value of 0.85. These findings show that the effects of Chinese loans contraction on both state-owned-corporates and private sectors' balance-sheets are more persistent with renminbi internationalization under renminbi-led currency swaps instrument, even if the spillover effects are less persistent.

Table 10—Shocks Priors and Posteriors under RMB-led currency swaps

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
σ_{α}	0.880	0.9741	0.3134	1.863	Inverted Gamma	0.7000
σ_{g}	0.760	0.772	0.2543	1.852	Inverted Gamma	0.6000
σ_{ϖ}	2.120	2.263	0.8299	3.4231	Inverted Gamma	1.3000
σ_{η}	0.140	0.1401	0.0519	0.3771	Inverted Gamma	0.0900
σ_{R_L}	0.460	0.4604	0.3942	0.7245	Inverted Gamma	0.0400
σ_{L}	0.270	0.2709	0.2209	0.3239	Inverted Gamma	0.0310
σ_{w}	0.920	0.971	0.2332	1.5614	Inverted Gamma	1.8000
σ_{ζ}	2.280	2.219	1.3911	3.1281	Inverted Gamma	0.6000
σ_{r}	0.090	0.891	0.0143	0.07456	Inverted Gamma	0.0800
ρ_{α}	0.85	0.98	0.98	1.05	Beta	0.08
ρ_{g}	0.85	0.95	0.88	0.99	Beta	0.10
ρ_{ϖ}	0.85	0.84	0.78	0.98	Beta	0.10
ρ_{η}	0.85	0.92	0.92	0.97	Beta	0.10
ρ_{R_L}	0.85	0.73	0.35	0.99	Beta	0.10
ρ_{L}	0.85	0.94	0.98	1.08	Beta	0.08
ρ_{ζ}	0.85	0.92	0.83	0.98	Beta	0.10
ρ_{w}	0.85	0.98	0.99	1.05	Beta	0.08
$\rho_{\alpha * g}$	0.85	0.83	0.69	0.98	Beta	0.10

Note: Results based on 30 chains, each with 300, 000 draws from the Metropolis algorithm.

5 Robustness Findings

This section examines the effects of renminbi internationalization on Chinese economy under the renminbi-led trade settlement and investment instruments on the one hand, and under the renminbi-led financial instruments on the other hand (Tables 11-14).

5.1 Renminbi Internationalization under Trade and Investment Instrument in China

Table 11 displays the state of Chinese economy after renminbi internationalization under trade settlement and investment instruments. The discount factor posterior parameter is estimated to be 0.999 greater than its prior parameter of 0.996. The total depreciation of capital is estimated to be 0.021 lower than its prior value of 0.25. the total share of capital into the production process is estimated to be 0.35, higher than its prior value of 0.3. The portfolio adjustment cost is estimated to 0.0004 lower than its prior parameter of 0.0005. These results indicate that, with renminbi internationalization, corporates are less financially constrained in China. The household consumption habit is estimated to be 0.67, lower than its prior value of 0.7. This results show that with RMB internationalization, households are saving more in China. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 1.1, higher than its prior value of 1. This results indicates that, both state-owned corporates and private sector enterprises evenly used labor workforce in the production process.

The price rigidity is estimated to be 0.46 lower than its prior value of 0.5. The price indexation is estimated to be 0.46 lower than its prior value of 0.5. Likewise, the wage rigidity is estimated to be 0.46 lower than its prior value of 0.5. The wage indexation is estimated to be 0.45 lower than its prior value of 0.5. These findings show that wages and prices are more flexible in China with renminbi internationalization under trade settlement and investment instruments.

The Chinese loan supply rigidity is estimated to 0.29, lower than its prior value of 0.5. Likewise, the Chinese loan supply indexation is estimated to 0.12, lower than its prior value of 0.5. This results indicate that, China loans supplied to Chinese corporates increases with renminbi internationalization under trade settlement and investment instruments.

The investment adjustment cost is estimated to 1.37, lower than its prior value of 4. This results indicate that renminbi internationalization under trade settlement and investment instruments intensifies investments in China because of lower cots. The depreciation rate of public capital is estimated to be 0.23, lower than its prior value of 0.5. By contrast, the depreciation rate of private capital is estimated to be 0.6, greater than its prior value of 0.5. This results reveal that state-owned corporates become more capital intensive in China because they accumulate more pledgeabe public-backed capital than the private sector enterprises with renminbi internationalization under trade settlement and investment instruments.

Table 11—Priors and Posteriors Parameters of RMB Trade Effects in China

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
β	0.996	0.999	0.991	1.5	Normal	0.10
δ	0.25	0.021	0.01	0.5	Beta	0.02
α	0.30	0.35	0.25	0.85	Beta	0.05
ξ_R	0.0005	0.0004	0.0001	0.0021	Gamma	0.00013
h	0.7	0.6793	0.6793	0.6793	Beta	0.25
τ	1	1.1125	1.1125	1.1127	Gamma	10.30
θ_p	0.5	0.4639	0.4391	0.6392	Beta	0.10
γ	0.5	0.4691	0.4214	0.6921	Beta	0.2
θ_w	0.5	0.4650	0.4502	0.6505	Beta	0.10
ν_w	0.5	0.4535	0.4359	0.53594	Beta	0.10
ϱ_L	0.5	0.4813	0.4912	0.5914	Beta	0.10
ζ	0.5	0.4549	0.4490	0.5490	Beta	0.15
Ψ	4	1.3702	1.3690	1.3712	Normal	1.5
δ_g	0.5	0.23	0.001	0.48	Normal	0.2
δ_p	0.5	0.68	0.51	0.86	Beta	0.15
V	0.1	0.08	0.02	0.15	Beta	0.05
h_p	0.5	0.493	0.4391	0.8394	Beta	0.18
h_g	0.5	0.320	0.07	0.35	Beta	0.2
r_π	2	3.1	2.60	4.50	Normal	0.15
r_y	0.12	6.5	0.8	15.38	Normal	0.05
ρ_r	0.85	0.88	0.85	0.98	Beta	0.10
θ_y	0.10	0.27	0.11	0.37	Beta	0.04
θ_I	0.08	0.15	0.01	0.25	Beta	0.04
ϑ_{L^p}	0.08	0.0934	0.01	1.0001	Beta	0.04
ϑ_{L^g}	0.2	0.2101	0.1	1.0003	Beta	0.07
μ_y	1	4.43	3.09	5.75	Gamma	0.75
η_p	1	0.87	0.02	1.75	Gamma	0.75
η_g	1	2.02	0.03	4.07	Gamma	0.75

Note: Results based on 100 chains, each with 2000, 000 draws from the Metropolis algorithm.

The loan-to-value ratio is estimated to 0.08 lower than its prior value of 0.1. This results demonstrate that, corporates in China are less financially constrained with renminbi internationalization under trade settlement and investment instruments. Moreover, the results shows that state-owned corporates are saving more with renminbi internationalization relative to private sector enterprises. The consumption habit of private sector enterprises corporates is estimated to 0.49 lower than its prior value of 0.5. By contrast, the consumption habit of state-owned corporates is estimated to 0.32 lower than its prior

value of 0.5.

The price stability parameter is estimated to 3.1 greater than its prior value of 2. Likewise, the output stabilization parameter is estimated to 6.5 greater than its prior value 0.12. The monetary policy persistence parameter is estimated to 0.88 greater than its prior value of 0.85. These finding demonstrate that, with renminbi internationalization, monetary policy effectively stimulate economic activity in China. However the Chinese economy face the resurgence of inflation pressure.

The consumption good openness is estimated to 0.27 greater than its prior value 0.1. The investment good openness is estimated to 0.15, greater than its prior value of 0.5. These results show with renminbi internationalization under trade settlement and investment instruments, Chinese economy benefits more from the bilateral trade between China and Africa, which foster more investments in China.

Likewise, the state-owned corporates loans openness is estimated to 0.21 greater that its prior value of 0.2.Also, the private sector corporate loans openness is estimated to 0.09 greater than its value 0f 0.08. This finding show that Chinese corporates benefit from renminbi internationalization under trade settlement and investment instruments, more so for state-owned corporates than for private sector corporates.

The elasticity of substitution of final goods is estimated to 4.3 greater than its prior value of 1. This results confirm that China benefit more from bilateral trade with Africa After renminbi internationalization. The elasticity state-owned corporates Chinese loans is estimated to 2.02 greater than its prior value of 1. Likewise, the elasticity of private sector corporates Chinese loans is estimated to be 0.87, near the prior value of 1. These findings demonstrate with renminbi internationalization under trade settlement and investment instruments, Chinese loans supplied is mostly directed towards Chinese corporates, more so for state-owned corporates than private sector corporates.

5.2 Renminbi Internationalization under Financial Instruments on China

Table 12 shows the state of Chinese economy after renminbi internationalization under RMB-led bond and RMB-led currency swap instruments. The discount factor posterior parameter is estimated to be 0.997 greater than its prior parameter of 0.996. The total depreciation of capital is estimated to be 0.24 lower than its prior value of 0.25. the total share of capital into the production process is estimated to be 0.32, higher than its prior value of 0.3. The portfolio adjustment cost is estimated to 0.0002 lower than its prior parameter of 0.0005. These findings indicate that, with renminbi internationalization under financial instruments, Chinese economy becomes less financially constrained. The household consumption habit is estimated to be 0.63, lower under financial than its prior value of 0.7. This results show that with RMB internationalization under financial instruments, households are saving more in China. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 1.2, higher than its prior value of 1. This results indicates that, both state-owned corporates and private sector enterprises evenly used labor workforce in the production process.

The price rigidity is estimated to be 0.47 lower than its prior value of 0.5. The price indexation is estimated to be 0.45 lower than its prior value of 0.5. Likewise, the wage rigidity is estimated to be 0.48 lower than its prior value of 0.5. The wage indexation is estimated to be 0.46 lower than its prior value of 0.5. These findings show that wages and prices are more flexible in China with renminbi internationalization under RMB-led bond and RMB-led currency swap instruments.

The Chinese loan supply rigidity is estimated to 0.29, lower than its prior value of 0.5. Likewise, the Chinese loan supply indexation is estimated to 0.12, lower than its prior value of 0.5. This results indicate that, China loans supplied to Chinese corporates increases with renminbi internationalization under RMB-led bond and RMB-led currency swap instruments.

The investment adjustment cost is estimated to 1.6, lower than its prior value of 4. This results indicate that renminbi internationalization under RMB-led bond and RMB-led currency swap instruments intensifies investments in China because of lower cots. The depreciation rate of public-backed capital is estimated to be 0.51, greater than its prior value of 0.5. By contrast, the depreciation rate of private-backed capital is estimated to be 0.21, lower than its prior value of 0.5. This results reveal that, with renminbi internationalization under RMB-led bond and RMB-led currency swap instruments, private sector corporates accumulate more pledgeabe private-backed capital than the state-owned corporates accumulate public-backed corporates.

The loan-to-value ratio is estimated to 0.09, lower than its prior value of 0.1. This results demonstrate that, corporates in China are less financially constrained with renminbi internationalization under RMB-led bond and RMB-led currency swap instruments. Moreover, the results shows that private sector enterprises continues to save more with renminbi internationalization under RMB-led bond and RMB-led currency swap instruments. The

consumption habit of private sector enterprises corporates is estimated to 0.21 lower than its prior value of 0.5. By contrast, the consumption habit of state-owned corporates is estimated to 0.51 greater than its prior value of 0.5.

Table 12—MCMC Priors and Posteriors Parameters of RMB Financial Instrument on China

	Mean		Interval		Dist SE	
Parameters	Prior	Posterior	$5th$	$90th$	Distribution	SE
β	0.996	0.997	0.99	1.4	Normal	0.10
δ	0.25	0.024	0.01	0.16	Beta	0.02
α	0.30	0.32	0.15	0.45	Beta	0.05
ξ_R	0.0005	0.0002	0.0001	0.0042	Gamma	0.00013
h	0.7	0.6349	0.5490	0.7350	Beta	, 0.25
τ	1	1.2007	1.2005	1.2010	Gamma	10.30
θ_p	0.5	0.472	0.4235	0.7238	Beta	0.10
γ_p	0.5	0.452	0.4274	0.5275	Beta	0.2
θ_w	0.5	0.488	0.6586	0.4590	Beta	0.10
ν_w	0.5	0.4638	0.4436	0.5437	Beta	0.10
ϱ_L	0.5	0.4601	0.4010	0.6011	Beta	0.10
ζ	0.5	0.458	0.4170	0.5519	Beta	0.15
Ψ	4	1.6832	1.6823	1.6841	Normal	1.5
δ_g	0.5	0.23	0.001	0.48	Normal	0.2
δ_p	0.5	0.68	0.51	0.86	Beta	0.15
V	0.1	0.09	0.02	0.13	Beta	0.05
h_p	0.5	0.213	0.1089	0.6517	Beta	0.18
h_g	0.5	0.512	0.07	0.35	Beta	0.2
r_π	2	5.8	1.50	11.15	Normal	0.15
r_y	0.12	7.15	0.08	20.24	Normal	0.05
ρ_r	0.85	0.87	0.81	0.89	Beta	0.10
θ_y	0.10	0.17	0.11	0.23	Beta	0.04
θ_I	0.08	0.06	0.01	0.10	Beta	0.04
ϑ_{L^p}	0.08	0.09	0.03	0.15	Beta	0.04
ϑ_{L^g}	0.2	0.11	0.05	0.27	Beta	0.07
μ_y	1	3.1043	0.923	4.751	Gamma	0.75
η_p	1	1.5207	0.03	3.672	Gamma	0.75
η_g	1	0.7622	0.43	1.597	Gamma	0.75

Note: Results based on 100 chains, each with 2000, 000 draws from the Metropolis algorithm.

The price stability parameter is estimated to 5.1 greater than its prior value of 2. Likewise, the output stabilization parameter is estimated to 7.15 greater than its prior value 0.12. The monetary policy persistence parameter is estimated to 0.87 greater than

its prior value of 0.85. These finding demonstrate that, with renminbi internationalization under RMB-led bond and RMB-led currency swap instruments, monetary policy is effective in fostering economic growth in China. Nevertheless, the Chinese economy is exposed to a sustained increase in inflation.

The consumption good openness is estimated to 0.17 greater than its prior value 0.1. The investment good openness is estimated to 0.06, lower than its prior value of 0.5. These results show with renminbi internationalization under RMB-led bond and RMB-led currency swap instruments, Chinese economy benefits more from the bilateral trade between China and Africa, but less so from investments in China.

Likewise, the state-owned corporates loans openness is estimated to 0.11 lower that its prior value of 0.2.Also, the private sector corporate loans openness is estimated to 0.09 greater than its value 0f 0.08. This finding show that Chinese corporates benefit from renminbi internationalization under RMB-led bond and RMB-led currency swap instruments, more so for private sector corporates than from the state-owned corporates.

The elasticity of substitution of final goods is estimated to 3.1 greater than its prior value of 1. This results confirm that China benefit more from bilateral trade with Africa After renminbi internationalization. The elasticity state-owned corporates Chinese loans is estimated to 0.7 lower than its prior value of 1. By contrast, the elasticity of private sector corporates Chinese loans is estimated to be 1.5, greater the prior value of 1. These findings demonstrate with renminbi internationalization under RMB-led bond and RMB-led currency swap instruments, Chinese loans supplied is mostly directed towards Chinese corporates, more so for the private sector corporates than the state-owned corporates.

6 Discussion of Estimations Findings

In this section we discuss estimations results by conducting comparison analysis, on the one hand between each of the four instruments of renminbi internationalization, on the other hand, between Africa and China under renminbi internationalization (Tables 13-14).

