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Global Shocks, Macroeconomic Uncertainty and Bank Lending

By
Anthony Simpasa
Martin W. Nandelenga

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Anthony Simpasa[1]

Martin W. Nandelenga
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Abstract

The interplay between macroeconomic uncertainty and bank lending has received increased attention in the literature but mainly focused on advanced economies. In developing countries and emerging market economies, the evidence remains sparse. This paper exploits granularity of bank level data to disentangle bank lending in periods of global shocks and macroeconomic uncertainty in Zambia. Zambia's policy reforms and attainment of debt relief in 2006, coupled with sustained increase in copper prices, created macroeconomic stability after years of fiscal weakness and slow economic growth. Debt relief and the return to growth led to reduction in government borrowing from the domestic banking sector. Thus, faced with high liquidity and improved macroeconomic situation, banks increased lending to the private sector. However, the onset of the Global Financial Crisis (GFC) and resultant macroeconomic uncertainty and negative copper price shock heightened banks' risk aversion. Banks' risk-taking behaviour was similar at the height of COVID-19. This paper addresses two principal questions: (i) sources of macroeconomic uncertainty; and (ii) banks' lending in response to global shocks and macroeconomic and commodity price uncertainty. The study uses fixed effects approach to uncover the evidence with bank level quarterly data from 1998 – June 2022, covering a period of improved stability following Zambia's banking crisis of early to mid-1990s and two major global shocks – GFC and COVID-19. The results show that shocks and uncertainty increase banks' risk aversion and reduced lending and credit tightening was more pronounced both during the GFC and COVID-19. This result holds even after controlling for banks' size although during the pandemic, the severity of the effect was moderated by the central bank's COVID-19 stimulus package to bolster market liquidity. Furthermore, the results confirm the crowding out effect of government borrowing from the banking sector while monetary and other policy interventions mitigate the effect of uncertainty in the credit market. These findings have profound policy implications for the banking sector, and more generally, bank lending under conditions of increased uncertainty.

Keywords: Copper prices; Uncertainty; Bank lending; Monetary policy; COVID-19

[1] Corresponding author. Address: Nigeria Country Department, African Development Bank, Plot 1521, Cadastral Zone A0, Abuja, Nigeria. Email: a.simpasa@afdb.org. The study benefitted from comments received from the Research Forum discussions held with Bank of Zambia staff. The findings and opinions expressed in this paper are entirely those of the authors and do not in any way represent the views or position of the African Development Bank, its Board of Directors or the countries they represent. The authors remain responsible for all the errors and omissions.

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1.0 Introduction

The effect of global commodity price shocks and macroeconomic uncertainties have received credence in empirical literature with both having profound effects on bank lending and the real economy. The Asian banking crisis is a painful reminder of how uncertainty can erode credit extension (Azis and Thorbecke, 2002)[2]. Recent episodes of crises such as the Global Financial Crisis (GFC) of 2008 – 2009 and COVID-19[3] have had similar effects,[4] with dislocations in credit markets extending to the real economy. For instance, during the GFC, banks' lending dried up, creating credit frictions that spilled over to the real economy. Although the depth of credit crunch was more severe in advanced and emerging economies due to their increased integration into global financial markets, the transmission of the shocks in developing countries was largely experienced through commodity markets. While the GFC directly influenced banks through capital reduction, COVID-19 had confounding impact, beginning as a health shock and then morphing into an economic crisis of monumental proportion.

Given the prominent role banks play in facilitating financial transactions and risk transformation, the financial disruptions created by such shocks as the GFC and COVID-19 on the credit market can therefore be substantial, depending on the depth and severity of the crisis and the policy response to mitigate impact of such shocks on the economy and livelihoods. In economies solely dependent on a single commodity for both fiscal revenues and export receipts, the impact on government's budget and banks' balance sheets can be quite significant. For instance, a sharp fall in commodity prices triggered by such shocks reduces the ability of governments dependent on commodities to raise revenues for the budget. During the GFC and COVID-19, for instance, banks and other financial institutions exposed to resource sectors were saddled with growing non-performing loans due to lower commodity prices and heightened macroeconomic risk. In Zambia, credit to the mining sector fell disproportionately more than in other sectors of the economy. The impact of such shocks on overall economy are nonetheless not unique to commodity producing economies.

This paper examines the nexus between commodity and macroeconomic uncertainties and banks' lending with special focus on the GFC and COVID-19 pandemic, taking Zambia as a case study. Zambia presents a fertile test for this experiment as it has gone through several fiscal and monetary policy challenges following these shocks. The country's fiscal largesse and slow economic growth in the late 1990s to early 2000s pushed the country into a fiscal and debt crisis, which were only eased with ascension to the Highly Indebted Poor Countries

[2] The Asian Banking Crisis started in July 1997 up to 1998 with significant losses in the banking industry and economies of the affected countries. Mishkin (1999) explains that the crisis was caused by inadequacy of the regulatory and supervisory framework, and human capacity to mitigate rising lending risks which culminated into deterioration of balance sheets.

[3] According to the WHO (2020), the COVID-19 pandemic is a disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first reported on 31st December 2019 in Wuhan, China and later declared a global pandemic by the World Health Organization on 11th March 2020.

[4]The banking industry has faced multiple shocks across the globe: international debt crisis of 1982; Russian economic crisis of 1992-1997; Latin America debt crisis of 1994-2002; East Asian economic crisis of 1997-2001; global financial crisis of 2007-2009; and the COVID-19 of 2020 to date. In this paper we consider the global financial crisis and COVID-19 period as they had direct effect on the global economy and Zambia in particular.

(HIPC) initiative, culminating in the 2005 debt relief. The macroeconomic gains from the debt relief were quickly eroded during GFC as price of copper, Zambia's main source of foreign exchange, fell, stocking widespread uncertainty and banks' risk aversion. This pattern was replicated during COVID-19 pandemic as banks became reluctant to advance credit to the distressed private sector despite the Bank of Zambia's pandemic refinancing facility of K10 billion (equivalent to US$500 million).

Against the above background, the paper aims to address the following issues (i) investigate sources of macroeconomic uncertainty; (ii) assess how banks' lending behaviour changed during the GFC and COVID-19 in response to macroeconomic and commodity price uncertainty, and if there is heterogeneity in lending across different bank sizes. The paper builds on the theory of bank optimization behaviour along the works of Abel (1983). This theory characterises banks as profit maximising agents by choosing optimal factor inputs to produce a particular level of output consistent with their objective function.

By focussing on a commodity exporting developing country which has experienced multiple policy and non-policy shocks, the paper makes valuable contribution to the literature in three key areas. First, we consider the interplay between commodity price and macroeconomic uncertainties on one hand and banks' lending on the other, the two areas that have not been fully interrogated in the literature. This investigation offers insights that would help to enrich the existent literature on banks' lending behaviour under uncertainty. Second, we consider the effect of the GFC and COVID-19 pandemic in our empirical framework while accounting for bank size to assess if there is any differential effect of these factors on lending. While we acknowledge existence of several studies on GFC and COVID-19 in the banking industry, to our knowledge, this is the first study that examines the effect of uncertainties and the role of these global shocks to banking lending behaviour in a developing economy. Third, we experiment our analysis on Zambia, a developing country that possesses important attributes that makes our study viable. For example, copper is the main export earner accounting for over 60 percent of export revenue and the country has suffered debt distress periods in 1990-2004 leading to debt relief under the HIPC initiative. The analysis in this study will help shape policy interventions for bank sector in developing economies to mitigate the effects of commodity prices and macroeconomic uncertainties.

Foreshadowing the main findings, this study documents that commodity price shocks and macroeconomic uncertainty influence banks' lending in Zambia. In particular, lower commodity price uncertainty increases banks' lending while inflation and exchange rate uncertainty have a debilitating impact on credit growth. The findings are robust to exogenous shocks and policy intervention such as the GFC, the COVID-19 pandemic, the HIPC debt relief initiative and fall in copper price. Notably, Zambia's HIPC period is clearly distinguishable in reinforcing effect of macroeconomic stability on banks' lending. Furthermore, monetary and policy decisions such as establishment of credit reporting standards mitigate the effect of uncertainty in Zambia's credit market. Overall, the findings confirm the presence of the bank lending and exchange rate channels and Zambia's banking sector is sensitive to macroeconomic uncertainty and commodity price shocks.