6.1 Discussion of Renminbi Internationalization Instruments in Africa

Table 13 present the results of comparison analysis between renminbi trade settlement, renminbi-led bond, renminbi-led investment, and renminbi-led currency swaps instruments in Africa. Among the four instrument, the renminbi trade settlement has the lowest estimated discount factor (0.991), whereas the renminbi-led investment has the highest discount factor, estimated at 0.97. The total depreciation of capital is estimated to be the lowest (0.18) under renminbi-led investment, and the highest under renminbi-led currency swap (0.04). The total share of capital into the production process is estimated to be the highest (0.29) under renminbi-led investment, and the lowest (0.23) under renminbi trade settlement. The portfolio adjustment cost is estimated to be the highest under (0.0007) renminbi trade settlement, and the lowest (0.0002) under renminbi-led investment. This result means that the adverse effects of renminbi internationalization on financial constraints in Africa is mostly felt under renminbi trade settlement instrument, but less so under renminbi-led investment.

The household consumption habit is estimated to be 0.72 and 0.73, respectively under renminbi-led currency swap, and under renminbi trade settlement instruments. By contrast, the household consumption habit is estimated to be 0.65 and 0.68, respectively under under renminbi-led investment and under renminbi-led bond instruments. This results imply that households in Africa continue to save more with renminbi internationalization under renminbi-led investment and under renminbi-led bond instrument, but less so under renminbi-led currency swap and under renminbi trade settlement instruments.

The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 0.9, under renminbi trade settlement instrument. Likewise, under both renminbi-led bond and renminbi-led investment instruments the elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 0.87. Also, it is estimated to 0.8 under renminbi-led currency swap instrument. This results show that renminbi internationalization closes the labor-intensity gap between state-owned corporates and private sector corporates, more so under the renminbi trade settlement instrument. The private sector enterprises become to hire as more labor inputs as the state-owned corporates.

The price rigidity is estimated to be the highest under renminbi-led currency swaps (0.63), and the lowest under renminbi-led-investment (0.55). The price indexation is estimated to be the highest under renminbi-led currency swaps (0.7), and the lowest under renminbi-led-investment (0.35). This results show that with renminbi internationalization,

prices are more rigid under renminbi-led currency swaps instrument, and less so under under renminbi-led-investment.

Likewise, the wage rigidity is estimated to be the highest under renminbi-led currency swaps (0.74), and the lowest (0.50) under renminbi-led bond instrument. The price indexation is estimated to be the highest under renminbi-led currency swaps (0.65), and the lowest under renminbi-led bond instrument (0.42). This results show that with renminbi internationalization, wages are more rigid under renminbi-led currency swaps instrument, and less so under under renminbi-led bond instrument.

The Chinese loan supply rigidity is estimated to be the highest under renminbi trade settlement (0.62), and the lowest (0.46) under renminbi-led bond instrument. Similarly, the Chinese loan supply indexation is estimated to be the highest (0.55) under renminbi-led currency swap instrument, and the lowest under renminbi-led bond instrument (0.45). These findings reveal that with renminbi internationalization, China loans supply to Africa remains steady under renminbi-led bond instrument, but declines under both renminbi trade settlement and renminbi-led currency swaps instruments.

The investment adjustment cost is estimated to be the highest (0.63) under renminbi-led currency swap instrument, and the lowest under renminbi-led investment instrument (0.0002). This findings reveals that with renminbi internationalization under renminbi-led investment instrument, corporates in Africa continue to benefit from lower investment costs, but less so under renminbi-led currency swap instrument.

The depreciation rate of public-backed capital is estimated to be the highest at 0.66 under renminbi trade settlement instrument, and the lowest (0.46) under renminbi-led bond instrument. By contrast, the depreciation rate of private backed-capital is estimated to be the highest at 0.54 under renminbi-led currency swap instrument, but the lowest under renminbi-led bond instrument (0.49). These findings demonstrates that with renminbi internationalization under under renminbi-led bond instrument, both state-owned corporates and private sector enterprises in Africa, continue to accumulate pledgeable collateral. However, with renminbi internationalization under both renminbi-led trade settlement and renminbi-led currency swaps instruments, financial constraints for corporates in Africa tighten, more so for the state-owned corporates than for the private sector enterprises.

The loan-to-value ratio is estimated to be the highest (0.15) under under renminbi-led currency swap instrument, and the lowest under renminbi-led bond instrument (0.10). This results show that, with renminbi internationalization, corporates in Africa are more financially constrained under renminbi-led currency swap instrument, and less lo under renminbi-led bond instrument. Furthermore, the consumption habit of private sector enterprises corporates is estimated to be the highest (76) under renminbi-led currency swap instrument, and the lowest under renminbi-led investment instrument (0.53). Likewise the consumption habit of state-owned corporates is estimated to be he highest (72) under renminbi-led currency swap instrument, and the lowest under renminbi-led investment instrument (0.51). This results reveal that with renminbi internationalization under renminbi-led investment both private sector enterprises and state-owned corporates con-

tinue to save more, but less so under renminbi-led currency swap instrument.

Regarding the effects on monetary policy reaction function, the price stability parameter is estimated to be the lowest (1.8) under renminbi trade settlement instrument, but the highest under renminbi-led currency swap instrument (2.3). This findings show that monetary policy is more willing to cushion inflation and ensure price stability with renminbi internationalization under renminbi trade settlement, but less so under renminbi-led currency swap instrument. The output stabilization instrument is estimated to be the lowest under renminbi trade settlement instrument (0.10), but the highest under renminbi-led investment instrument (0.2). This result show that monetary policy is more effective to stimulate economic activity with renminbi internationalization under renminbi-led investment, but less so under renminbi-led trade settlement. The The monetary policy persistence parameter is estimated to be the highest (0.87) under renminbi-led bond, and the lowest under renminbi trade settlement instrument (0.74). This finding show that monetary policy is more persistent with renminbi internationalization under renminbi-led investment, and less so under renminbi trade settlement instrument.

The consumption good openness is estimated to be the highest (0.17) under renminbi-led bond instrument, but the lowest under renminbi trade settlement instrument (0.001). The investment good openness is estimated to be the highest (0.12) under renminbi-led investment instrument, but the lowest under renminbi trade settlement instrument (0.001). These results demonstrate that renminbi internationalization under renminbi trade settlement contravene bilateral trade between African economies and China, as well as investment expansion in Africa, but less so under renminbi-led bond instrument.

Moreover, the state-owned corporates loans openness is estimated to be the highest (0.23) under renminbi-led investment instrument, and the lowest under renminbi trade settlement instrument (0.001). The private sector enterprises loans openness is estimated to be the highest (0.09) under under renminbi-led bond instrument, and the lowest under renminbi trade settlement instrument (0.001). These findings demonstrate that with renminbi internationalization, China loans supply to Africa remains steady for state-owned corporates under renminbi-led investment instrument, and for private sector enterprises under renminbi-led bond instrument, but less so under renminbi trade settlement instrument.

The elasticity of substitution of final goods is estimated to be the lowest (0.001) under renminbi trade settlement, and the highest (2.5) under renminbi-led bond instrument. This results show that bilateral trade contracts between China and Africa with renminbi internationalization under renminbi trade settlement, but less so under under renminbi-led bond instrument.

The elasticity state-owned corporates Chinese loans is estimated to be the lowest (0.001) under renminbi trade settlement, and the highest (1.8) under renminbi-led investment instrument. This results show that, with renminbi internationalization financial constraints is relaxed under renminbi-led investment instrument for state-owned corporates, but less so under renminbi trade settlement. Likewise, the elasticity of private sector corporates Chinese loans is estimated to be the lowest (0.0003) under renminbi-led currency swaps

instrument, and the highest (1.5) under renminbi-led bond instrument. This results reveal that, with renminbi internationalization financial constraints is relaxed under renminbi-led bond instrument for the private sector corporates, but less so under renminbi-led currency swaps instrument.

Table 13— MCMC Priors and Posteriors Comparison RMB Instruments

	RMB Trade		RMB-led Bond		RMB-led Inv		RMB-led Currency	
Parameters	Prior	Posterior	Prior	Posterior	Prior	Posterior	Prior	Posterior
β	0.99	0.991	0.99	0.995	0.99	0.9971	0.99	0.9949
δ	0.25	0.023	0.25	0.0210	0.25	0.0182	0.25	0.0494
α	0.30	0.23	0.30	0.28	0.30	0.29	0.30	0.2722
ξ_R	0.0005	0.0007	0.0005	0.0005	0.0005	0.0002	0.0005	0.0008
h	0.7	0.7349	0.7	0.6895	0.7	0.6595	0.7	0.7232
τ	1	0.9210	1	0.8721	1	0.8721	1	0.8159
θ_p	0.5	0.5649	0.5	0.6199	0.5	0.5599	0.5	0.6356
γ_p	0.5	0.4762	0.5	0.3893	0.5	0.3593	0.5	0.07
θ_w	0.5	0.5780	0.5	0.5085	0.5	0.5485	0.5	0.7467
ν_w	0.5	0.4617	0.5	0.42241	0.5	0.5141	0.5	0.6546
ϱ_L	0.5	0.6229	0.5	0.4670	0.5	0.5570	0.5	0.4829
ζ	0.5	0.4846	0.5	0.4562	0.5	0.4962	0.5	0.5512
Ψ	4	0.2545	4	0.0044	4	0.0002	4	0.6341
δ_g	0.5	0.6636	0.5	0.4615	0.5	0.4815	0.5	0.4801
δ_p	0.5	0.5097	0.5	0.4994	0.5	0.5194	0.5	0.5466
V	0.1	0.1286	0.1	0.1013	0.1	0.1113	0.1	0.1537
h_p	0.5	0.7306	0.5	0.5796	0.5	0.5360	0.5	0.7696
h_g	0.5	0.6592	0.5	0.5673	0.5	0.5130	0.5	0.7220
r_π	2	1.81	2	1.85	2	2.01	2	2.3581
r_y	0.12	0.10	0.12	0.15	0.12	0.215	0.12	0.1509
ρ_r	0.85	0.74	0.85	0.84	0.85	0.874	0.85	0.7948
θ_y	0.10	0.0010	0.10	0.17	0.10	0.1101	0.10	0.0032
θ_I	0.08	0.0015	0.08	0.0698	0.08	0.1206	0.08	0.0409
ϑ_{L^p}	0.08	0.0010	0.08	0.09	0.08	0.071	0.08	0.0021
ϑ_{L^g}	0.2	0.0010	0.2	0.1108	0.2	0.2310	0.2	0.0056
μ_y	1	0.001	1	2.503	1	0.8010	1	0.0668
η_p	1	0.0012	1	1.5026	1	0.9001	1	0.0003
η_g	1	0.0017	1	0.7871	1	1.8001	1	0.6141

Note: Results based on 100 chains, each with 2000, 000 draws from the Metropolis algorithm.

6.2 Discussion of China-Africa Economic Partnership under RMB Internationalization

Table 14 displays the results of the comparison analysis between China and Africa after renminbi internationalization, on the one hand under renminbi trade settlement instrument, on the other hand under renminbi-led bond instrument.

6.2.1 Discussion of China-Africa Bilateral Trade under Renminbi Internationalization

The discount factor posterior parameter is estimated to be 0.999 in China, greater than its estimated value in Africa (0.991). The total depreciation of capital is estimated to be 0.021 in China, lower than its value in Africa estimated at 0.023. The total share of capital into the production process is estimated to be 0.35 in China, higher than its value in Africa estimated at 0.25. The portfolio adjustment cost is estimated to 0.0004 in China, lower than its value in Africa estimated at 0.0005. These findings reveal that renminbi internationalization under renminbi trade settlement instrument strengthens corporates financial endowment in China, whereas it reinforces financial constrains faced by corporates in Africa.

The household consumption habit is estimated to be 0.67 in China, lower than its estimated value in Africa (0.73). This result demonstrates the saving glut in China and the saving shortage in Africa with renminbi internationalization under renminbi trade settlement instrument. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 1.1 in China, higher than its estimated value in Africa (0.9). This finding show that with renminbi internationalization under renminbi trade settlement instrument, there is more job creation in China by both the state-owned corporates and the private sector enterprises, but less so for corporates in Africa.

The price rigidity is estimated to be 0.46 in China, lower than its estimated value of 0.56 in Africa. The price indexation is estimated to 0.46 in China, lower than its estimated value of 0.47 in Africa. Similarly, the wage rigidity is estimated to be 0.46 in China, lower than its estimated value of 0.57 in Africa. The wage indexation is estimated to 0.45 in China, lower than its estimated value of 0.46 in Africa. These findings demonstrate that prices and wages become more flexible in China with renminbi internationalization under renminbi trade settlement instrument. By contrast, prices and wages become relatively more rigid in Africa.

The Chinese loan supply rigidity is estimated to 0.29 in China, lower than its estimated value of 0.62 in Africa. The Chinese loan supply indexation is estimated to 0.12 in China, lower than its estimated value of 0.48 in Africa. These results emphasize that renminbi internationalization under renminbi trade settlement instrument make more financial resources available for both state-owned corporates and private sector corporates in China.

By contrast, it enhance financial constraints in Africa by substantially reducing Chinese loans supply to both state-owned corporates and private sector enterprises.

The investment adjustment cost is estimated to 1.37 in China, lower than its estimated value of 0.25 in Africa. This results indicate that renminbi internationalization under trade settlement and investment instruments intensifies investments in China because of lower cots, but contravenes investment in Africa because of higher costs. The depreciation rate of public capital is estimated to be 0.23 in China, lower than its estimated value of 0.66 in Africa. By contrast, the depreciation rate of private capital is estimated to be 0.6 in China, higher than its estimated value of 0.5 in Africa. This results reveal that state-owned corporates become more capital intensive in China because they accumulate more pledgeabe public-backed capital than the private sector enterprises with renminbi internationalization under trade settlement instrument. By contrast, in Africa, it is the private sector enterprises that resist to renminbi internationalization, as they continue to accumulate more pledgeabe private-backed capital.

The loan-to-value ratio is estimated to 0.08 in China, lower than its estimated value of 0.12 in Africa. These findings show that renminbi internationalization under trade settlement instrument relaxes financial constraints for corporates in China. By contrast it enhances financial constraints for corporates in Africa. The consumption habit of private sector enterprises corporates is estimated to 0.49 in China lower than its estimated value of 0.73 in Africa. Likewise, the consumption habit of state-owned corporates is estimated to 0.32 lower than its estimated value of 0.65 in Africa. These results show that renminbi internationalization under trade settlement instrument increases saving glut for both state-owned corporates and private sector corporates in China. By contrast, it induces saving shortages for both state-owned corporates and private sector corporates in Africa.

The price stability parameter is estimated to 3.1 greater than its estimated value of 1.8 in Africa. This result shows that renminbi internationalization under renminbi trade settlement instrument exposes China inflationist pressures, while strengthening price stability in Africa. The output stabilization parameter is estimated to 6.5 greater than its estimated value of 0.10 in Africa. This result shows that renminbi internationalization under renminbi trade settlement instrument stimulates economic activity in China, while representing a drag on economic activity in Africa. The monetary policy persistence parameter is estimated to 0.88 in China, greater than its estimated value of 0.74 in China. So, with renminbi internationalization under renminbi trade settlement instrument, monetary policy is more persistent in China than in Africa.

The consumption good openness is estimated to 0.27 in China, greater than its estimated value of 0.001 in Africa. The investment good openness is estimated to 0.15 in China, greater than its estimated value of 0.001 in Africa. These results show renminbi internationalization under trade settlement instrument increases China gains from the bilateral trade between China and Africa, and leads to investment expansion in China. By contrast, it contravenes investments expansion in Africa because of diminishing gains from China Africa bilateral trade.

Likewise, the state-owned corporates loans openness is estimated to 0.21 in China, greater that its estimated value of 0.001. The private sector corporate loans openness is estimated to 0.09 in China, greater than its estimated value 0f 0.001. These findings show that renminbi internationalization under trade settlement instrument make more Chinese loans available for both state-owned corporates and private sector corporate in China. On the contrary, less Chinese loans are available for both state-owned corporates and private sector corporates in Africa, in result of renminbi internationalization under trade settlement instrument.

The elasticity of substitution of final goods is estimated to 4.3 in China, greater than its estimated value of 0.001 in Africa. This results show that renminbi internationalization under trade settlement instrument leads to trade intensification in China, but less so in Africa. The elasticity state-owned corporates Chinese loans is estimated to 2.02 in China, greater than its estimated value of 0.001 in Africa. Likewise, the elasticity of private sector corporates Chinese loans is estimated to be 0.87 in China, greater than its estimated value of 0.001 in Africa. These findings demonstrate with renminbi internationalization under trade settlement instrument, Chinese loans are mostly directed towards Chinese corporates. On the contrary, renminbi internationalization under trade settlement instrument deepens financial constraints for both state-owned corporates and private sector enterprises.

6.2.2 Discussion of China-Africa Financial Engagement under Renminbi Internationalization

RMB-led bond in China vs. RMB-led bond in Africa

The discount factor posterior parameter is estimated to be 0.997 in China, greater than its estimated value in Africa (0.995). The total depreciation of capital is estimated to be 0.24 in China, lower than its value in Africa estimated at 0.02. The total share of capital into the production process is estimated to be 0.32 in China, higher than its value in Africa estimated at 0.28. The portfolio adjustment cost is estimated to 0.0002 in China, lower than its value in Africa estimated at 0.0005. These findings reveal that renminbi internationalization under renminbi-led bond instrument strengthens corporates financial endowment in China, whereas it reinforces financial constrains faced by corporates in Africa.

The household consumption habit is estimated to be 0.63 in China, lower than its estimated value in Africa (0.68). This result demonstrates the saving glut in China and the saving shortage in Africa with renminbi internationalization under renminbi-led bond instrument. The elasticity of substitution of labor supply between state-owned corporates and private sector corporate is estimated to be 1.2 in China, higher than its estimated value in Africa (0.87). This finding show that with renminbi internationalization under renminbi-led bond instrument, there is more job creation in China by both the state-owned corporates and the private sector enterprises, but less so for corporates in Africa.

The price rigidity is estimated to be 0.47 in China, lower than its estimated value of 0.61

in Africa. The price indexation is estimated to 0.45 in China, greater than its estimated value of 0.38 in Africa. Similarly, the wage rigidity is estimated to be 0.48 in China, lower than its estimated value of 0.5 in Africa. The wage indexation is estimated to 0.42 in China, exactly as its estimated value of 0.42 in Africa. These findings demonstrate that prices and wages become more flexible in China with renminbi internationalization under renminbi-led bond instrument, but less so in Africa.

The Chinese loan supply rigidity is estimated to 0.29 in China, lower than its estimated value of 0.61 in Africa. The Chinese loan supply indexation is estimated to 0.12 in China, lower than its estimated value of 0.45 in Africa. These results emphasize that renminbi internationalization under renminbi-led bond instrument make more financial resources available for both state-owned corporates and private sector corporates in China. By contrast, it enhance financial constraints in Africa by substantially reducing Chinese loans supply to both state-owned corporates and private sector enterprises.

The investment adjustment cost is estimated to 1.6 in China, greater than its estimated value of 0.004 in Africa. This results indicate that renminbi internationalization under renminbi-led bond instrument intensifies investments in Africa because of lower cots, relatively to China. The depreciation rate of public capital is estimated to be 0.51 in China, greater than its estimated value of 0.46 in Africa. By contrast, the depreciation rate of private capital is estimated to be 0.21 in China, lower than its estimated value of 0.49 in Africa. This results reveal that state-owned corporates become more capital intensive in Africa because they accumulate more pledgeabe public-backed capital than their Chinese counterpart with renminbi internationalization under renminbi-led bond instrument. By contrast, the private sector enterprises become more capital intensive in China because they accumulate more pledgeabe private-backed capital than their African counterpart with renminbi internationalization under renminbi-led bond instrument.

The loan-to-value ratio is estimated to 0.09 in China, lower than its estimated value of 0.1 in Africa. These findings show that renminbi internationalization under renminbi-led bond instrument relaxes financial constraints for corporates in China. By contrast it enhances financial constraints for corporates in Africa. The consumption habit of private sector enterprises corporates is estimated to 0.21 in China lower than its estimated value of 0.57 in Africa. Likewise, the consumption habit of state-owned corporates is estimated to 0.51 lower than its estimated value of 0.56 in Africa. These results show that renminbi internationalization under renminbi-led bond instrument increases saving glut for both state-owned corporates and private sector corporates in China. By contrast, it induces saving shortages for both state-owned corporates and private sector corporates in Africa.

The price stability parameter is estimated to 5.1 greater than its estimated value of 1.85 in Africa. This result shows that renminbi internationalization under renminbi-led bond instrument exposes China inflationist pressures, while strengthening price stability in Africa. The output stabilization parameter is estimated to 7.15 greater than its estimated value of 0.15 in Africa. This result shows that renminbi internationalization under renminbi-led bond instrument stimulates economic activity in China, while representing a drag on eco-

nomic activity in Africa. The monetary policy persistence parameter is estimated to 0.87 in China, greater than its estimated value of 0.84 in Africa. So, with renminbi internationalization under renminbi-led bond instrument, monetary policy is more persistent in China than in Africa.

Table 14—Priors and Posteriors Parameters Comparison Afica vs China

	Africa		Africa		China		China	
Parameters	RMB-led	Trade	RMB-led	Fin Inst	RMB-led	Trade	RMB-led	Fin Inst
β	0.99	0.991	0.99	0.995	0.99	0.999	0.99	0.997
δ	0.25	0.023	0.25	0.02	0.25	0.021	0.25	0.024
α	0.30	0.25	0.30	0.28	0.30	0.35	0.30	0.32
ξ_R	0.0005	0.0005	0.0005	0.0005	0.0005	0.0004	0.0005	0.0002
h	0.7	0.7349	0.7	0.6895	0.7	0.6793	0.7	0.6349
τ	1	0.9210	1	0.8721	1	1.1125	1	1.2007
θ_p	0.5	0.5649	0.5	0.6199	0.5	0.4631	0.5	0.4737
γ_p	0.5	0.4762	0.5	0.3893	0.5	0.4618	0.5	0.4574
θ_w	0.5	0.5780	0.5	0.5785	0.5	0.4653	0.5	0.488
ν_w	0.5	0.4617	0.5	0.4241	0.5	0.4535	0.5	0.4236
ϱ_L	0.5	0.6229	0.5	0.6170	0.5	0.2913	0.5	0.2960
ζ	0.5	0.4846	0.5	0.4562	0.5	0.1290	0.5	0.1218
Ψ	4	0.2545	4	0.0044	4	1.3702	4	1.6832
δ_g	0.5	0.6636	0.5	0.4615	0.5	0.23	0.5	0.5123
δ_p	0.5	0.5097	0.5	0.4994	0.5	0.68	0.5	0.2168
V	0.1	0.1286	0.1	0.1213	0.1	0.08	0.1	0.09
h_p	0.5	0.7306	0.5	0.5760	0.5	0.493	0.5	0.2138
h_g	0.5	0.6592	0.5	0.5630	0.5	0.321	0.5	0.5187
r_π	2	1.85	2	1.85	2	3.1	2	5.1
r_y	0.12	0.10	0.12	0.15	0.12	6.5	0.12	7.15
ρ_r	0.85	0.74	0.85	0.84	0.85	0.88	0.85	0.87
θ_y	0.10	0.0012	0.10	0.17	0.10	0.27	0.10	0.17
θ_I	0.08	0.0015	0.08	0.06	0.08	0.15	0.08	0.06
ϑ_{L^p}	0.08	0.0014	0.08	0.09	0.08	0.0910	0.08	0.09
ϑ_{L^g}	0.2	0.0013	0.2	0.11	0.2	0.2109	0.2	0.11
μ_y	1	0.0014	1	2.543	1	4.43	1	3.143
η_p	1	0.0012	1	1.502	1	0.8732	1	1.521
η_g	1	0.0018	1	0.787	1	2.0276	1	0.7287

Note: Results based on 100 chains, each with 2,000,000 draws from the Metropolis algorithm.

The consumption good openness is estimated to 0.17 in China, exactly as its estimated value of 0.17 in Africa. The investment good openness is estimated to 0.06 in China, exactly

as its estimated value of 0.06 in Africa. These results show renminbi internationalization under renminbi-led bond instrument raises gains from trade both in China and Africa, and triggers investment expansion both in China and Africa.

Likewise, the state-owned corporates loans openness is estimated to 0.11 in China, exactly as its estimated value of 0.11. The private sector corporate loans openness is estimated to 0.09 in China, exactly as its estimated value of 0.09. These findings show that renminbi internationalization under renminbi-led bond instrument make more Chinese loans available for both state-owned corporates and private sector corporate in China as well as in Africa.

The elasticity of substitution of final goods is estimated to 3.1 in China, greater than its estimated value of 2.5 in Africa. This results show that renminbi internationalization under renminbi-led bond instrument leads to trade intensification in China, but less so in Africa. The elasticity state-owned corporates Chinese loans is estimated to 0.7 in China, exactly as its estimated value of 0.7 in Africa. Likewise, the elasticity of private sector corporates Chinese loans is estimated to be 1.5 in China, exactly as its estimated value of 1.5 in Africa. These findings demonstrate with renminbi internationalization under renminbi-led bond instrument, Chinese loans are directed towards Chinese corporates as well as towards Africans' corporates.

7 Counterfactual Analysis of RMB Internationalization

The benchmark case is an era of relaxed financing constraints in African economies due to persistent capital outflows from China to Africa. Scenarios analysis departs from this baseline to simulate the situation where monetary authorities exit from easing monetary policy in China by promoting renminbi internationalization.

7.1 China-Africa Financial and Trade Dynamics Before RMB internationalization

Figure 1 and Figure 2 respectively displays the dynamics of African economy and Chinese economy following a positive government spending shock before renminbi internationalization (Benchmark case). The shock leads to an expansionary economic activity, with increased production and investment in both Africa and China. Relaxed financing constraints in African economies due to China loans to Africa, as well as, bilateral trade dynamics, may explains these expansionary effects.

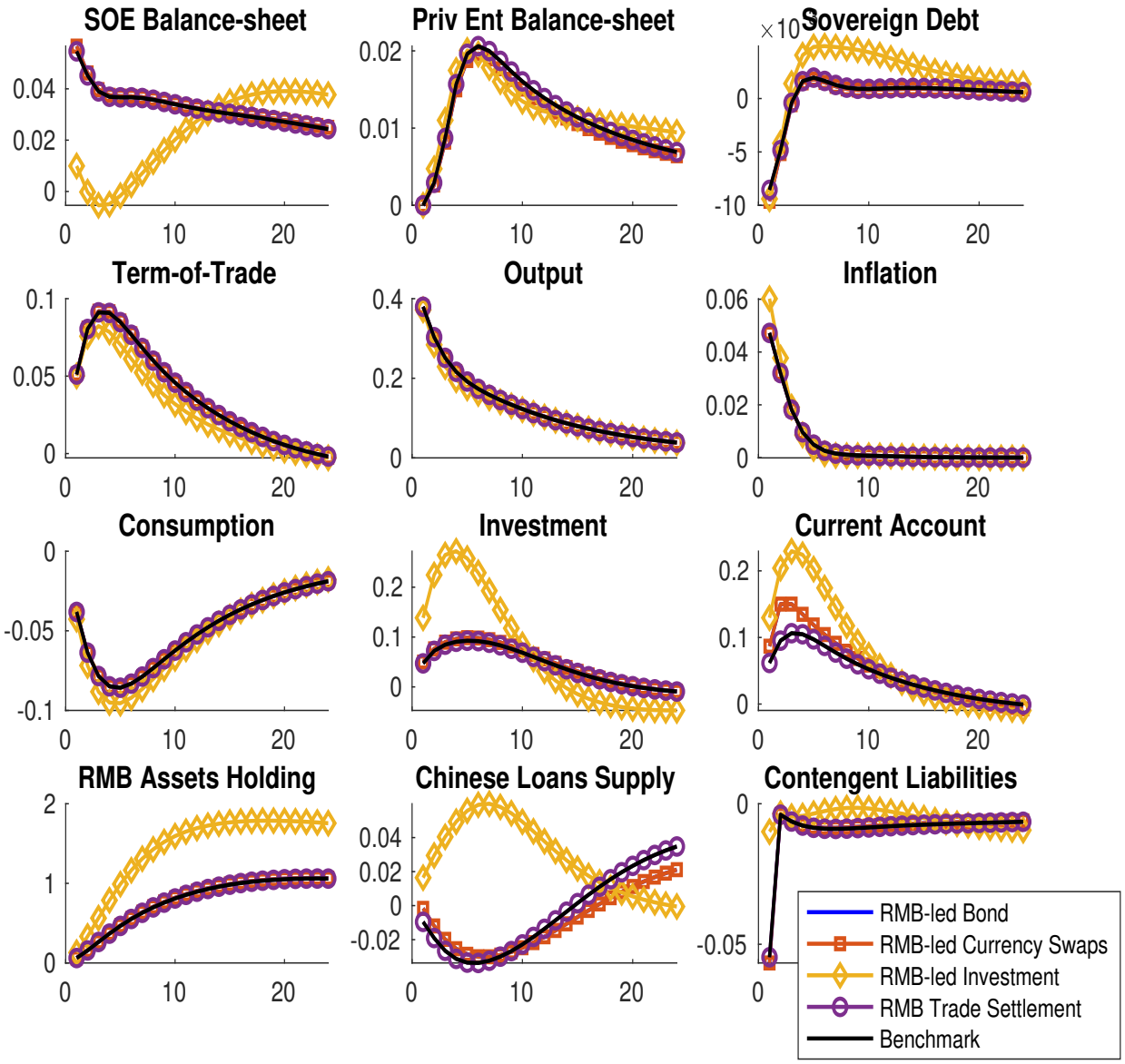
Indeed, state-owned enterprises and private enterprises' balance-sheets increase in Africa. But in China while state-owned enterprises balance-sheet decreases, private enterprises balance-sheet increase. This is because corporates loans increase, more so in Africa than in China. In Africa, both state-owned corporates and private sector corporates contract more loans to finance new investment projects following public spending expansion. In China, loans supply increases to meet the corporates loans demand in both economies. The increases of state-owned corporates loans demand in Africa dampens the international financial frictions facing Africa enterprises and help to mostly divert Chinese loans to Africa in detriment of China. This is because the increase of the value of public capital-backed collateral, as well as the value of private capital-backed collateral in Africa, increases Chinese loans to Africa corporations in detriment of Chinese corporation.

Because of this international market fragmentation, sovereign debt declines and becomes sustainable in Africa, while increasing in China. As the differentiation between public and private capital-backed collateral improves the international allocation of financial resources, it amplifies the positive impact of public spending in Africa's corporate balance-sheet and sovereign debt, and the negative impact in the China's corporates balance-sheet and sovereign debt.