The rest of the paper is organised as follows. Section 2 looks at stylised facts on commodity price shocks, macroeconomic performance, and banks' lending in Zambia. In section 3, we

provide a theoretical foundation on the interplay between uncertainty and the credit market. Section 4 is a summary of related theoretical and empirical literature while in section 5, we present the methodological framework for empirical testing of the relationship between uncertainty and banks' lending. Section 6 presents results and analysis, and section 7 concludes the paper with policy implications.

2.0 Macroeconomic Situation and Banking Sector Performance in Zambia

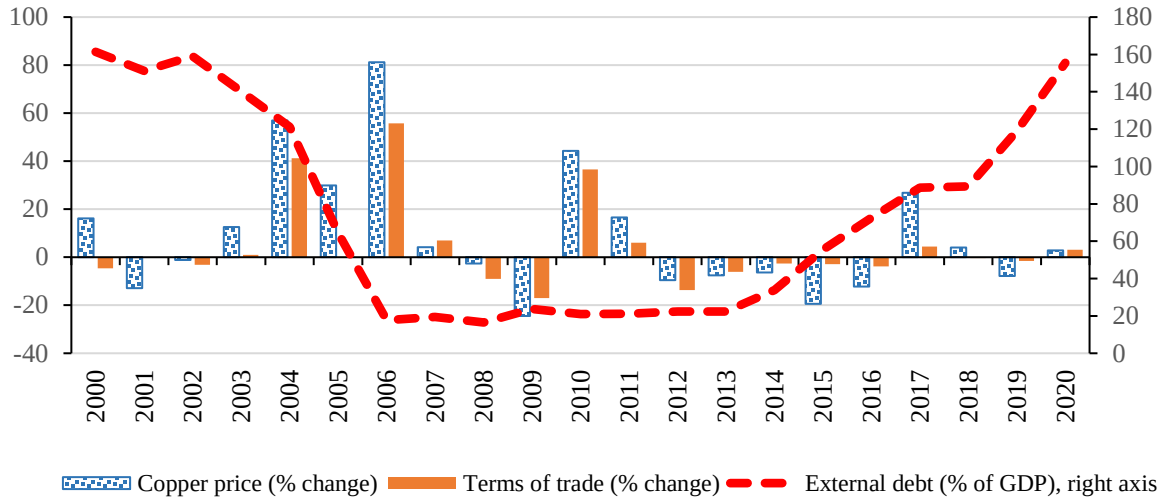
2.1 Economic Reforms, Macroeconomic Stability and Growth

Zambia's macroeconomic performance over the past three decades is deeply rooted in the reform agenda initiated in the early 1990s. The reforms entailed a marked shift from a regime of dirigiste policies towards reliance on market principles as the mainstay of Zambia's economic governance and resource allocation. The early dose of policy reforms took the broad form of liberalisation of all commodity and factor prices and removal of administrative controls on banks' setting of interest rates. Progressively, all incentives that advantaged a particular field of investment or sector were abolished and credit allocation was informed by risk-return considerations. Removal of administrative controls on banking operations was complemented by strengthening of the regulatory and supervisory framework to curb wanton risk taking and imprudent lending. Further, the central bank (Bank of Zambia) adopted indirect instruments of monetary policy to rein in inflation and ensure effective coordination with fiscal policy. In addition, Zambia adopted a managed float foreign exchange rate regime, which was further supported and reinforced by liberalisation of the capital account in 1994 which also paved way for full retention of export proceeds.

Against a background of a hyped reform agenda and international goodwill in delivering foreign aid in the early 1990s, Zambia rode a wave of fiscal consolidation, underpinned by implementation of the cash budget to curb fiscal profligacy and stem inflationary pressures. To strengthen effectiveness of monetary policy, the Bank of Zambia introduced open market operations and Treasury bills (TBs) auctions to manage liquidity and secure additional resources for the government's budget. Foreign exchange sales and purchases and core liquid assets and statutory reserve ratios were added to a menu of monetary policy instruments.

The reforms progressed unhindered in the early years, but momentum was lost in the second half of the decade. The government stepped off the reform pedal, and cash budgeting gave way to increased fiscal profligacy and weakness in institutional governance, completely erasing macroeconomic gains the reforms had ignited early on. By 1999, real per capita income was about 8 percent lower than its value in 1991. Lower government's commitment to the reform agenda governance concerns resulted in donors' withholding of their support. After peaking at US$2.3 billion in 1995, official development assistance (ODA) to Zambia declined precipitously to US$500 million (at constant 2015 US$) in 1998, the year of the country's weakest economic and governance record in the 1990s. In per capita terms, ODA

Figure 1: Copper price, terms of trade and external debt



Source: Bank of Zambia and Statistics Dept., AfDB

fell from US$223.2 to just US$35.3 over the same period. Although the economy grew by an average of 3.4 percent between 1995 and 1999, the macroeconomic situation was fast deteriorating. The loss in donor inflows coupled with fiscal profligacy led to growing internal and external account imbalances, which were compounded by the 1998 drought and falling copper prices. Inflation rose again, hitting 27 percent in 1999 after falling steadily to 24.4 percent the previous year, from a high of 61.9 percent in 1994 while exchange depreciation made external debt service more difficult, compounding external imbalances.

Although the main thrust of Zambia's market economic principles has broadly been maintained, there have been episodes of populist actions and fundamental policy mistakes. The economy also remains vulnerable to the vagaries of exogenous shocks. With more than 80 percent of exports coming from copper sales, the full retention of export proceeds means government competes with the market in the purchase of foreign exchange.

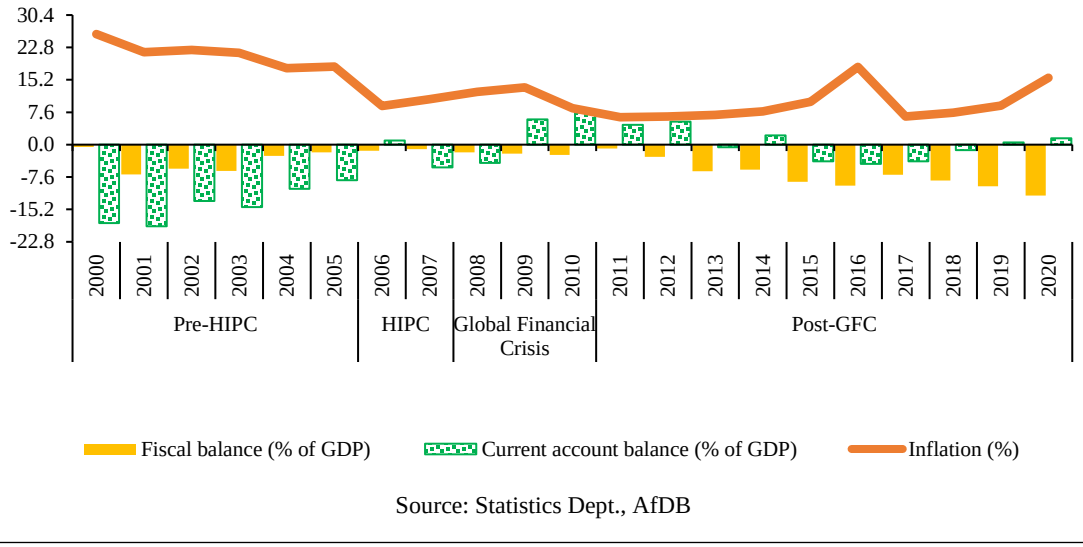
The dawn of the 21st century brought an aura of optimism for economic recovery and sustained growth, with the conclusion of privatisation of Zambia's remaining prized mining assets. This optimism was however short-lived. In 2002, Anglo-American Corporation (AAC) announced cessation of its operations in Zambia after nearly 100 years of copper mining in the country. Anglo's shock exit drew the government to a quick takeover, with obvious fiscal implications including stoking macroeconomic instability. Unbeknown to both AAC and the government however, copper prices recovered strongly, sustaining a rally for the ensuing four years. Between 2002 and 2006, the international price of copper rose by an average of 45 percent from US$1,670 per ton to US$6,940 per ton. This increase induced a positive terms of trade shock, averaging 24 percent over the same period (see Figure 1).