This difference in the magnitude of sovereign debt between both economies is partly reflected by the dynamics of term of trade between China and Africa. The favorable effects of public spending on both state-owned enterprises and private enterprise productive capacities in Africa improve the term-of trade. The increase of the relative price of China goods also stimulate activity and investment in Africa. The term-of-trade increases thus in Africa, as the African economy experiences a surplus of net exports to China. By contrast, there is a deterioration of term of trade, mainly driven by the international financial market segmentation. The deterioration of China' terms of trade increases thus

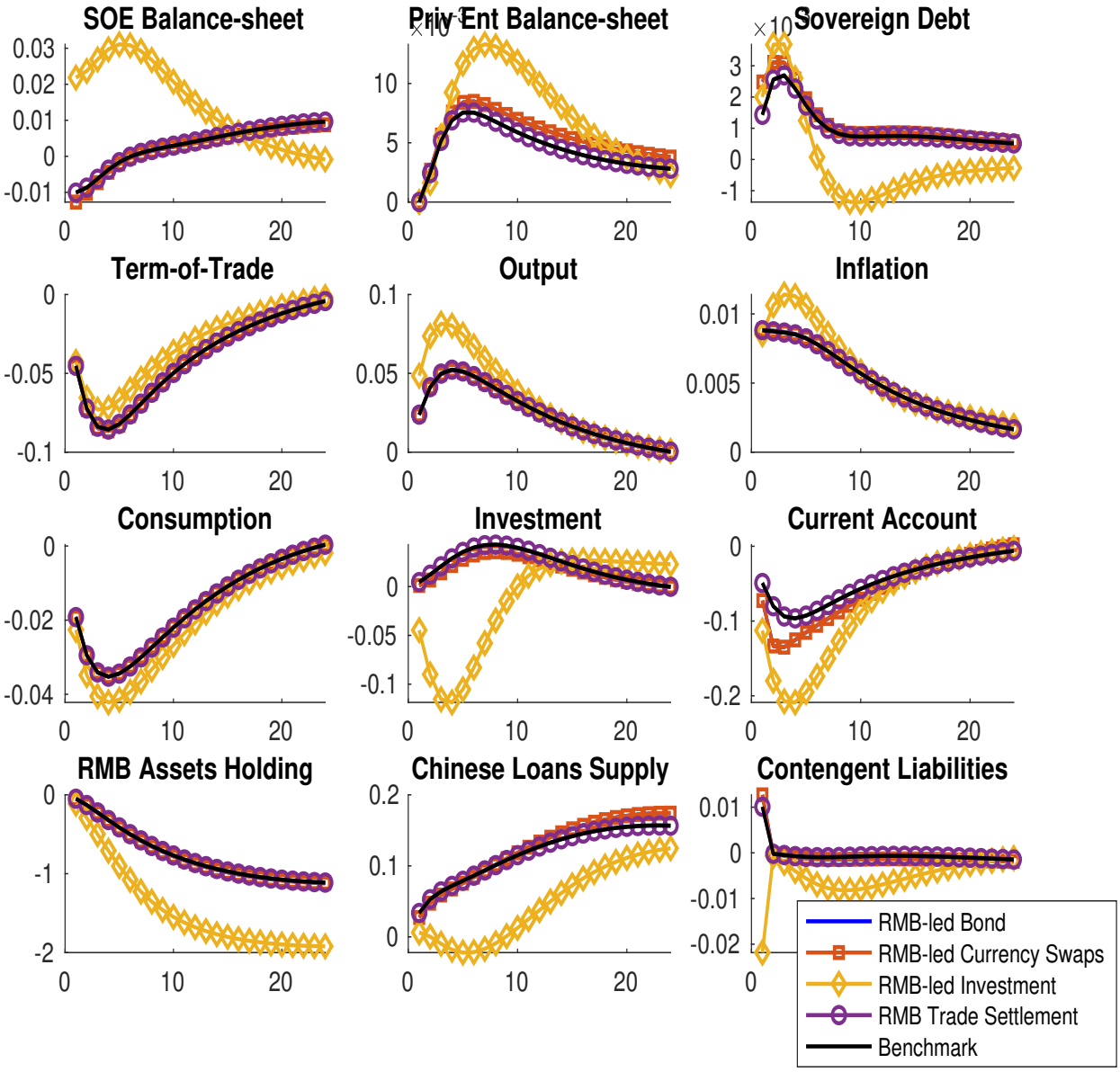
the relative competitiveness and the exports of Africa countries goods towards China.

Figure 1. Government Spending shock Africa



Note: The figure shows the .

Figure 2. Government Spending shock China



Note: The figure shows the .

As a consequence, the current account adjustment in both economies is differently affected by the international financial market segmentation. The differentiation between public and private capital-backed collateral significantly affects the dynamics of the cur-

rent account. China loans to Africa clearly deteriorate China' current account. Investment in Africa is mainly fuelled by Chinese loans. This implies a net increase in foreign resources to more productive firms in Africa. International financial market segmentation clearly impacts negatively China state-owned corporations' performance, as more lending resources are diverted towards Africa. With china-Africa financial relations, the increase in international allocation of financial resources is reflected by a decrease in china' loan supply for Chinese corporations. By contrast, current account is improved in Africa. As more more loans are diverted from china corporation to Africa corporations, and more and more Africa corporations' production is exported to China, the current account of Africa increases to reflect the international financial market segmentation, that offset the financial frictions facing African's corporations.

The differentiation between public and private capital-backed collateral act thus as a acts as a mechanism that accentuates the expansionary effect of the public spending on Africa's corporates and sovereign, by improving both the term of trade and the current account.

7.2 Effects of RMB-led Investment internationalization

Figure 3 and 4 depicts the response of corporates in China and Africa following Chinese renminbi internationalization through renminbi-led investment. At first glance, the internationalization of the renminbi leads to a contraction of activities in both state-owned corporates and private sector corporates, more so for the former, particularly in Africa. This negative effect is accentuated by the presence of international financial frictions in the model, and two channels are involved in the propagation of this mechanism. First, the international collateral constraint channel, whereby renminbi trade settlement changes the shadow value of loans and therefore demands of both types of corporate collapse. Second, the assets-price effect, whereby changes in the value and levels of both public and private capital alter their collateral values when corporations pledge them as a guarantee, Hence, the decline in accumulation of both public and private capital pushes down the price of those physical capitals, so that corporates also lose from the wider financing tightening that lower collateral values induce. As a result, investment in state- owned corporates and investment in private sector corporates is reduced by the tighter access to credit, so that the respective labor demands and output of each type of corporate all feature a common decrease.

Secondly, in comparison to the benchmark case, results reveal that, when the financial constraint is tightened, the contractionary effect of Chinese internationalization becomes larger than in the case where the financial constraint is relatively relaxed (benchmark). The asset-price effect leads to a decrease in corporate investments more than the benchmark case. In addition, the international collateral constraint channel induces a lower level of consumption demand than under the benchmark case. Both channels lead to a decrease in corporate output below what was the case under the relatively loose financial constraints. However, the magnitude of the negative effects differs between the two types of corporations, with the tightening financing constraint affecting state-owned corporations more severely than private sector corporations. Basically, as financing conditions of the state-owned corporates tighten even more, relative prices in the sector decrease below the benchmark level. The state-owned corporations responded to the renminbi internationalization by increasing their demand for unskilled workers more than under the benchmark level and decreasing their demand for public capital less than under the benchmark level. The acquisition by state-owned corporates of less physical capital relative to unskilled labor leads to a reduction of their investment level below the benchmark level.

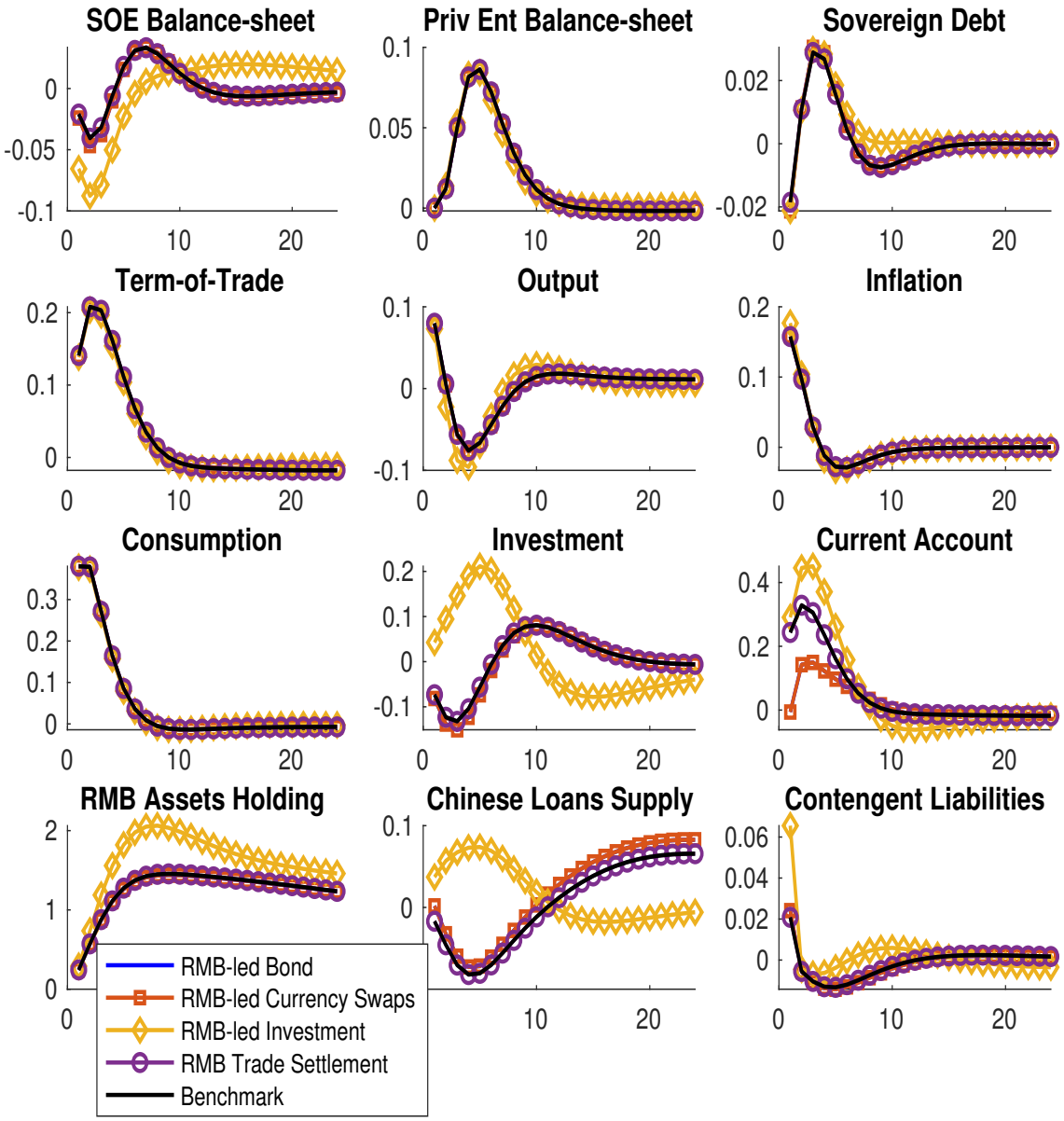
In addition, the decline in the accumulation of public physical capital both pushes the price of physical capital down and induces lower collateral valuations, which amplify the initial effect. The negative effect of lower collateral valuation decreases the productivity of state-owned corporates below the benchmark level. Furthermore, because state-owned corporations are less competitive, they will reduce their wages below the benchmark level in order to afford more workers.

By contrast, private sector corporates remain more competitive due to financial vulner-

ability. In the presence of Chinese renminbi internationalization, private sector corporates will also face a decrease in their relative prices below the benchmark level. They react to Renminbi internationalization by hiring fewer workers than under the benchmark case. All of this drives private sector corporations to continue demanding and amassing private capital in order to sustain their productive capacities. Due to the lack of additional funding, private sector corporations invest less than under the benchmark, and their investment level remains slightly below the benchmark level. To sustain their investment decisions, private sector corporates will reduce their wages below the benchmark level. As the sector adjusts to new financing conditions, the low labor cost and resilience of physical capital demand and accumulation raise private sector corporate output above the level of state-owned corporations.

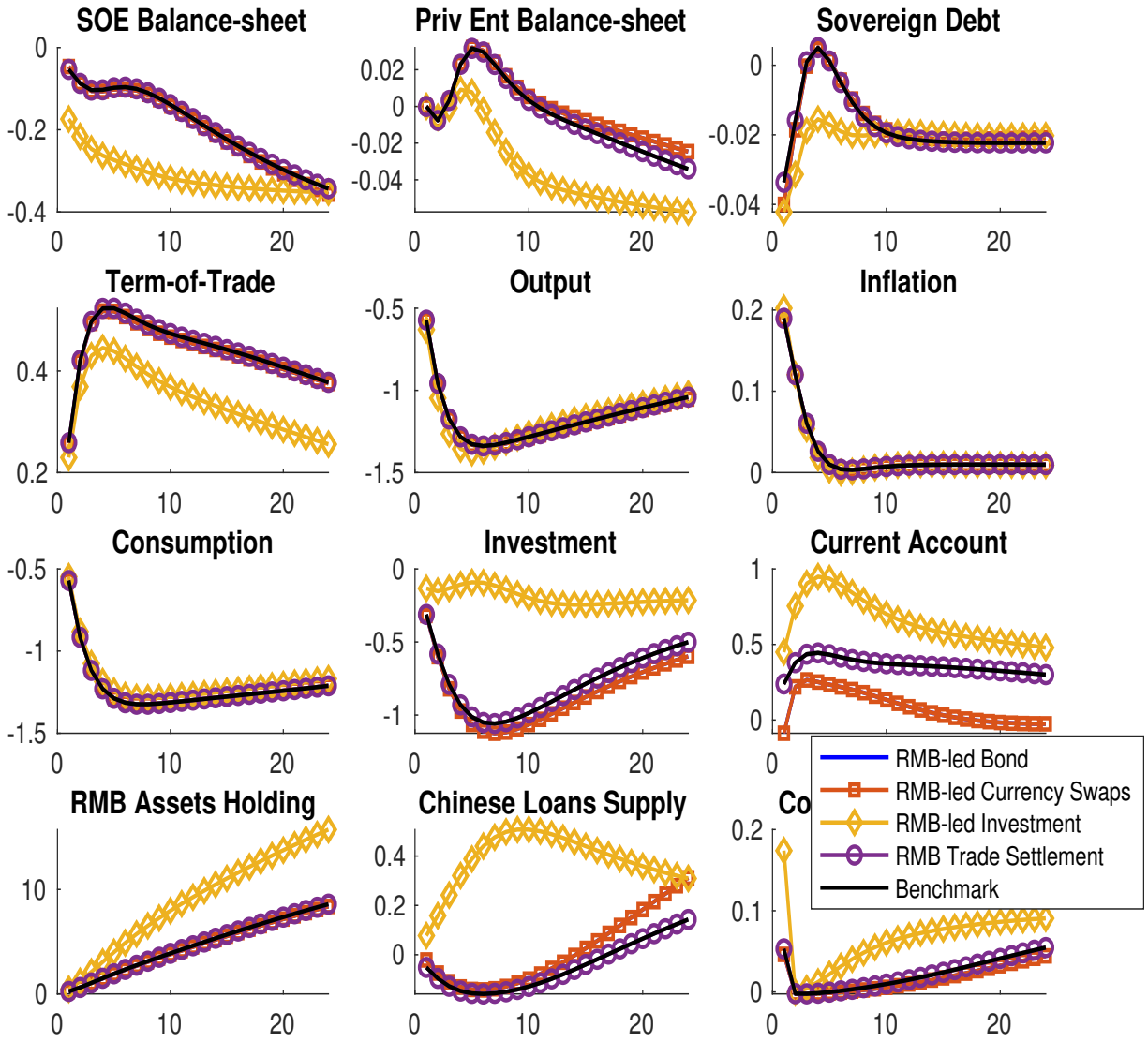
Hence, the Chinese renminbi internationalization deteriorates the productive capacities of corporates in African economies, more so for state-owned corporates than for private sector corporates. This is justified by the fact that, while state-owned corporates increase demand for labor to insulate against the effects of renminbi internationalization on their productive capacities, private sector corporates continue to increase demand for private capital because they are less financially constrained than their state-owned corporate counterparts.

Figure 3. Productivity shock China



Note: The figure shows the .

Figure 4. Productivity shock Africa



Note: The figure shows the .

7.3 The Trade Effects of RMB internationalization

Figure 5 and Figure 6 displays the effects in China and Africa of Renminbi internationalization through trade settlement instrument. The normalization of renminbi adversely affects corporates balance-sheet, more so for state-owned enterprises, and less so for private enterprises, both in China and Africa. Sovereign debt sharply increases both in China and Africa. This adverse effects are principally due to the decrease of the value of the public capital-backed collateral, and the private capital-backed collateral, more so for the former.

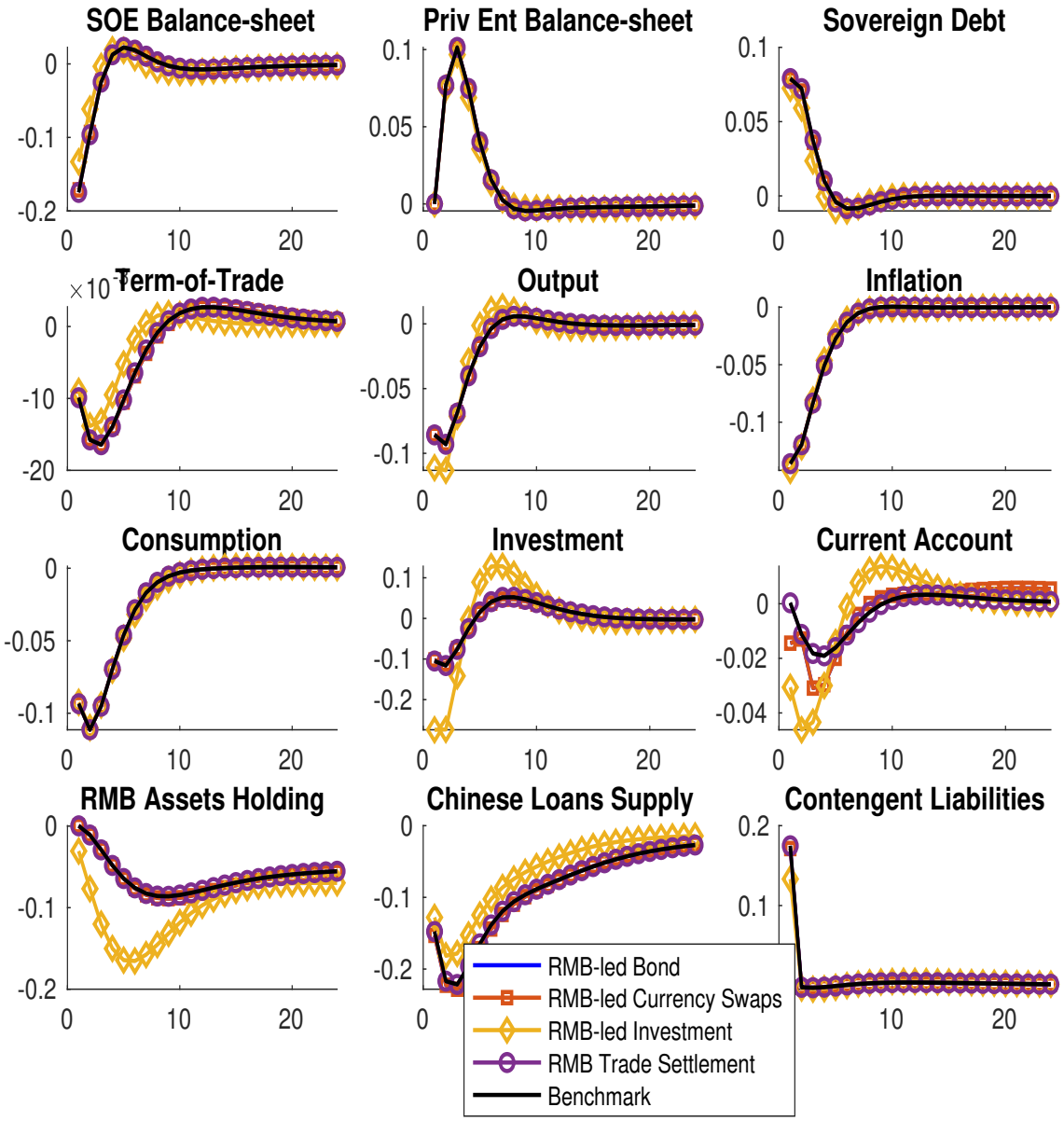
The reduction of corporates' balance-sheet depresses investment and production both in China and in Africa. The contractionary economic activity is explained by the collapse of the realization of investment projects in China and Africa. These insolvent investment projects induces higher interest rate on Chinese loans, which further depress investment and in turn fuels higher sovereign debt. The good news is that renminbi internationalization is deflationary as it also triggers the sharp decreases of inflation in China and Africa.

As response the central bank lower the policy rate to curb deflation. Lower interest rate coupled with higher sovereign debt both in Africa and China triggers a sharp decline of Chinese loans, due to the internationalization of Renminmbi. However, as China is the issuer of renminbi this loose monetary policy is not strong enough to dilute the adverse effect of RMB internationalization, leading to a sharp decline of consumption in china, in line with its rebalancing policy. By contrast, in Africa, the lower policy rate increases consumption demand. But this increase is unable to dampens the adverse effects of renminbi internationalization on investments, leading to the decline in production.

As consumption demand of Chinese goods decline whereas consumption demand of African goods increases, China's term of trade deteriorates, while Africa improves its term of trade. The positive impact observed in Africa term of trade is because trade settlement is the instrument through which Renminmbi is internationalized in this scenario. Nevertheless the improvement of Africa's term of trade is not strong enough to turn sovereign debt sustainable, leading to a deterioration of current account in Africa. Likewise, in China, the higher sovereign debt coupled with negative term of trade induce a shard current account deficit. The segmentation of public-backed collateral and private backed collateral acts as a mechanism that amplifies the adverses effects of renminmbi trade settlement internationalization, more so in China than in Africa.

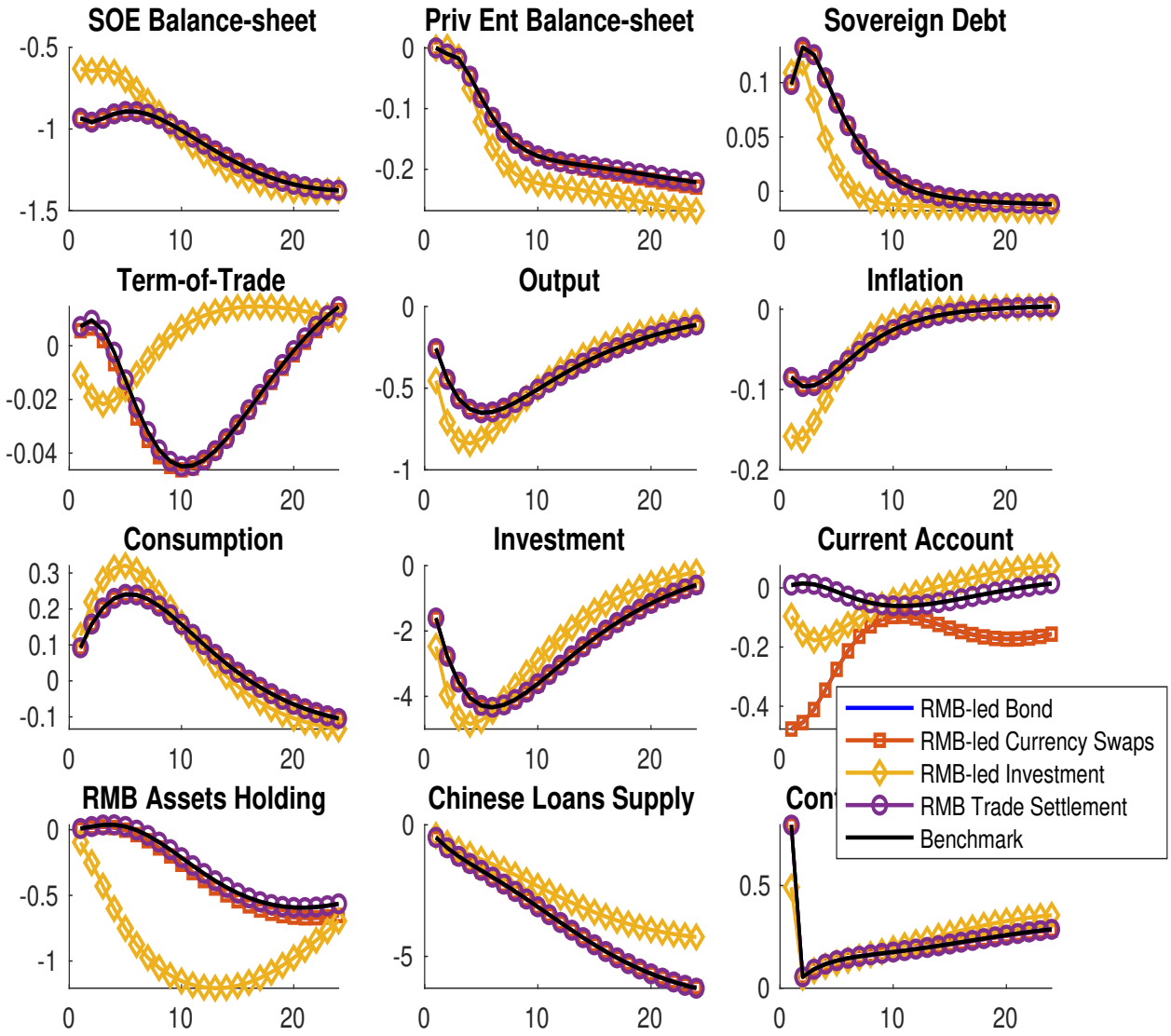
In sum, the corporates balance-sheet and sovereign debt performance both in China and Africa worsen with renminbi internationalization, as economic activity decreases and investment depress due to international financial market segmentation. The higher sovereign and declining corporates' investment leads the current account deterioration in China and Africa. Thus international financial market segmentation clearly amplifies the diffusion of the adverse effects of renminbi internationalization both in China and Africa.

Figure 5. Monetary Policy shock China



Note: The figure shows the .

Figure 6. Monetary Policy Shock Africa



Note: The figure shows the .

7.4 Effects of RMB-led Bond internationalization

Figure 7 and Figure 8 describe China and Africa economies when more economic agents in Africa purchase more bonds denominated in renminbi issued by China. This demand of renminbi-led bond by Africa countries implies a huge capital outflow from Africa to China.

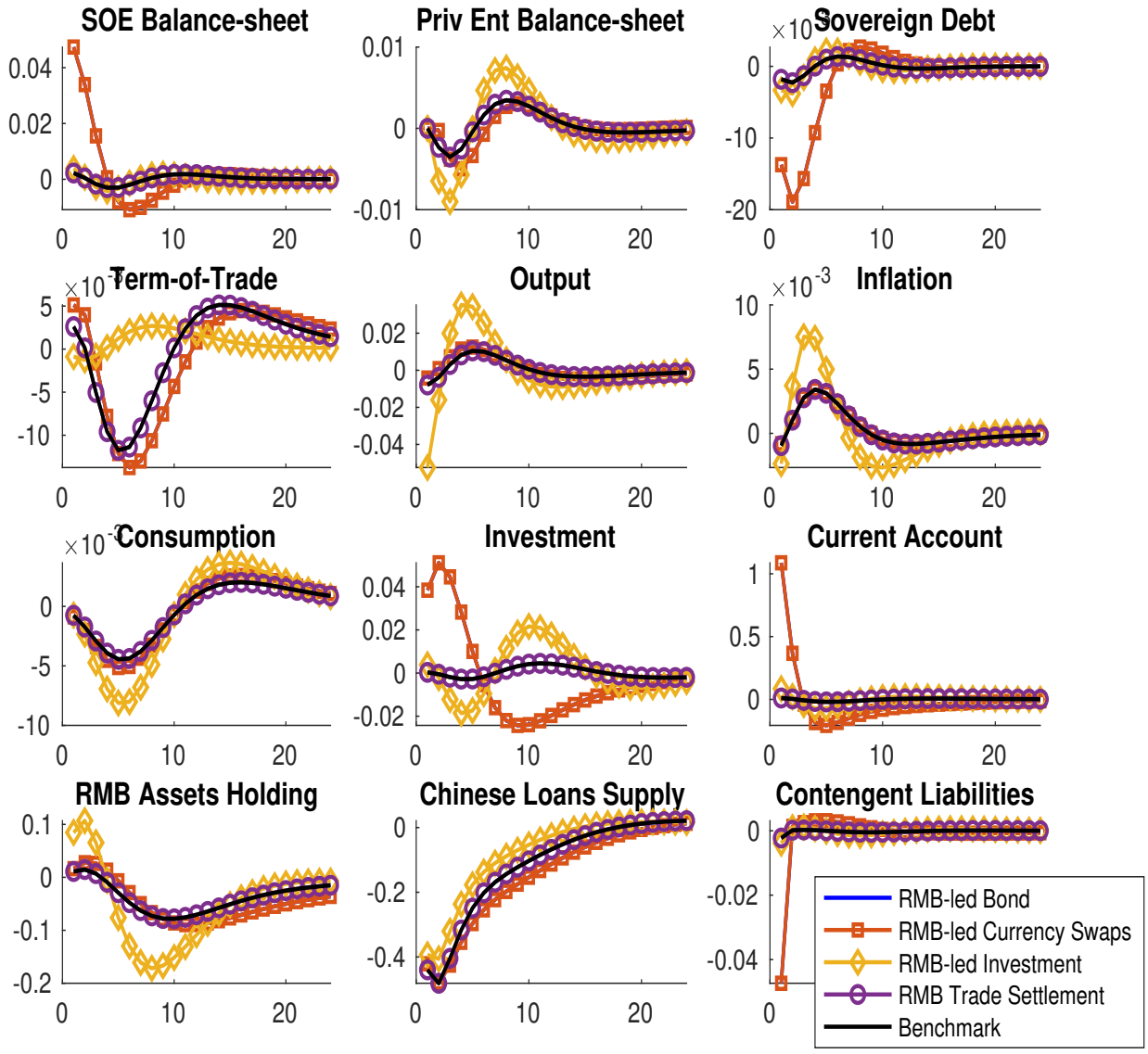
This renminbi-led bond internationalization represents an increase in the resources for China. It improves the liquidity situation of China which in turn implies the creation of more loans for Chinese Corporates. As response, both the balance-sheet of state-owned corporates and the balance-sheet of private sector corporates soar in China, whereas sovereign debt collapse.This induces an increase of China' investment, which in turn leads to more economic activity. With higher investment and buoyant economic activity in China, renminbi-led bond leads to an improvement in the terms of trade in China.

However, the situation is dissimilar in Africa. The renminbi-led bond internationalization triggers shortage of resources of corporates in Africa. As a result, both the balance-sheet of state-owned corporates and the balance-sheet of private sector corporates shrink in Africa. This shift of financial resources out of Africa drag corporates' investments, household consumption, which in turn depresses economic activity. Initially more Chinese corporate loans are distributed in Africa. But, as renminbi internationalization leads to a decrease in the net-worth of corporations, it increases the probability of unproductive projects. This, in turn, depresses corporates' investment in Africa. This situation is worsens by the deterioration of term of trade in Africa due to the improvement of the competitiveness of Chinas' goods. The goods news is that, as China loans to Africa decreases, sovereign debt in Africa decreases as well. The decline in sovereign debt dampens the deterioration of the term of trade, which help to slightly stabilize the current account.

Indeed, renminbi internationalization trough renminbi-led bond impacts the dynamics of the bilateral current account. As the dynamics of investment in Africa is reversed, renminbi internationalization enhances the expansion of investment in China and, by so, affects the dynamics of the current account. Hence, the increased in investment in China is financed by economic agents in Africa which purchase bonds denominated in renminbi. This reaction of investment combined with the impact of the terms of trade improvement, lead to the current account surplus in China. So, the current account surplus in China is particularly driven by the abundant capital availability from renminbi-led bond internationalization and the amelioration of term of trade induced by soaring investments.