The surge in price of copper coincided with the resumption in foreign aid assistance, arguably in response to the new government's renewed commitment to reforms and resultant favourable economic policy environment. The reforms eventually led to Zambia's qualification for debt relief under the Heavily Indebted Poor Countries (HIPC) and

multilateral debt relief (MDR) initiatives. Foreign aid more than doubled in five years, rising steadily from US$570 million in 2001 to US$1,470 million in 2006. Debt relief reduced Zambia's public external debt from about US$7 billion (159.2 percent of GDP) in 2002 to less than US$1 billion (11.2 percent of GDP) in 2006. Gross international reserves improved from US$116.5 million (0.9 months of import cover) in 2001 to US$947.2 million (equivalent to 2.5 months of imports) in 2007.

Macroeconomic gains made in the period preceding the HIPC debt relief were consolidated with continued commitment to reforms, supported by high copper prices. Thus, from 2005 to 2009, Zambia enjoyed strong economic growth, averaging 7.5 percent. Buoyed by improved donor and private capital flows, coupled with expenditure restraint within the broader context of the HIPC and MDR initiative, Zambia's fiscal position improved with the deficit narrowing from 7 percent of GDP in 2001 to 1 percent in 2007 while the external current account narrowed further, reaching a surplus of 1 percent of GDP. Tight monetary policy curbed growth in bank credit and with the improvement in fiscal deficit, inflationary pressures eased. Inflation reached single digit average of 9.1 percent in 2006, for the first time in 20 years, having dipped to a low of 7.9 percent in October of that year (see Figure 2).

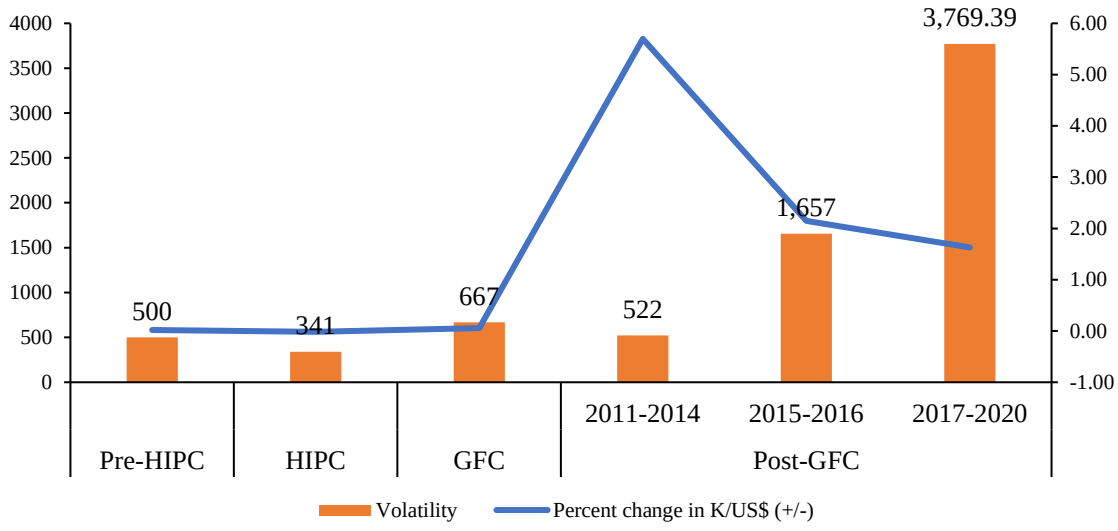
Figure 2: Zambia Key macroeconomic indicators, 2000-2020



Source: Statistics Dept., AfDB

The reduction in debt service payments coupled with higher foreign inflows led to exchange rate appreciation and lower volatility (see Figure 3). With lower debt service payments, government's borrowing requirements fell in tandem. Thus, the copper price boom did not only generate a large increase in foreign exchange earnings but also helped improve the internal macroeconomic situation.

Figure 3: Evolution of the exchange rate



Source: Computed from Bank of Zambia data

The onset of the 2008-2009 GFC triggered widespread risk aversion in international financial markets, leading to a global recession. Although the severity of the GFC was mostly felt in advanced and some emerging market and frontier economies, most developing countries dependent on commodity exports were equally affected. The impact of the crisis on primary commodity exports was nearly instantaneous and, in Zambia, reverberated on two fronts. As a net exporter, the fall in global demand for copper and attendant decline in price meant lower exports and weaker fiscal revenues. With reduced exports, supply of foreign exchange by the mines declined. Net foreign exchange supplies by mines declined progressively to US$250.7 million in the fourth quarter of 2008 from US $306.5 million, US $340.5 million and US $294.9 million in the third, second and first quarters, respectively. Over the first quarter of 2009, net supply by the mines was further down to US$182.6 million, underscoring the severity of the crisis on Zambia's key source of foreign exchange.

The fall in revenues led to widening of the fiscal deficit, which more than doubled to 2.4 percent of GDP in 2010 from 1 percent prior to the crisis in 2007. From April 2008, inflation breached the seven-month stretch of single digit, soaring to 16.6 percent in December 2008, before it ebbed gradually, returning to the pre-crisis level in 2010. The rise in inflation was reinforced by the pass-through effects of exchange rate depreciation. The deterioration in global economic environment and emerging political uncertainty surrounding the death of the reformist President Mwanawasa in August 2008 led to depreciation of the Kwacha, Zambia's currency. By end of 2008, local currency lost more than a quarter of its value year-on-year. With falling global demand for copper and shrinking private capital inflows, second order effects of exchange rate volatility were evident across all aspects of the Zambian economy. In Zambia, the exchange rate plays an important indexing role in price setting for most commodities and services.

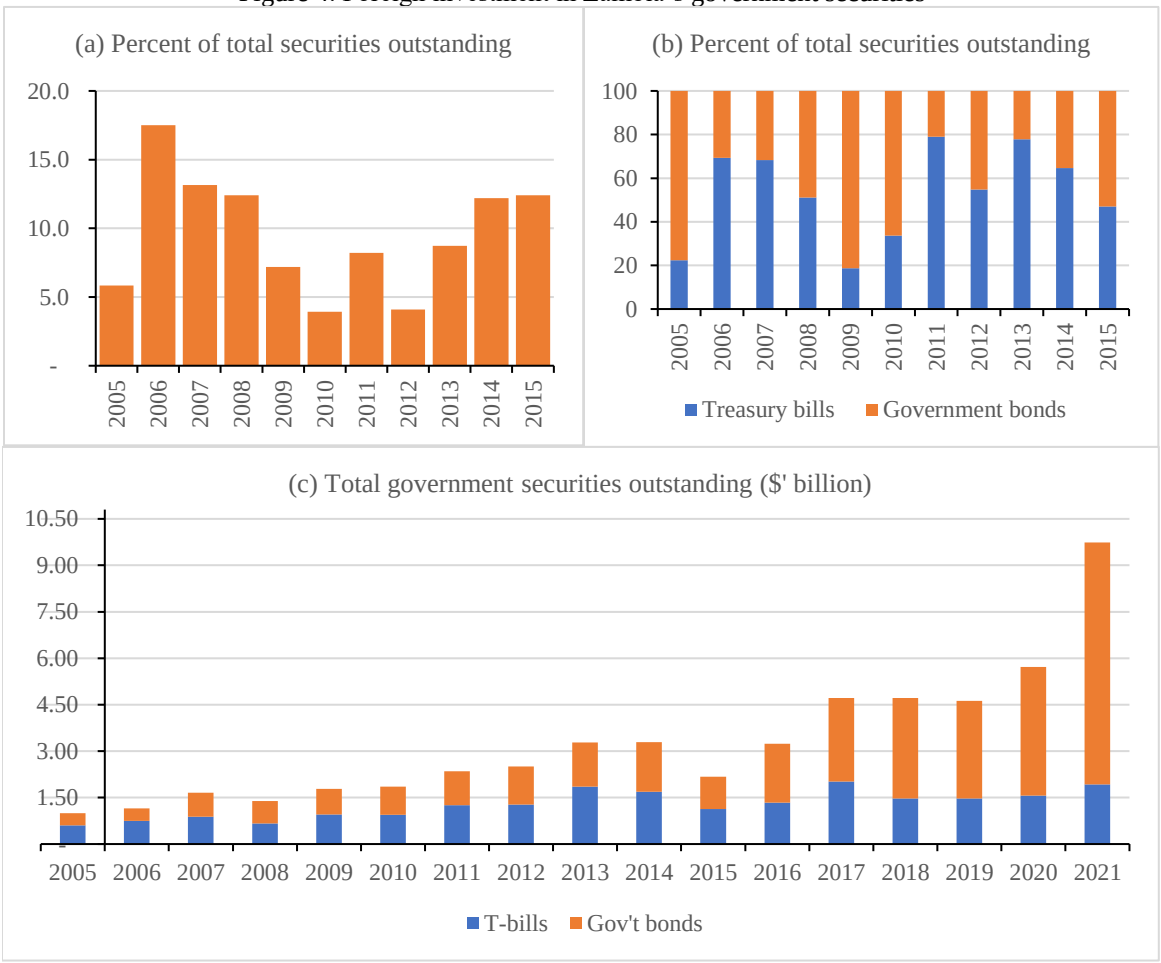
Zambia's economic recovery from the GFC took a cue from receding global risk aversion in 2010, thanks to improvements in investments and higher commodity prices induced by rebound in global demand. Real GDP grew by 10.3 percent, driven by agriculture, transport