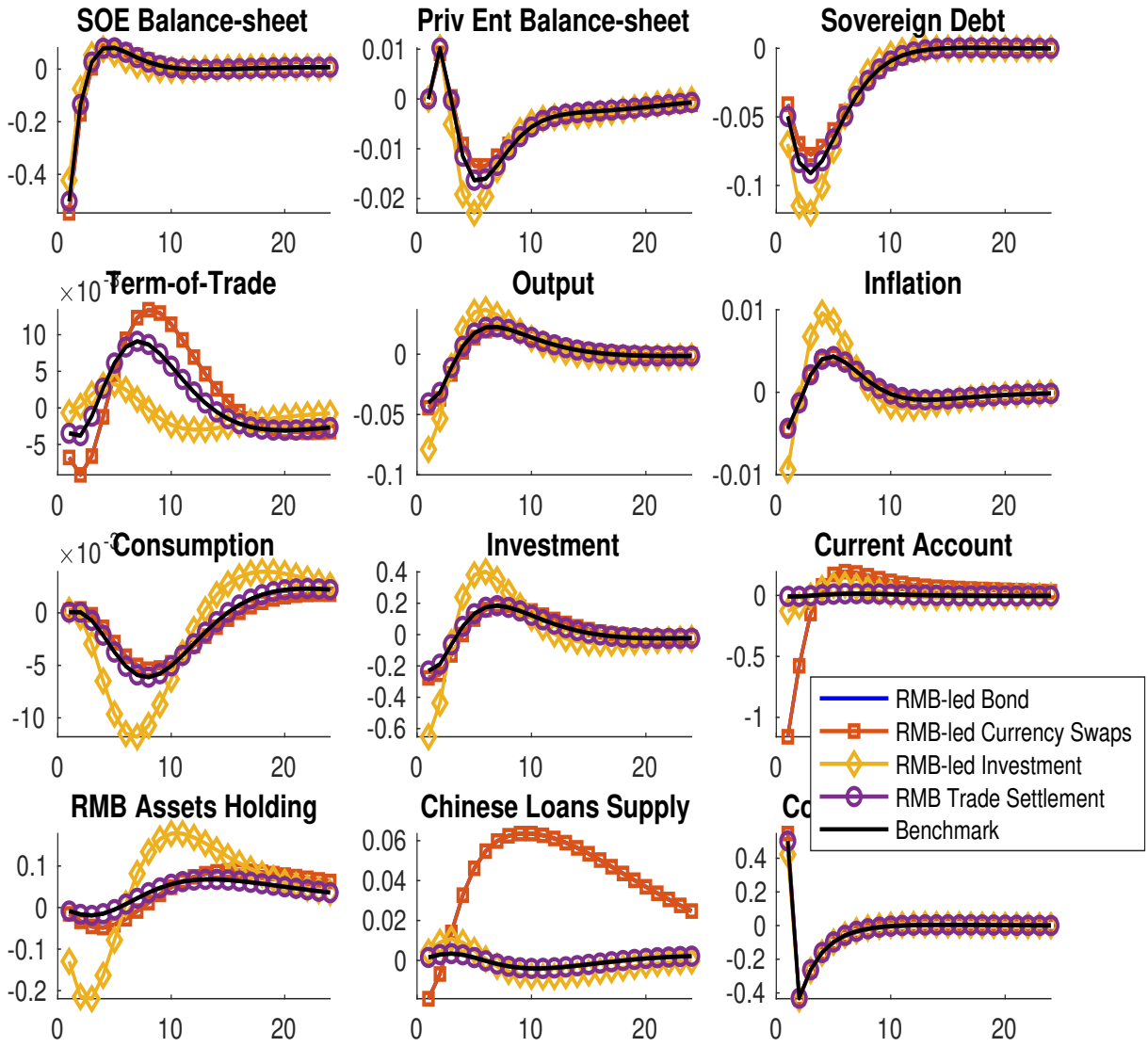
Renminbi internationalization trough renminbi-led bond acts as a mechanism that amplifies the transmission of resources from corporates' investment in Africa to corporates' investment in China. Now, Chinese entrepreneurs have access to African financial resources which increases investment in China. With renminbi-led bonds, the further renminbi internationalization, the decrease is the availability of China loans to Africa, and the deepest is corporates balance-sheet deterioration, and the higher is the sovereign debt.

Figure 7. EFP shock China



Note: The figure shows the .

Figure 8. EFP shock Africa



Note: The figure shows the .

7.5 Effects of RMB-led currency swaps internationalization

Figure 9 and Figure 10 reflects the effects of renminbi internationalization on corporate balance-sheets in Africa and China through renminbi-led currency swaps instrument. The internationalization of the renminbi adversely affects the loan-to- value ratio of both corporates, more so in Africa than in China. Indeed, the renminbi-led currency swaps acts as a quantitative tightening that leads to a reduction in the loan-to-value ratio below the benchmark level. A decline in the loan-to-value ratio tightens the financial constraint and allows a decrease in the availability of loans, more so in Africa than in China. While investment rose in China, the resulting fall in investment in Africa induces a decrease in labor hiring and public as well as private capital demands. Lower demand for both private capital and public capital sharply decreases their respective values, tightening the collateral constraint further. While sovereign debt rose both in China and in Africa, a tightening of the borrowing constraint due to renminbi-led currency swaps internationalization has a worsening effect on the balance-sheets of corporates in Africa, but less so in China.

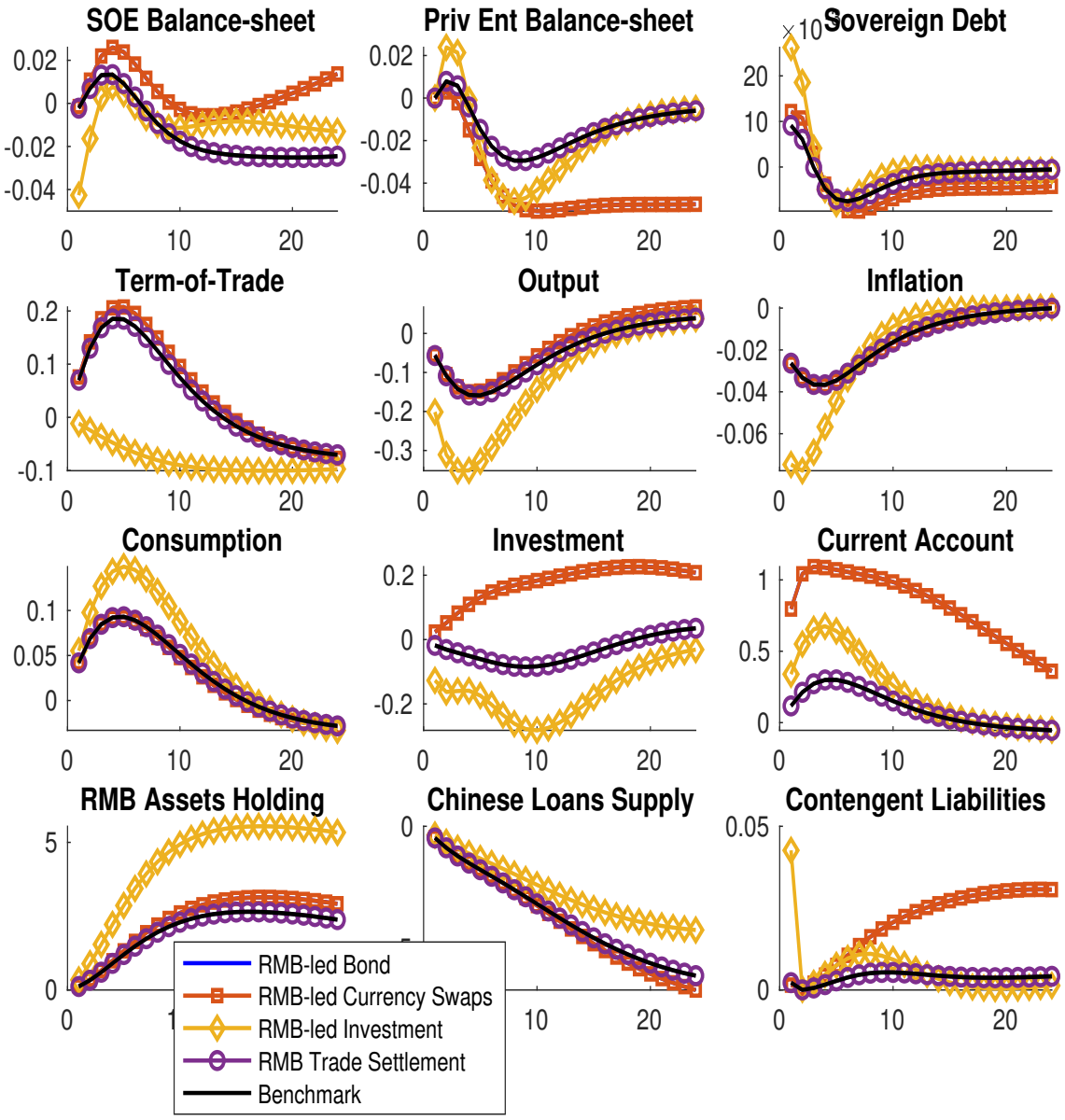
For the state-owned corporates in Africa, the negative effects of renminbi internationalization are more accentuated. Since the state-owned corporates knew that the Chinese renminbi internationalization would be permanent and that they would not be able to make the reimbursement of their loans under those circumstances in the long run, they initially mostly decreased the accumulation of public capital and slightly decreased the demand for loans below the benchmark level. Subsequently, the tightening of the collateral constraints induced by the renminbi internationalization further amplifies the effect by leading to a decrease in labor demand by the state-owned corporates. The initially stronger decrease in demand induces an even stronger reduction in loans due to the asset-price effect. This deterioration in financing conditions contracts activity in state-owned corporates and pushes them to reduce investment further, which in turn induces a lower price of public capital and hence lower collateral valuations, reinforcing the initial effect. As a result, in the state-owned corporate sector, the decrease in the accumulation of public capital and the quantity of loans induces a persistent deterioration of the state-owned corporate balance sheet.

By contrast, the balance sheets of private sector corporates show a sign of resilience following the renminbi-led currency swaps internationalization. The tightening of state-owned corporate financing constraints implicitly increases the amount of loans available to private sector corporations. The private sector corporates react by raising their investment slightly, but this remains below the benchmark level. This leads afterward to a smooth investment level towards a steady state over time. Luckily, the increase in consumption offsets the level of investment and induces an increase in the productivity of the private sector. As private sector corporate productivity rises, so does their return, prompting them to increase, on the one hand, their demand for private capital (because the relative price of private capital is now lower than in the benchmark case), and on the other, their accumulation of private capital, in order to mitigate the negative effects of renminbi internationalization on their

balance-sheet. Hence, because private sector corporates accumulate pledgeable collateral more efficiently than state-owned corporates, rising productivity and consumption limit the negative effects of renminbi internationalization on their balance sheets.

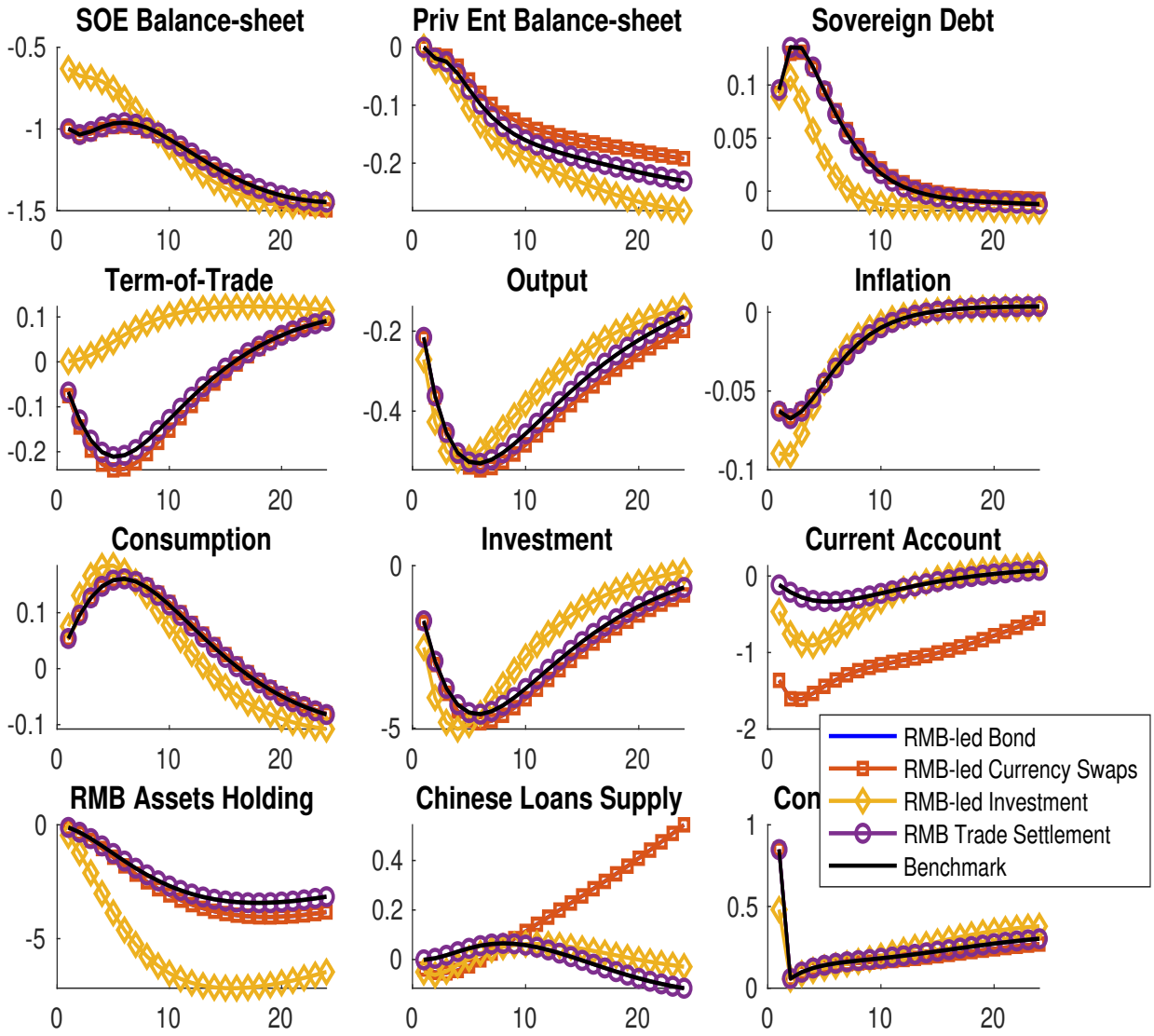
Overall, renminbi internationalization by China, on the one hand, leads to the reduction of the quantities of loans supplied to both state-owned corporates and private sector corporates; on the other hand, it induces the collapse of the value of public capital and private capital as collateral. Both effects worsen the respective balance-sheets of corporates in African economies. The adverse effects are more accentuated on the balance-sheet of state-owned corporates because private sector corporates accumulate pledgeable collateral more efficiently than state-owned corporates.

Figure 9. Net-worth shock China



Note: The figure shows the .

Figure 10. Networth shock Africa



Note: The figure shows the .