and communication, construction, and mining sectors. Inflation rate returned to single digit (8.5 percent), compared to 13.5 percent in 2009. Increasing international copper prices coupled with strong macroeconomic fundamentals from 2010-2011 led to the lowering of exchange rate depreciation and volatility relative to the crisis period.

The economic recovery and macroeconomic gains made in the immediate post-GFC period could not however be sustained. The increase in international price of copper on fiscal revenues was offset by expansionary public infrastructure spending and the large public sector wage bill, both largely financed by an increase in domestic and external borrowing. From 2015, macroeconomic imbalances were further entrenched with the economy facing strong internal headwinds despite relatively favourable external conditions. From 2015 to 2019, real GDP growth slowed to 3.1 percent per annum from 7.1 percent in the preceding five years, mainly due to lower copper prices, decline in agricultural output and impact of hydro-electric power outages resulting from low rainfall. Crucially, government's insufficient policy adjustment to these exogenous shocks exacerbated macroeconomic instability with fiscal consolidation subordinated to debt accumulation. Zambia was back to procyclicality that has historically and repeatedly characterised policy making in the country.

The improvement in business climate in the immediate post-HIPC initiative period attracted investors into the domestic debt and equity market. In the domestic debt market, participation of non-residents increased from virtually nothing prior to 2005, to about 6 percent of total government securities in circulation and rose exponentially the following year, reaching 18 percent (Figure 4). Non-resident's investment in domestic debt market was in response to policy reforms precedent to the HIPC initiative, and their overall long-term assessment of Zambia's favourable macroeconomic situation. However, over the next two years (2007-2008), non-resident holdings of government securities declined, and with the onset of the GFC, their investments fell further to 4 percent in 2010. Investment rebounded, doubling in 2011, buoyed by Zambia's graduation from a low income to lower middle-income country. However, deterioration of macroeconomic situation beginning 2012 eroded the marginal gains made in 2010-2011. From 2012, government's interventionist policies which led to expansionary fiscal policy, fuelled increased borrowing, thereby creating growing uncertainty on the path the economy was taking. Thus, non-resident holding of government securities from 2013-2015 was barely at the same level as in 2006.

Figure 4: Foreign investment in Zambia's government securities



Source: Computed from Bank of Zambia data

The issuance of three Eurobonds amounting to US$3 billion - debut issue of US$750 million in 2012 and two more issuances in 2014 and 2015 for US$1 billion and US$1.25 billion, respectively, was followed by a spiralling of external commercial public debt. As of June 2021, total public external debt stood at US$16.9 billion with commercial borrowing contributing US$6.23 billion (37 percent), including US$3.1 billion non-bonded debt (GRZ, 2021). The first Eurobond was due for redemption in 2022, but Zambia already defaulted on coupon payments, the first one (US$42.5 million) in November 2020, which further exacerbated the already fragile macroeconomic situation. This triggered a downgrade from CC to restricted default by Fitch Ratings. The S and P Global Rating had already downgraded the country to selective default from the equivalent rating due to Government's reneging on its commitment to make debt service payments. In 2021, Zambia's public external debt to GDP ratio stood at about 76 percent of GDP, higher than the recommended sustainability threshold by the International Monetary Fund (IMF).

As the economy slid into slower growth and revenues declined and constraints on access to concessional external financing grew further, the government resorted to high borrowing from the domestic financial sector. During 2005-2008 (HIPC and immediate post-HIPC era),

annual treasury bills and government bonds outstanding averaged US$0.7 billion and US$0.6 billion, respectively. During the GFC, the government increased its tender size for government securities and by 2010, outstanding securities amounted to US$1 billion for each asset class. Further, deterioration in macroeconomic conditions from 2016 escalated government debt accumulation. Thus, from 2016 to 2019, domestic debt rose by about a quarter to US$5.7 billion. Within few months, domestic public debt had shot by 70 percent to about US$10 billion by June 2021, largely due to a near doubling of government bonds outstanding. The increase stemmed from two factors – floating of ZMW2.7 billion (equivalent to about US$146 million) of the COVID-19 bond and accumulation of additional resources, presumably to meet spending needs for the 2021 general elections and payment to contractors to fund uncompleted infrastructure projects.

At the onset of the COVID-19 pandemic, Zambia's fiscal and public debt situation was already precarious. The 2019 joint IMF/World Bank debt sustainability analysis had classified Zambia as being at high risk of debt distress (World Bank and IMF, 2019). The default on Eurobond effectively drove the country in a situation of debt distress. Rapid depreciation of the local currency and lax fiscal policy amplified inflationary pressures with annual inflation reaching 16 percent in 2020, offsetting impact of tight monetary policy. The external account position however benefited from soaring copper prices, which rose steadily as fears of a deepening pandemic gradually eased in mid-2020 before the outbreak of the new virus variants stoked renewed fears. By the end of 2020, copper was trading 25 percent higher than at the beginning of the year. However, Zambia's severe debt situation has completely overshadowed any positives from higher copper prices. Rather than appreciate on a cue from stronger copper inflows, the lingering effects of default and failure by government to strike a deal with Eurobond creditors, cast a dark shadow on the country's economy.

2.2 Banking Sector Performance and Lending in Zambia

Over the past two decades, the Zambian banking sector has generally been stable, which bodes well for investment in the sector and the economy more broadly. In 2000, there were 13 banks operating in Zambia. This number comprised 6 domestic (including government owned), 6 foreign owned and one hybrid between the Zambian and foreign government equity interests. The entry of new banks between 2000 and 2010 brought the total to 18 and the number remained unchanged in 2021 because of the acquisition of a local bank by foreign equity interest. Of the 18 banks, only 5 were locally owned while 13 were majority foreign owned. The sector also comprised four large and 14 small banks, measured in terms of assets.

The share of the four largest banks in total industry assets stood at 75.6 percent in 2000 depicting their market dominance (see Table 1). Concentration ratio fell to 63.1 percent in 2010 as the number of banks increased, with new entrants capturing part of the market share. The concentration ratio declined steadily over the next decade to 53.5 percent in 2019. The fall in share of four largest banks in total assets underscores growing contestability for market dominance. Simpasa (2013) posits that the increase in foreign bank presence and privatisation in 2008 of the majority government owned (and one of the large banks) heightened competitive pressures in the Zambian banking industry. Crucially, one bank

which was ranked fourth in 2000, emerged as the largest, relegating the previously top ranked bank to third position.

Table 1 also shows that traditional intermediation activities (loans) account for about 40 percent of total banking industry assets but has declined from 2010 peak of 55 percent. However, loans generate the bulk of interest income, averaging more than 70 percent except in 2019 when loans generated just 54 percent of interest income. The decline was mainly to observed slump in credit as shown by decline in share of loans to total assets for that period.[5] Credit to the private sector remains the largest component of banks' lending however, although it has declined since 2000 except in 2016 when it rose to 64 percent from 58 percent the preceding year. In 2019, a little over half of banks' credit was to private sector non-financial firms while lending to households accounted for about 30 percent.

Table 1: Banking sector indicators, end-period

		2000	2005	2010	2015	2019[a]
(i)	Share of assets of four largest banks (percent of total assets)	75.6	70.2	63.1	57.1	53.5
(ii)	Investments (percent of total assets)					
	Loans	40.8	31.4	54.8	40.2	38.0
	Government securities	12.1	24.5	27.8	12.8	21.9
(ii)	Source of interest income (percent share)[a]					
	Loans	72.7	60.8	70.9	75.3	54.2
	Government securities	27.3	39.2	29.1	24.7	45.8
(iii)	Lending by borrower (percent share)					
	Private sector	80.0	73.7	58.0	64.1	55.3
	Individuals and households	12.3	19.6	32.2	30.1	29.2
	Central government	0.4	0.1	3.2	1.8	0.3
	Others	7.3	6.6	6.6	3.9	15.2

Source: Computed using data from Bank of Zambia
Notes:\[a] Data for December of each year.

Only 0.3 percent was direct lending to the central government although the figure excludes investment in government securities, treated differently on the banks' balance sheet and for regulatory purposes. Government securities accounted for about 22 percent of total banks' assets in 2019, an increase from 12.1 percent in 2000 and 13 percent in 2015 after an increase in 2010. The shift in investment from loans to government securities reflected banks' flight to safety due to deterioration in macroeconomic conditions from 2016 onwards, which made lending to the private sector unattractive and increasingly risky. Between 2016 and 2019, the average ratio of non-performing loans to gross loans stood at 11.5 percent, compared with 7.3 percent recorded from 2008-2015, even after factoring in impact of the global financial crisis.

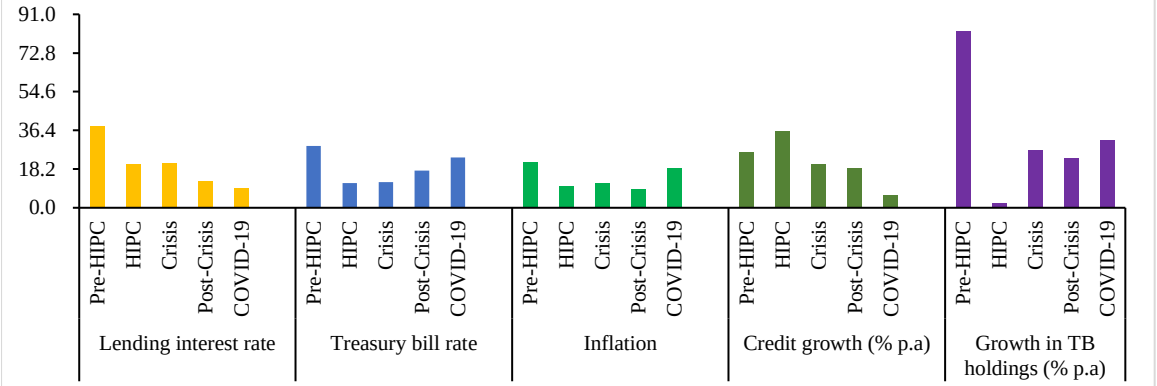
Although lending interest rates have declined since 2000, the corresponding increase in yield rates on government securities due to higher domestic borrowing led to crowding out of the private sector as shown by lower credit growth. The fall in domestic credit was especially high for households and individuals, which had previously enjoyed a one-shock

[5] It is important to note that credit captures total lending, for example, both local and foreign currency loans. Foreign currency loans are converted at source using the prevailing exchange rate, mainly the US dollar.

strong growth in 2008 in the aftermath of the HIPC debt relief in 2006 and prior to deepening of the global financial crisis.

Lending to households was mainly in form of payday loans, as low and stable inflation and reduced exchange rate volatility improved banks' risk profiling of salaried workers. Previously, this category of the credit market was redlined by commercial banks, and largely resorted to high interest rate bearing loans from non-bank financial institutions and

Figure 5: Average interest rates, inflation and banks' lending



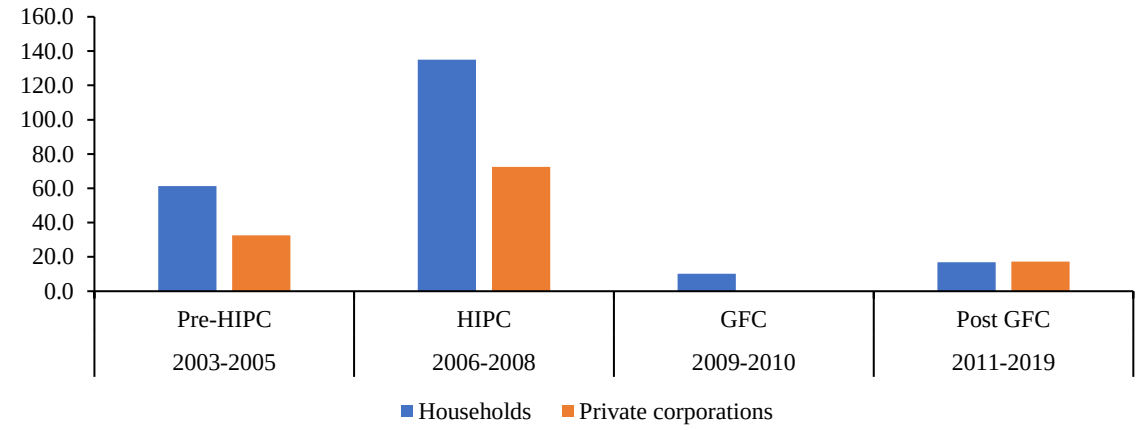
Source: Bank of Zambia (fortnightly statistics)

informal lenders such as the infamous shylocks. In contrast, domestic credit to the public sector halved during the same period due to lower lending to government. As banks' credit conditions tightened in response to the global financial crisis and further weakening of macroeconomic conditions beginning from 2016, credit growth slowed down overall.

Prior to the global financial crisis, donor inflows augmented the build-up in banking system's liquidity, stoked by government's reduced borrowing in view of the HIPC financial gains. Banks' liquid reserves rose from 23 percent of total assets in 2001 to about 40 percent in 2005. Correspondingly, banks' claims on the central government declined from 53 percent of GDP in 2000 to 12 percent in 2005 and by 2007, the ratio was only 3 percent of GDP. Higher banking system liquidity led to reduction in base lending interest rates (see Figure 5). With government's domestic borrowing reduced and interest rates fallen, banks' credit to the private sector more than doubled and quadrupled for private corporations and households, respectively (see Figure 6). As noted previously, foreign portfolio inflows into government securities and the capital market increased prior to the GFC. As the crisis deepened however, these inflows quickly evaporated as foreign investors sought safe havens in more liquid emerging market assets. Rising risk aversion at the height of the crisis stoked an increase in the cost of credit with the banks' average base lending rate increasing to as high as 23.3 percent in November 2009 from 18.3 percent at the onset of the crisis in July 2008.

In 2010, the global economy started recovering from the financial crisis, thanks to improvements in investments and higher commodity prices induced by increasing demand.