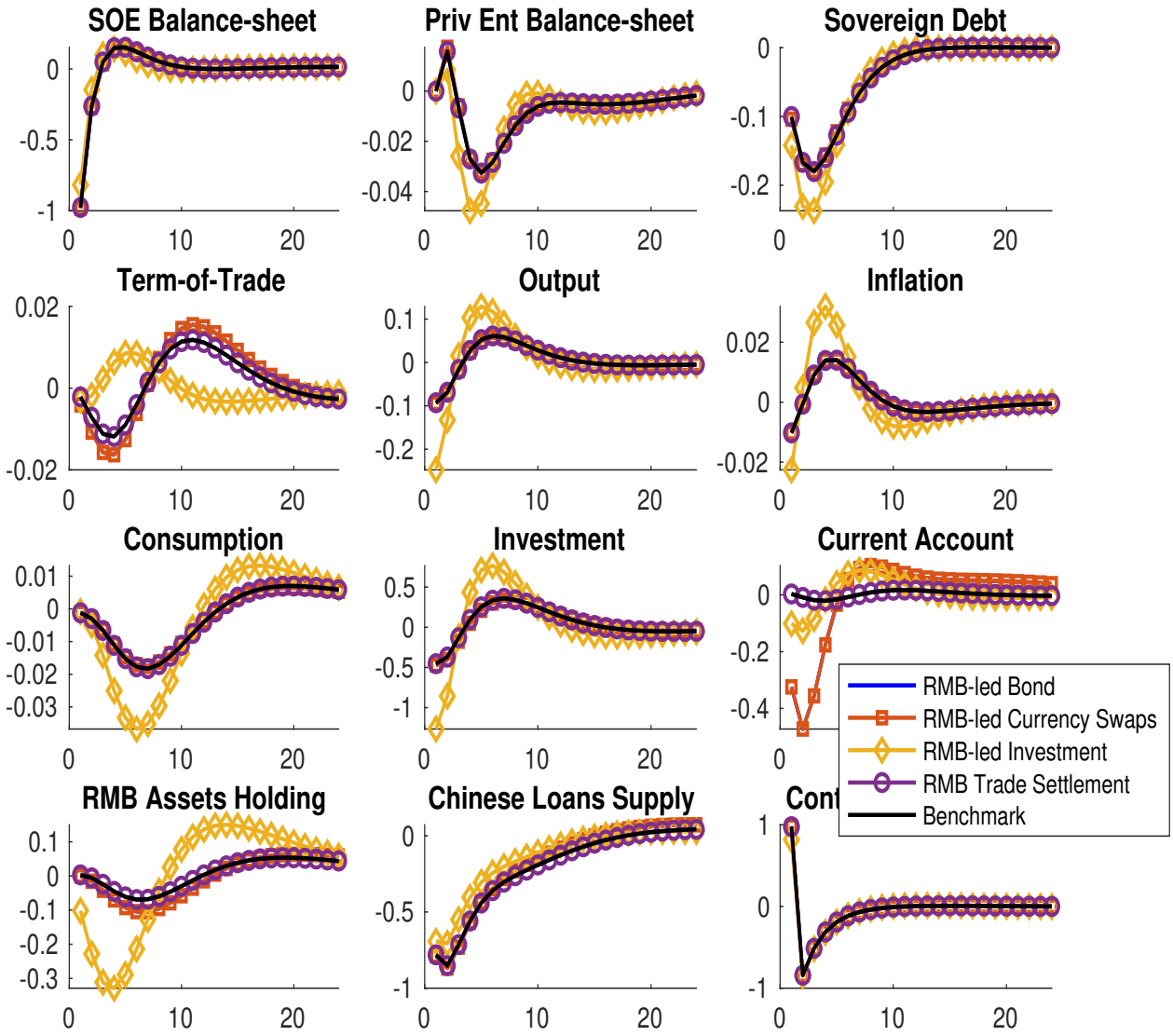
7.6 Effects of RMB internationalization under Contingent Liabilities Realization

Figure 11 and Figure 12 illustrate the effect of China's renminbi internationalization on the dynamic between contingent liabilities and state-owned corporates. In Africa, renminbi internationalization triggers the default of state-owned corporates and, in turn, the realization of contingent liabilities. Since the government intermediates between state-owned corporates and China, the realization of contingent liabilities raises the transfer from economic agents to the government. The increase in taxes paid by economic agents leads to a decrease in the disposable revenue. As a result, the demand for deposits in the banking sector will be negatively affected. The fall of deposits induces the decline of banking sector assets. To re-balance its balance sheet, the banking sector will seek to reduce loans. Loans supplied decline for both state-owned corporates and private sector corporates, more so for the former. This process is intensified by the international collateral constraint channel, as China raises the requirements to supply loans, including collateral. Since state-owned corporates are directly concerned by contingent liabilities, its realization further accentuates their shortage in the segmented credit market. Because of the complementarity effect between state-owned corporates and private sector corporates, both corporates face thus the deterioration of their balance-sheet. This leads to a collapse of investment project realization and consumption demand in Africa. As Africa encounters the contraction of its economic activity and the deterioration of its term of trade, the reduction of the sovereign debt is made at the cost of a current account deficit.

In contrast, in China corporates are not directly concerned by the contingent liabilities in Africa, and easily overcomes the adverse effect of its realization via the international collateral channel. The level of loans granted to the Chinese corporates are at least identical to the level before the realization of contingent liabilities. Both state-owned corporates and private sector corporates increase their investments as well as consumption demand. In addition, to compensate for the high cost of private capital, corporates will increase their demand for skilled labor. The rise in investment and consumption will lead to an increase in the output in China. The increase of output and investment induces the improvement of term of trade. China benefit thus of a surplus of current account because of the internationalization of renminbi.

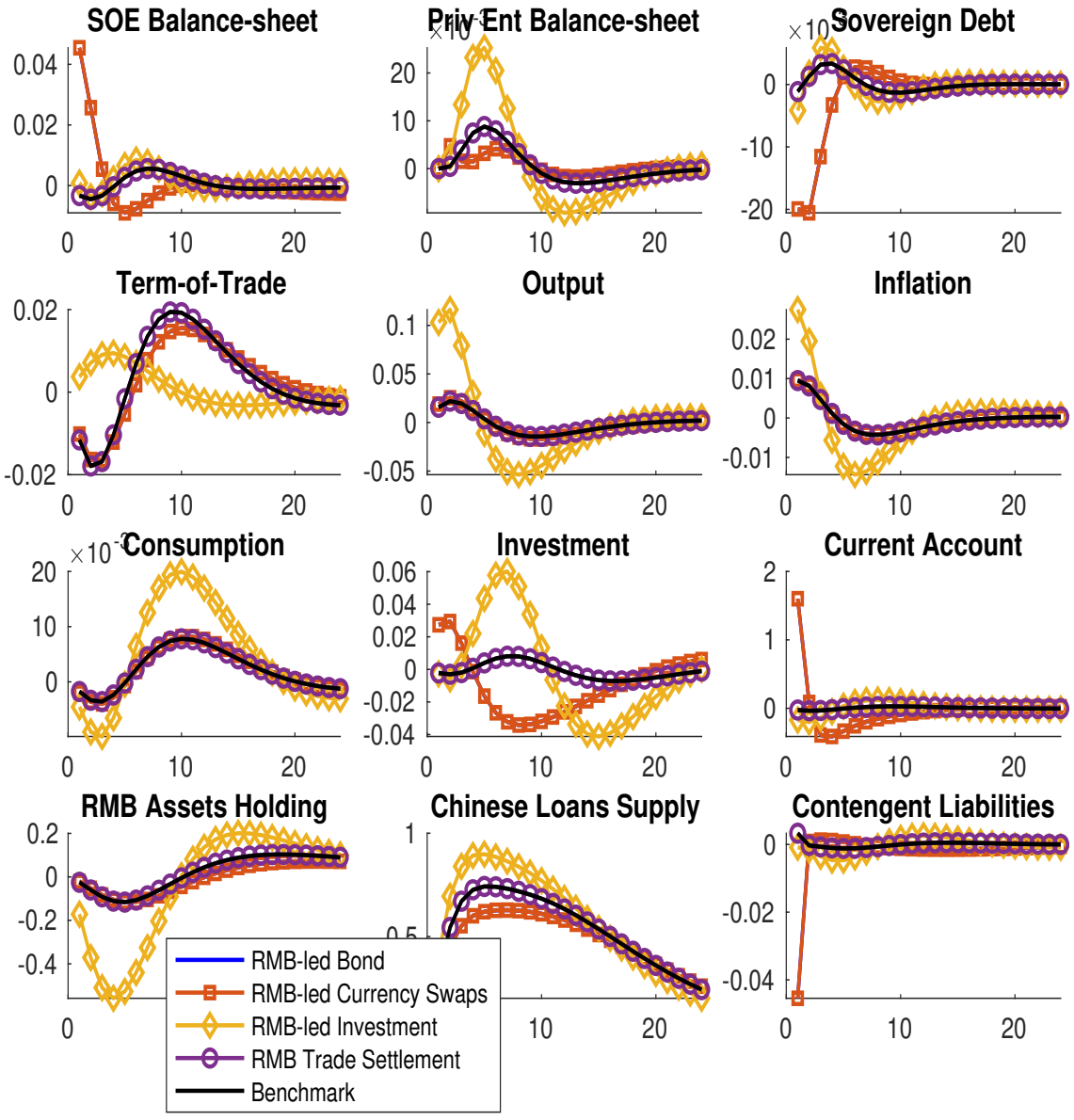
All in all, the realization of contingent liabilities due to the state-owned corporations default adversely affects private sector corporations and induces a sharp deterioration of the balance-sheet of both corporates. The resulting decrease in investment and consumption accentuated by the effect of the international collateral channel leads to a decrease in output. Hence, the realization of contingent liabilities acts as a powerful channel through which the adverse effects of Chinese renminbi internationalization on state-owned corporates balance-sheet in Africa expand and spill over to the private sector corporate balance-sheet, and in turn deteriorate the term of trade and lead to a huge current account deficit that help to reduce sovereign debt.

Figure 11. Contingent Liabilities shock Africa



Note: The figure shows the .

Figure 12. Contingent Liabilities shock China



Note: The figure shows the .

8 Welfare Analysis

We conduct welfare analysis of two types policy, before the renminbi internationalization, and after the renminbi internationalization, both in China and Africa. Tables1-5 reports the results of welfare outcomes in China and Africa before the renminbi internationalization, relative to the results of welfare outcomes of both economies after the renminbi internationalization. Table 1 displays the welfare outcomes of the overall effects of the renminbi internationalization. Whereas Table 2-5 denotes the welfare outcomes under each of the four instruments through which renminbi internationalization operates. Specifically, the results of the standard deviation of economic activity, price stability, and sovereign debt, in each countries, under each type of policy are presented.

8.1 Welfare Analysis of RMB Internationalization

The welfare policy evaluation is based on a second order approximation of equilibrium conditions of the model using estimated parameters at their posterior mean.Table 1 provides the results of renminbi internationalization.

Before renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.692 lower than the estimated standard deviation coefficient of output in Africa of 0.837. This result suggest that the economic activity in China is more vibrant than Africa even before renminbi internationalization. Second, the standard deviation coefficient of inflation in China is estimated to 0.418 lower than the estimated standard deviation coefficient of inflation in Africa of 0.427. This result suggest that China respond strongly to inflation than Africa does before renminbi internationalization. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.523 lower than the estimated standard deviation coefficient of inflation in Africa of 2.052. This result suggest that Africa faces a huge burden of sovereign debt, whereas the level of sovereign debt is China is sustainable before renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.010% greater than the welfare gain in Africa which is estimated to 0.03%. Thus, before renminbi internationalization welfare increases more in China than in Africa.

With renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.690 lower than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.692. This result implies that, renminbi internationalization improve the balance-sheet of both state-owned enterprises and private sector enterprises in China. Second, the standard deviation coefficient of inflation in China is estimated to 0.36 lower than the estimated standard deviation coefficient before renminbi internationalization of 0.41. This result implies that renminbi internationalization is deflationary in China. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.523 lower than the estimated standard deviation coefficient before renminbi internationalization of 1.518. This result suggest that both state-owned corporates and pri-

vate sector corporates in China accumulate more efficiently pleadable public-backed and private-backed collateral with renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.014% greater than the welfare gain before renminbi internationalization of 0.010%. Thus, renminbi internationalization increase welfare in China relative to Africa.

By contrast, in Africa, first, the standard deviation coefficient of output in China is estimated to 0.84 greater than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.83. This result implies that, renminbi internationalization adversely impacts the balance-sheet of both state-owned enterprises and private sector enterprises in Afria. Second, the standard deviation coefficient of inflation in Africa is estimated to 0.47 greater than the estimated standard deviation coefficient before renminbi internationalization of 0.42. This result implies that renminbi internationalization is inflationary in Africa. Third, the standard deviation coefficient of sovereign debt in China is estimated to 2.0529 greater than the estimated standard deviation coefficient before renminbi internationalization of 2.0521. This result suggest that both state-owned corporates and private sector corporates in Africa accumulate less efficiently pleadable public-backed and private-backed collateral with renminbi internationalization. Intuitively, the welfare outcome is estimated to be 0.008% lower than the welfare outcomes before renminbi internationalization of 0.03%. Hence, renminbi internationalization adversely affects welfare in Africa relative to China.

Table 1—Welfare Analysis of RMB Internationalization

	Before RMB Internationalization		After RMB Internationalization	
	China	Africa	China	Africa
Economic Activity (σ_y)	0.69298	0.83701	0.69091	0.84045
Price Stability (σ_π)	0.41866	0.42737	0.36509	0.47804
Sovereign Debt (σ_L)	1.5236	2.0521	1.5188	2.0529
Welfare (%)	0.010339	0.031878	0.014261	0.0087034

Note: Results .....

Overall, our findings reveal that, while renminbi internationalization is welfare-relevant for China, it does not improve welfare in Africa. the main driver of this finding lies in the international financial frictions that face face both state-owned corporates and private sector corporates in the international segmented credit market. Africa marginally gain from their bilateral relation with China before renminbi internationalization. But, with renminbi internationalization, Africa is worse-off. The drivers of welfare improving renminbi international instruments are further discussed in the following sections.

8.2 Welfare Analysis under RMB Trade Settlement

Table 2 provides the results of renminbi internationalization trough the trade settlement instrument . Before renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.694 lower than the estimated standard deviation coefficient of output in Africa of 0.837. This result suggest that the economic activity in China is more vibrant than Africa even before renminbi internationalization. Second, the standard deviation coefficient of inflation in China is estimated to 0.416 lower than the estimated standard deviation coefficient of inflation in Africa of 0.427. This result suggest that China respond strongly to inflation than Africa does before renminbi internationalization. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.55 lower than the estimated standard deviation coefficient of inflation in Africa of 2.075. This result suggest that Africa faces a huge burden of sovereign debt, whereas the level of sovereign debt is China is sustainable before renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.010% greater than the welfare gain in Africa which is estimated to 0.029%. Thus, before renminbi internationalization welfare increases more in China than in Africa.

With renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.691 lower than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.694. This result implies that, renminbi internationalization improve the balance-sheet of both state-owned enterprises and private sector enterprises in China. Second, the standard deviation coefficient of inflation in China is estimated to 0.363 lower than the estimated standard deviation coefficient before renminbi internationalization of 0.416. This result implies that monetary policy is strongly affected renminbi internationalization in China. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.552 lower than the estimated standard deviation coefficient before renminbi internationalization of 1.556. This result suggest that both state-owned corporates and private sector corporates in China accumulate more efficiently pleadable public-backed and private-backed collateral with renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.015% greater than the welfare gain before renminbi internationalization of 0.010%. Thus, renminbi internationalization increase welfare in China relative to Africa.

By contrast, in Africa, first, the standard deviation coefficient of output in China is estimated to 0.841 greater than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.837. Second, the standard deviation coefficient of inflation in Africa is estimated to 0.477 greater than the estimated standard deviation coefficient before renminbi internationalization of 0.427. Third, the standard deviation coefficient of sovereign debt in China is estimated to 2.0818 greater than the estimated standard deviation coefficient before renminbi internationalization of 2.0754. As a result, the welfare outcome is estimated to be 0.0055% lower than the welfare outcomes before renminbi internationalization of 0.029%. Hence, renminbi internationalization adversely

affects welfare in Africa relative to China.