Figure 6: Growth in banks' credit (percent per annum)



Source: Computed using data from Bank of Zambia Fortnightly Statistics

The Zambian economy also started to recover, buoyed by investor confidence and relative improvement in macroeconomic conditions aided by high copper prices and receding exchange rate volatility. Increasing international copper prices coupled with strong macroeconomic fundamentals strengthened the Kwacha, which appreciated by 4.7 percent against the dollar. Consequently, commercial banks' interest rates decreased in 2010. The weighted average lending base rate fell to 20.9 percent from 22.1 percent the previous year. Subsequently, commercial banks' loans and advances grew substantially from 2011 but the reversal in economic fortunes beginning 2016 impacted on banks' lending to the private sector.

2.3 COVID-19 Pandemic and Bank Lending in Zambia

The boom-bust episodes in Zambia's macroeconomic conditions impose short-term adverse effects and affect banks' performance. Short periods of economic upturns are punctuated by prolonged periods of downturns. The cyclicality in economic conditions often translates into persistent weakness in banks' earnings and asset quality. Thus, the COVID-19 crisis confronted Zambian banks when the economy was experiencing prolonged weak macroeconomic situation underpinned by laxity in fiscal adjustment and growing debt burden. This affected performance in the banking sector. Although growth in banks' credit was not significantly impacted, asset quality was severely impaired. In 2020, the ratio of gross non-performing loans to total loans rose to 11.6 percent from 9.8 percent the previous year. This figure was above the 10 percent regulatory threshold (BoZ, 2021). The impact of weak asset quality on earnings was however mitigated by improved interest income from government securities as the deepening COVID-19 crisis bid up yield rates to near pre-HIPC levels. This helped keep the return on assets in positive territory at 2.1 percent albeit lower than the average of 3.1 percent posted in the two years preceding the pandemic and in real terms, the returns were negative due to high inflation.

3.0 Literature Review

The section reviews both theoretical and empirical literature in relation to commodity and macroeconomic uncertainty and bank lending. The theoretical literature offers the hypothesis linking macroeconomic uncertainty to bank lending, while empirical literature, provides evidence on the uncertainty – bank lending nexus.

3.1 Theoretical Underpinnings

The theoretical underpinning of macroeconomic uncertainty and bank lending nexus is based on (i) the Friedman hypothesis, (ii) inflation uncertainty and inflation and (iii) effect of output uncertainty on inflation and economic growth. First, Friedman (1977) proffers the real effects of inflation built on two parts. In part one, the Friedman hypothesis posits that an increase in inflation will influence an unpredictable policy by monetary authorities thereby exacerbating uncertainty of future expected inflation. Part two of Friedman's hypothesis argues that the increasing inflation distorts the efficacy of price mechanism in allocating resources efficiently and thus resulting in negative output. Indeed, Friedman's work highlights the influence of inflation on welfare in society. Second, the cash-in-advance model proposed by Dotsey and Sarte (2000) elucidates the behaviour of households in presence of uncertainty. Their hypothesis presumes that an increase in uncertainty induces precautionary and risk aversion behaviour among households. The authors argue that an expansionary monetary policy induces inflation and thus, increasing uncertainty on the return to monetary balances resulting in fall in the demand for money balances and consumption. In the end, the increased precautionary savings lead to a pool of funds available to finance investment projects.

The theoretical framework of macroeconomic uncertainty has also been built around the effect of inflation uncertainty on average inflation rate. The Cukierman and Meltzer (1986) hypothesis argues that policy makers applies expansionary monetary policy to surprise the agents and enjoy output gains. The authors' framework follows the Barro-Gordon setup and predicts positive causality from inflation uncertainty to inflation. In the same vein, Devereux (1989) extends on Barro-Gordon model by focusing on the effect of exogeneous real output uncertainty on the degree of wedge indexation and optimal inflation. The author argues that increased uncertainty scales down the optimal amount of wedge indexation that motivates policymakers to induce inflationary pressure to achieve favourable real effects.

Lastly, it has been postulated that macroeconomic uncertainty is based on output uncertainty. It is believed that output variability and output growth manifest independence characteristics. In this regard, output variation may be triggered by price misperceptions in reaction to a monetary shock. In addition, changes in levels of output could be due to increased usage of other factors including technology. Keynes (1936) argues that entrepreneurs consider economic fluctuations in their investments. Therefore, higher output fluctuations result in lower investment, as investors discern the higher risk embedded in the investment projects. Furthermore, Black (1987) posits that there is a positive impact of output fluctuations on output growth as investment in high risk projects will be undertaken when the expected returns are high.

The theoretical underpinnings of commodity price and exchange rate pass-through effect provide a firm foundation for the relationship of the two variables. First, changes in

commodity prices lead to changes in exchange rate. For Zambia, a small open economy that heavily depends on copper exports, an increase in international price of copper elevates the demand for domestic currency resulting in appreciation of the currency (Rossi (2013) and Zhang et al. (2016)). Second, the theory postulates that exchange rates are determined by the net present value of commodities like copper. Thus, the causal effect emanates from commodity price to exchange rate.

3.2 Empirical Evidence

This section presents empirical work based on two strands of literature (i) macroeconomic uncertainty and bank lending behaviour, and (ii) financial crisis or shocks and bank lending behaviour. The first strand focuses on studies that elucidate the relationship between macroeconomic uncertainty and bank lending. Calmes and Théoret (2014) examine banks' systemic risk and macroeconomic uncertainty in Canada and the United States (US) during 1997-2011. They compute an index of macroeconomic risk using loan to asset ratio while uncertainty is derived using non-interest income. Their findings show that risk and uncertainty reduce during periods of low economic growth and financial crisis. Using a GARCH framework, Talavera et al. (2012) examine bank lending behaviour and macroeconomic instability in Ukraine for the period 2003-2008. They generate the conditional variance for macroeconomic uncertainty based on monetary aggregates and consumer and producer price indices. The findings show that banks reduce lending with increased macroeconomic uncertainty. However, the findings are heterogeneous based on bank size with small banks seen to be less affected by macroeconomic uncertainty compared to their large counterparts.

Baum et al. (2006) investigate whether macroeconomic volatility affects the efficacy of non-financial firms' liquid asset allocations. They construct proxies for macroeconomic volatility using conditional variance of real gross domestic product (GDP), index of industrial production, consumer price index (CPI) inflation and returns of the S and P stock index. Using an IV-GMM framework, the authors establish that during periods of uncertainty, there is inefficient allocation of liquid assets. Baum et al. (2009) reach similar findings in a sample of US banks in examining the effect of macroeconomic uncertainty on loan allocation for the period 1979Q1-2003Q3. Using conditional variance of industrial productivity and CPI inflation as a proxy for macroeconomic uncertainty and loan to asset ratio to measure cross-sectional dispersion, the authors find that increased macroeconomic uncertainty reduces loan to asset ratios among banks. Bordo et al. (2016) corroborate these findings, noting that policy uncertainty negatively influences bank credit growth in the US.

Quagliariello (2009) examines banks' allocation of loans during periods of macroeconomic uncertainty in Italy during 1990Q1-2005Q1. Using GARCH method to determine macroeconomic uncertainty for variance of non-performing loans (idiosyncratic uncertainty), inflation, industrial productivity growth and all share index as proxies of macroeconomic uncertainty and variance of loan to asset ratio. The results are consistent with other studies, suggesting that macroeconomic uncertainty reduces the banks investment portfolio and influences the investment behaviour of Italian banks. In addition, during periods of uncertainty, the banks' forecast ability is deterred.

Furthermore, several empirical works have been undertaken on the role of bank behaviour and the economy. Rhoades and Güner (2003) investigate the occurrence of a credit crunch in Turkey and whether the effect was demand or supply side driven. The authors utilize unanticipated inflation as a proxy of economic uncertainty while political uncertainty is proxied by coalition and duration (number of days the government has been in power by the last day of the month). The authors use monthly data for the period January 1986 - March 2000 in a system of equations model. The findings show that economic uncertainty negatively influences demand and supply of loans, and the credit crunch is driven by supply side factors. On the other hand, Ibrahim and Shah (2012) investigate how macroeconomic uncertainty and financial uncertainty affect bank lending in Malaysia, using a variety of econometric modelling techniques applied to quarterly data from 1991Q1 to 2011Q2. The authors use stock market index return as a proxy of financial uncertainty. The findings show the presence of a positive correlation between real bank credit and stock market price with real output. However, macroeconomic uncertainty is negatively correlated with real output and thus suppresses credit growth and stock market prices.

The second strand of literature provides empirical evidence on the financial crisis and bank lending behaviour. Swamy (2012) investigates bank lending behaviour in India during periods of financial crisis using weekly data for the period December 2006 – March 2011. The author use Johansen cointegration technique in the analytical work and the results show a negative relationship between financial crisis and credit growth. Ivashina and Scharfstein (2010) examines the effect of bank run on lending during the global financial crisis. Using system-GMM on monthly data, they find simultaneous run by borrowers that reduced banks' deposits which led to high commercial and industrial loans reporting in banks' balance sheets. The authors also find that banks reduced their lending during the global financial crisis. Relatedly, Albertazzi and Bottero (2014) investigate the lending behaviour of domestic and foreign banks during the global financial crisis period. They utilize quarterly data for the period 2006Q4-2010Q4 in a fixed effect framework and found that foreign banks restricted credit supply compared to local banks. This result is consistent with Wu et al. (2021) which showed that foreign banks tend to restrict lending in periods of heightened uncertainty.

Košak et al. (2015) examines the bank lending behaviour during the global financial crisis period by considering the role of bank capital. They consider both developed, emerging and developing countries in a panel model data setup for the period 2000-2010. They find that a higher quality of Tier 1 bank capital and government regulatory support enhanced lending during the crisis period. However, the effect was heterogeneous among groups of countries and regions, with banks' lending in member countries of the Organisation for Economic Cooperation and Development (OECD) and the BRICS benefitting from high capital buffers and policy support. In addition, they find that Tier 2 capital was not effective to mitigate the effects of the financial crisis. Kapan and Minoiu (2018) examine the relationship of bank stability and transmission of financial shocks to the real economy in 48 advanced and emerging economies. They use quarterly data for the period 2006Q1-2010Q1 in a fixed effect panel model framework. The findings show that banks with a strong balance sheet were able to continue with credit supply during the crisis period. They also find that bank recapitalisation significantly restored stability in the banking sector during the same period.

Empirical studies have been done to evaluate effect of COVID-19 on the banking sector. Dermirguc-Kunt et al., (2021) investigates the effect of financial sector policy announcements on banks' stocks for 52 countries during COVID-19 period. The findings show that liquidity support and expansionary monetary policy mitigated the negative effect of COVID-19. Colak and Oztekin (2021) examines the impact of COVID-19 on banks' lending in 125 countries using a difference-in-difference model. The finding shows that COVID-19 has negatively affected banks' lending, and this was exacerbated by infection rates, regulatory and institutional framework and market structure. Elnahass et al., (2021) examine the impact of COVID-19 on banks' lending stability for 116 countries using quarterly data from 2019 to 2020. The findings show that COVID-19 led to a decline in bank performance, increased default and liquidity risk. The findings remain heterogeneous across regions and banks.

At country level, Barua and Barua (2022) examine the effect of COVID-19 on banks' lending in Bangladesh. The findings show that all banks experienced a reduction in capital adequacy, risk weighted asset values and interest income and large banks were more vulnerable compared to small banks. Long et al. (2022) examines the impact of COVID-19 on the banking sector and the economy using monthly data from January 2020 – June 2021 in a fixed effect model. The findings show that COVID-19 increased inflation and monetary policy in South Korea although central bank's activism reduced the negative impact of the pandemic on inflation. Elnahass et al. (2021) examines the impact of COVID-19 on bank stability among 1,090 banks in 116 countries using quarterly data from 2019 to 2020. Using a panel framework, they find that COVID-19 negatively affected bank stability and performance. Along the same line, Ghosh and Saima (2021) examine the sustainability and resilience of Bangladesh banks during COVID-19 in a multiple-criteria-decision-making model. They find heterogeneous results as banks with low capital and high non-performing loans are susceptible to pandemic shocks.

Nguyen et al. (2022) examines the impact of monetary policy on bank performance during COVID-19 among the Vietnamese banks in a system GMM framework. Using quarterly data, they find that monetary policy influenced bank performance during the pandemic period. Further, the findings show reduced efficacy of monetary policy in small banks compared to large banks due to negative effects of COVID-19.

Table 2. Previous research on macroeconomic uncertainty and bank lending

Author(s)	Objective	Period	Focus	Measure of MU	Model	Findings
Quagliariello (2009)	The paper investigates the role of MU on banks' decision on optimal asset allocation.	Quarterly data from 1990Q1 to 2005Q1	Italian banks	Conditional variance for both Industrial productivity and Inflation	Instrumental Variable (IV)	MU influences the banks investment decisions. Periods of crisis results to clustering behaviour.
Baum *et al.* (2013)	The paper examines the effect of monetary policy and financial sector uncertainty of banks' lending behaviour.	Quarterly data from 1986Q1 to 2000Q4	US banks	Conditional variance for interest rates, rate of total loans and Commercial and Industrial (Cand I) loans	Kashyap and Stein model	Financial uncertainty in monetary policy transmission.
Baum *et al.* (2009)	The paper examines the effect of MU on bank lending.	Quarterly data for the period 1979Q1-2003Q3	All US banks	Consumer Price Index and Industrial Production Index	IV-GMM	MU distorts loan allocation and a doubling of MU results to between 6 – 10 percent loan allocation distortion.
Calmes and Théoret (2014)	The paper investigates the banks behaviour on macroeconomic risk and uncertainty.	Quarterly data, varies from 1997Q1 to 2011Q4	Canada and US	Macroeconomic Risk and MU variables includes first and second moments, respectively. The variables include loan to asset ratio, share of non-interest income, GDP growth, output gap, inflation.	EGARCH	Banks exhibit homogeneous behaviour in presence of MU. This behaviour also manifests during financial crisis period.
Talavera *et al.* (2012)	The paper examines the MU and bank lending behaviour.	Quarterly data for the period 2003Q2-2008Q2	Ukraine	Conditional variances from GARCH model for variables: monetary aggregates M1 and M2, demand deposits, time deposits, consumer price index and producer price index.	System-GMM	Risk averse behaviour in banks manifests during periods of uncertainty. Large banks are more affected by uncertainty compared to small banks.
Bordo *et al.* (2016)	The paper investigates the effect of economic policy uncertainty on bank credit growth and the effect	Quarterly data for the period 1961Q2-2014Q3	US	EPU Index based on (i) historical newspaper index, (ii) overall EPU	System-GMM, VAR's and	Policy uncertainty negatively affects credit growth.

	of uncertainty on bank lending behaviour.			index (EPU1985) and (iii) finance uncertainty (EPUFin)	Diffusion Index (DI)	Capital-to-asset ratio and bank liquidity-asset influence policy uncertainty. Positive long run correlation between real output and real bank credit as well as real stock market prices.
Ibrahim and Shah (2012)	The paper examines the bank lending and macroeconomic as well as financial uncertainty nexus.	Quarterly data for the period 1991Q1-2011Q2	Malaysia	Financial Uncertainty are represented by stock market index returns.	VAR and VECM	MU is negatively correlated with output and thus depresses real credit and real stock prices.
Rhoades and Güner (2003)	The paper examines the occurrence of credit crunch. It also determines whether the credit crunch was demand or supply side.	Monthly data for the period January 1986 - March 2000.	Turkey	Economic uncertainty proxied by unanticipated inflation while coalitions and durations represent Political Uncertainty[1].	SEM	Economic Uncertainty negatively affects the demand and supply of loans. Supply-side influenced credit crunch.
Swamy and Sreejesh (2012)	The paper examines bank lending behaviour during periods of financial instability.	Weekly data for the period Dec. 2006-March 2011	India		Johansen Cointegration	During financial crisis period bank credit is negatively correlated with financial crisis.

Note: Authors compilation. Abbreviations: US – United States, MU – Macroeconomic Uncertainty, EPU – Economic Policy Uncertainty, System of Equations Model.
[1]Coalition is a dummy variable with value 1 if the government in power is a coalition and zero otherwise, duration refers to the number of days the government has been in power by the last day of the month.