The results underlines the role of renminbi-led trade settlement in enhancing international financial frictions arising from the renminbi internationalization. When bilateral trade between Africa and China is settled in renminbi, trade policy does no longer improve welfare in Africa. This is because both state-owned corporate and private sector corporate in Africa does not longer accumulated pledgeable public and private backed capital collateral efficiently. These developments expose thus Africa either to over-borrowing with higher sovereign debt, or under-borrowing with lower sovereign debt financed by higher current account deficit, inducing welfare losses in Africa relatively to China.

Particularly, the welfare outcomes under renminbi internationalization through trade settlement is estimated to 0.005% lower than the benchmark case of 0.008% (Table 1). This finding reveals that, renminbi-led trade settlement is one of the major drivers of the adverse effects of renminbi internationalization in Africa.

Table 2—Welfare Analysis under RMB Trade Settlement

	Before RMB Internationalization		After RMB Internationalization	
	China	Africa	China	Africa
Economic Activity (σ_y)	0.69416	0.83734	0.69152	0.84108
Price Stability (σ_π)	0.41699	0.42714	0.36372	0.47791
Sovereign Debt (σ_L)	1.5567	2.0754	1.5523	2.0818
Welfare (%)	0.010928	0.029143	0.015239	0.0055013

Note: Results .....

8.3 Welfare Analysis under RMB-led Bonds

Table 3 provides the results of renminbi internationalization trough the renminbi-led bond instrument. Before renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.692 lower than the estimated standard deviation coefficient of output in Africa of 0.836. This result suggest that the economic activity in China is more vibrant than Africa even before renminbi internationalization. Second, the standard deviation coefficient of inflation in China is estimated to 0.418 lower than the estimated standard deviation coefficient of inflation in Africa of 0.427. This result suggest that China respond strongly to inflation than Africa does before renminbi internationalization. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.518 lower than the estimated standard deviation coefficient of inflation in Africa of 2.045. This result suggest that Africa faces a huge burden of sovereign debt, whereas the level of sovereign debt is China is sustainable before renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.031% greater than the welfare gain in Africa which is estimated to 0.0099%. Thus, before renminbi internationalization welfare increases more in China than in Africa.

With renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.690 lower than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.692. This result implies that, renminbi internationalization improve the balance-sheet of both state-owned enterprises and private sector enterprises in China. Second, the standard deviation coefficient of inflation in China is estimated to 0.365 lower than the estimated standard deviation coefficient before renminbi internationalization of 0.418. This result implies that renminbi internationalization is deflationary in China. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.514 lower than the estimated standard deviation coefficient before renminbi internationalization of 1.518. This result suggest that both state-owned corporates and private sector corporates in China accumulate more efficiently pleadable public-backed and private-backed collateral with renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.014% greater than the welfare gain before renminbi internationalization of 0.03%. Thus, renminbi internationalization increase welfare in China relative to Africa.

By contrast, in Africa, first, the standard deviation coefficient of output in China is estimated to 0.840 greater than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.836. Second, the standard deviation coefficient of inflation in Africa is estimated to 0.478 greater than the estimated standard deviation coefficient before renminbi internationalization of 0.427. Third, the standard deviation coefficient of sovereign debt in China is estimated to 2.0512 greater than the estimated standard deviation coefficient before renminbi internationalization of 2.0454. As response, the welfare outcome is estimated to be 0.0092% lower than the welfare outcomes before renminbi internationalization of 0.0099%. Hence, renminbi internationalization adversely

affects welfare in Africa relative to China.

The goods news is that, the results stress the role of Renminbi-led bond in undermining international financial frictions arising from the renminbi internationalization. The welfare outcomes under renminbi internationalization through renminbi-led bond is estimated to 0.009% greater than the benchmark case of 0.008% (Table 1). This findings reveals that, renminbi-led bond is also able to dampens frictions arising from the outflows of Chinese loans from Africa, and yield some welfare gains. This is because renminbi internationalization adverses effects in Africa's welfare is curtailed under renminbi-led bonds instrument.

All in all, renminbi internationalization through renminbi-led bonds decrease welfare gains in comparison to China. However, there are still welfare gains, as the international friction regarding the Chinese loans on corporates in Africa is suppressed.

Table 3—Welfare Analysis under RMB-led Bonds

	Before RMB Internationalization		After RMB Internationalization	
	China	Africa	China	Africa
Economic Activity (σ_y)	0.69298	0.8369	0.69072	0.84045
Price Stability (σ_π)	0.41866	0.42748	0.36558	0.47804
Sovereign Debt (σ_L)	1.5188	2.0454	1.514	2.0521
Welfare (%)	0.031878	0.0099649	0.014261	0.0092533

Note: Results.....

8.4 Welfare Analysis under RMB-led Investment

Table 4 provides the results of renminbi internationalization trough the renminbi-led investment instrument. Before renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.695 lower than the estimated standard deviation coefficient of output in Africa of 0.835. This result suggest that the economic activity in China is more vibrant than Africa even before renminbi internationalization. Second, the standard deviation coefficient of inflation in China is estimated to 0.416 lower than the estimated standard deviation coefficient of inflation in Africa of 0.429. This result suggest that China respond strongly to inflation than Africa does before renminbi internationalization. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.584 lower than the estimated standard deviation coefficient of inflation in Africa of 1.897. This result suggest that Africa faces a huge burden of sovereign debt, whereas the level of sovereign debt is China is sustainable before renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.014% greater than the welfare gain in Africa which is estimated to 0.013%. Thus, before renminbi internationalization welfare increases more in China than in Africa.

With renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.689 lower than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.695. This result implies that, renminbi internationalization improve the balance-sheet of both state-owned enterprises and private sector enterprises in China. Second, the standard deviation coefficient of inflation in China is estimated to 0.367 lower than the estimated standard deviation coefficient before renminbi internationalization of 0.416. This result implies that renminbi internationalization is deflationary in China. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.438 lower than the estimated standard deviation coefficient before renminbi internationalization of 1.584. This result suggest that both state-owned corporates and private sector corporates in China accumulate more efficiently pleadable public-backed and private-backed collateral with renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.019% greater than the welfare gain before renminbi internationalization of 0.014%. Thus, renminbi internationalization increase welfare in China relative to Africa.

By contrast, in Africa, first, the standard deviation coefficient of output in China is estimated to 0.841 greater than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.835. Second, the standard deviation coefficient of inflation in Africa is estimated to 0.478 greater than the estimated standard deviation coefficient before renminbi internationalization of 0.429. Third, the standard deviation coefficient of sovereign debt in China is estimated to 2.103 greater than the estimated standard deviation coefficient before renminbi internationalization of 1.8973. So, the welfare outcome is estimated to be 0.0012% lower than the welfare outcomes before renminbi internationalization of 0.013%. Hence, renminbi internationalization adversely affects wel-

fare in Africa relative to China.

However, these results demonstrate the role of Renminbi-led investment in undermining international financial frictions arising from the renminbi internationalization. The welfare outcomes under renminbi internationalization through renminbi-led investment is estimated to 0.0012% greater than the benchmark case of 0.008% (Table 1). This findings reveals that, renminbi-led investment is also able to offset frictions arising from the outflows of Chinese loans from Africa, and yield substantial welfare gains in Africa. This is because renminbi internationalization adverses effects in Africa's welfare is curtailed under renminbi-led investment instrument.

In sum, renminbi internationalization through renminbi-led investment decrease welfare gains in comparison to China. However, there are still welfare gains, as the international friction regarding the Chinese loans on corporates in Africa is suppressed.

Table 4—Welfare Analysis under RMB-led Investment

	Before RMB Internationalization		After RMB Internationalization	
	China	Africa	China	Africa
Economic Activity (σ_y)	0.6951	0.83534	0.68929	0.8416
Price Stability (σ_π)	0.41601	0.42987	0.36771	0.47804
Sovereign Debt (σ_L)	1.5847	1.8973	1.4348	2.1038
Welfare (%)	0.014959	0.013777	0.019476	0.0012091

Note: Results.....

8.5 Welfare Analysis under RMB-led Currency Swaps

Table 5 provides the results of renminbi internationalization trough the renminbi-led investment instrument. Before renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.695 lower than the estimated standard deviation coefficient of output in Africa of 0.837. This result suggest that the economic activity in China is more vibrant than Africa even before renminbi internationalization. Second, the standard deviation coefficient of inflation in China is estimated to 0.416 lower than the estimated standard deviation coefficient of inflation in Africa of 0.427. This result suggest that China respond strongly to inflation than Africa does before renminbi internationalization. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.584 lower than the estimated standard deviation coefficient of inflation in Africa of 2.097. This result suggest that Africa faces a huge burden of sovereign debt, whereas the level of sovereign debt is China is sustainable before renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.026% greater than the welfare gain in Africa which is estimated to 0.013%. Thus, before renminbi internationalization welfare increases more in China than in Africa.

With renminbi internationalization, first, the standard deviation coefficient of output in China is estimated to 0.692 lower than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.695. This result implies that, renminbi internationalization improve the balance-sheet of both state-owned enterprises and private sector enterprises in China. Second, the standard deviation coefficient of inflation in China is estimated to 0.362 lower than the estimated standard deviation coefficient before renminbi internationalization of 0.416. This result implies that renminbi internationalization is deflationary in China. Third, the standard deviation coefficient of sovereign debt in China is estimated to 1.580 lower than the estimated standard deviation coefficient before renminbi internationalization of 1.584. This result suggest that both state-owned corporates and private sector corporates in China accumulate more efficiently pleadable public-backed and private-backed collateral with renminbi internationalization. Unsurprisingly, the welfare gain in China is estimated to be 0.072% greater than the welfare gain before renminbi internationalization of 0.026%. Thus, renminbi internationalization increase welfare in China relative to Africa.

By contrast, in Africa, first, the standard deviation coefficient of output in China is estimated to 0.841 greater than the estimated standard deviation coefficient of output before renminbi internationalization of of 0.837. Second, the standard deviation coefficient of inflation in Africa is estimated to 0.478 greater than the estimated standard deviation coefficient before renminbi internationalization of 0.427. Third, the standard deviation coefficient of sovereign debt in China is estimated to 2.103 greater than the estimated standard deviation coefficient before renminbi internationalization of 2.097. As a result, the welfare loss is estimated to be -0.03% lower than the welfare gain before renminbi internationalization of 0.013%. Thus as clearly reported, renminbi-led currency swaps

diminishes welfare in Africa.

Consequently, these findings underscore the role of renminbi-led trade currency swaps in intensifying international financial frictions arising from the renminbi internationalization. When Africa and China engage in renminbi-led currency swaps, renminbi internationalization triggers welfare losses in Africa. This is because, renminbi-led currency swaps creates welfare transfers from China to Africa.

In fact, the welfare outcomes under renminbi internationalization through trade settlement is estimated to -0.03% lower than the benchmark case of 0.008% (Table 1). Hense, renminbi internationalization creates international welfare transfers between Africa and China, so that the Africa situation clearly deteriorates with respect to the benchmark results reported in Table 1, thus questioning the implementation of renminbi internationalization for Africa.

All in all, these finding demonstrate that, renminbi-led currency swaps is one of the major drivers of the adverse effects of renminbi internationalization in corporates balance-sheet and sovereign debt in Africa.

Table 5—Welfare Analysis under RMB-led Currency Swaps

	Before RMB Internationalization		After RMB Internationalization	
	China	Africa	China	Africa
Economic Activity(σ_y)	0.6951	0.83771	0.69217	0.8416
Price Stability (σ_π)	0.41601	0.42706	0.36254	0.47804
Sovereign Debt (σ_L)	1.5847	2.0977	1.5807	2.1038
Welfare (%)	0.026081	0.013777	0.072561	-0.033654

Note: Results....

Overall, the reaction of China to renminbi internationalization leads to higher welfare improvements. By contrast, the reaction of Africa to renminbi internationalization leads to lower welfare outcomes. Nevertheless, when considering each type of renminbi internationalization instruments, welfare outcomes fluctuate quite much. This is because, welfare outcomes is significantly sensitive to each type of instrument, and in some cases, we may observe welfare reversals leading to welfare transfers between the two economies. First, when renminbi internationalization is conducted with trade settlement and currency swaps instruments, it incurs welfare losses in Africa, creating a welfare transfer towards China. By contrast, when renminbi internationalization is conducted with bonds and investment instruments, it incurs welfare gains in Africa. Under these two instruments, Africa is able to adjust its policy stance in a better way and records welfare gains from renminbi internationalization.

9 Conclusion

This paper aims to assess the effects of the internationalization of the Chinese renminbi on state-owned corporate balance-sheets and sovereign debt in Africa.

This research adds three important dimensions to the literature on the China-Africa nexus: (i) Sovereign debt analysis by distinguishing between state-owned corporations and private-sector corporations' balance-sheet. (ii) international financial market segmentation, in which we differentiate between public and private capital-backed collateral. (ii) Evaluation of the effects of Renminbi internationalization.

Specifically, we developed a stochastic monetary business cycle model to conduct this topical experiment. The model is quite successful in reflecting trade settlement, financial transactions, and the conduct of monetary policy both in China and in African economies, before and after the internationalization of the renminbi. We start by modeling China-Africa's past experiences with capital inflows into Africa from China due to trade, investment, and large public debt.

Subsequently, we model future prospects of renminbi internationalization as the reversal of capital flows in Africa due to the rebalancing of Chinese economies, the reduction of the People's Bank of China's balance sheet, the invoicing of Chinese exports to Africa in renminbi, the currency swap operations between China and African central banks, and the purchase of Renminbi-denominated bonds by African economic agents. We introduce the realization of contingent liabilities as a unique government expense when state-owned corporates default.

Our analysis illustrates how differentiated types of corporates in Africa may segment financial markets and create international financial frictions. It demonstrates how China's renminbi internationalization affects these differentiated types of corporate vulnerabilities. It highlights how international financial frictions emphasize the dynamic between rebalancing strategies in China and corporate activities in Africa. The analysis reveals how the contingent liabilities can transmit the adverse effects of renminbi internationalization from the state-owned corporate sector to an entire economy in Africa.

More granularly, findings reveal that the renminbi trade settlement deteriorates the productive capacities of corporates in Africa, more so for state-owned corporates than private sector corporates. These negative effects are accentuated by the presence of international financial frictions in the model, and two channels are involved in the propagation of this mechanism. First, there is the international collateral constraint channel, in which Chinese trade invoicing and settlement change the shadow value of loans, causing both state-owned and private-sector corporate demands to collapse.Second, the asset price effect, whereby changes in the value and levels of both public and private capital alter their collateral values when corporates pledge them as a guarantee,

Furthermore, we found that Renminbi-denominated bonds in Renminbi offshore markets and the dynamism of other Chinese financial instruments, on the one hand, lead to the reduction of the quantities of loans supplied to both state-owned corporates and

private sector corporates, on the other hand, induce the collapse of the value of public capital and private capital as collateral. Both effects worsen the respective balance sheets of corporates in Africa. The adverse effects are more accentuated on the balance-sheet of state-owned corporates because private sector corporates accumulate pledgeable collateral more efficiently than state-owned corporates. Moreover, results reveal that the realization of contingent liabilities acts as a powerful channel through which the adverse effects of the internationalization of the Chinese renminbi on state-owned corporates spill-over to the entire economy and exposes African countries to higher sovereign debt.

The dynamic analysis confirms that the internationalization of the Chinese renminbi internationalization worsens the balance sheets and the productive capacities of both state-owned corporates and private sector corporates. However, due to their different levels of financing constraints, state-owned corporations appear to be more affected by renminbi internationalization than private sector corporations.This is explained by the fact that, following the internationalization of the Chinese renminbi, private sector corporates in Africa employ a relatively small portion of the economy's workforce but equip each worker with significantly more capital.

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