4.0 Model Specification, Methodology and Data Description

4.1 The Model

This section proffers a model that builds on bank optimization problem that constitutes the firms' investment behaviour modelled along the works of Abel (1983) with the assumption that firms operate in a perfectly competitive environment. The modelling framework in this paper follows the monopolistic competition which remains prevalent in banking industry of developing economies. For Africa, this characteristic prevails as banks exhibit monopolistic competition (Fosu, 2012) and in Zambia, Simpasa (2013) finds that banks earn their income under conditions on monopolistic competition. We follow banks' optimization problem in line with Talavera et al. (2012). As such, banks' present value equals the expected discounted flow of profits as follows:

$$f(L_{it}, C_{it-1}) = max \sum_{t=1}^{\infty} \frac{1}{1+\beta} E_{it-1}[\pi_{it}] \qquad 1.1$$

where β denotes the discount factor, π refers to the banks' expected stream of profits, while L_{it} and C_{it-1} denotes labour hired and amount borrowed by the bank for onward lending (intermediation role), respectively[6]. The time and bank effects are represented by t and i, respectively. Moreover, the bank hires labour at a cost ω and borrows money at interest r^c which it offers as credit with interest rates r_t^b in a perfectly elastic loan market. To offer financial credit B_{it} the bank will incur costs of labour and borrow money C_{it-1} in perfectly inelastic market. The model framework entail rising convex costs obtained due to borrowing modification. The cost adjustment function is represented by constant elasticity, $\gamma > 1$. Therefore, the profit function of banks is a function of revenues from financial credit advanced less operational costs given as follows:

$$\pi_{it} = r_t^b B_t - \omega_t L_{it} - r^c C_{it}^{\gamma} \qquad 1.2.$$

In the banking industry, the provision of loans follows a simple Cobb-Douglas production function outlined below:

$$B_t = L_{it}^{\alpha} C_{it-1}^{1-\alpha} \qquad 1.3$$

where α is the output elasticity of labour that ranges between zero and one. The interest rates in the credit market are determined by the equilibrium between loan demand and loan supply given as $B_t^d = B_t^s = \vartheta B_t$, where ϑ denotes the set of identical banks. While Abel (1983) framework approaches this problem and treats uncertainty as emanating from the demand side, our model assumes the supply of credit is the main source of uncertainty as shown in Eqn. 1.4 below. Banks supply loans, but also face uncertainty. An individual bank's loan supply function is downward sloping as represented by:

[6] For detailed derivation of the equations used in the theoretical framework see Appendix A1. As noted earlier, the theoretical framework of bank optimization borrows from Abel (1983) and Hahm (1996) with derivation adopted from Talavera et al. (2012).

$$r_t^b = (B_t^s)^{1/\varepsilon}\theta_t \quad 1.4$$

where ε is the elasticity of supply that oscillates between zero (0) and infinity and θ_t is the stochastic shift variable that shifts with change in credit supply. A random walk behavior in θ_t denotes uncertainty in the supply of credit and can be modelled as follows:

$$log\theta_t - log\theta_t \sim N\left({\sigma^2}/{2}, \sigma^2\right) \quad 1.5$$

Increase in financial credit in presence of elasticity of supply and the stochastic shifting variable in Eqn. 1.1. shifts the supply curve to the right. To model the uncertainty in loan supply market, a geometric random walk process for the shift parameter is given in Eqn. 1.5. Taking first order conditions for Eq. 1.1 with respect to L_{it} and C_{it-1} results in the following formulations:

$$ar_t^b L_{it}^{\alpha-1} C_{it-1}^{1-\alpha} - \omega = 0 \quad 1.6$$

$$\frac{1}{1+\beta} E_t[(1-\alpha) r_{t-1}^b L_{t+1}^{\alpha} C_t^{-\alpha}] - \gamma r^c C_t^{\gamma-1} \quad 1.7$$

Plugging Eqns. 1.6 and 1.3 into Eqn. 1.4 yields the following loan interest rate:

$$r_t^b = \{(nC_{t-1})^{1/\varepsilon} (\frac{\overline{\omega}}{\alpha})^{\alpha/(1-\alpha)\varepsilon} \theta_t\}^{1/[1+(\frac{\alpha}{(1-\alpha)\varepsilon}]} \quad 1.8$$

Optimal borrowing in presence of the stochastic shifting variable yields the following:

$$C_t = \{\frac{1}{\rho r^c} \frac{1-\alpha}{1+\beta} (\frac{\alpha}{\overline{\omega}})^{\alpha(\varepsilon-1)k} (\frac{1}{k})^k \theta_t^{\varepsilon k} e^{\left(\frac{1}{2}\right)\varepsilon k(\varepsilon k-1)\sigma^2}]^{1/(k+\rho-1)} \quad 1.9$$

Further modification by insertion of Eqn. 1.9 and interest rate at equilibrium Eqn. 1.8 into Eqn. 1.3 yields the following:

$$B_{t+1} = (C_t)^{1-\alpha k} (\frac{1}{n})^{\alpha k} (\frac{\alpha}{\overline{\omega}})^{\frac{\alpha(1-\alpha k)}{1-\alpha}} \theta_{t+1}^{\alpha\varepsilon k} \quad 1.10$$

We modify Eqn. 1.5 to yield an expression that denotes the effect of uncertainty on bank loans given as follows:

$$B_{t+1} = (\frac{1-\alpha}{\gamma r^c (1+\beta)})^{\frac{1-\alpha k}{z}} ({1}/{n})^{\frac{k[(1-\alpha k)+\alpha z]}{z}} ({\alpha}/{\overline{w}})^{\frac{\alpha(1-\alpha k)[k(1-\alpha)(\varepsilon-1)+z]}{(1-\alpha)z}} \times \theta_t^{\frac{\varepsilon k[1+\alpha(z-k)]}{z}} e^{(1/2)\sigma^2[(\varepsilon k-1)/z+\alpha(\alpha\varepsilon k-1)]} \quad 1.11$$

Therefore, taking the partial derivative of bank loans, L_{it} in Eqn. 1.11 with respect to uncertainty yields the following:

$$\frac{\partial B_{it+1}}{\partial \sigma^2} = \frac{1}{2} B_{it+1} \left[\frac{(\varepsilon k-1)(1-\alpha k)}{z} + \alpha(\alpha\varepsilon k - 1)\right] \quad 1.12$$

where σ^2 denotes uncertainty in the supply for credit in the banking industry and the partial derivative $0 > \partial B_{it+1}/\partial\sigma^2 > 0$ depending on prevailing macroeconomic conditions. Our model findings show that the relationship between uncertainty and banks' lending is less than zero in presence of inelastic supply. The elasticity of loan supply is denoted by ε that oscillates between zero and infinity[7] and $z = k + \gamma - 1$ and $k = 1/[(1-\alpha)\varepsilon + \alpha]$

4.2 Empirical Strategy

Our empirical framework is based on robust formulation of the banks' loan supply under uncertainty. To better capture the nuances of banks' lending, we conduct our estimation in a panel data framework, informed by diagnostic test of the appropriate modelling approach. Specifically, our baseline model is based on Fixed Effect (FE) panel data estimation. Fixed effects estimation mitigates the problem of unobserved bank heterogeneity. The banking industry experiences common effects as they undertake their intermediation role. This is also reflected in similar regulatory framework in line with monetary authorities and banks are exposed to similar macroeconomic conditions. This makes FE a better candidate to address the objectives outlined in this paper. We also use Pooled Ordinary Least Squares (P-OLS) as an alternative in examining the effect of macroeconomic uncertainty on banks' lending. We acknowledge that both the FE and P-OLS may suffer from serial correlation and thus, implement the two frameworks with standard errors clustered by banks. The FE specification is presented as follows:

$$lta_{i,t} = \alpha + \beta_i U_{i,t} + \xi TB_{it} + \gamma_i X_{i,t} + \theta\Pi + \vartheta_i + \varepsilon_{i,t} \qquad 1.13$$

where lta refers to ratio of loans to total assets. U denotes a proxy measure of uncertainty that includes copper prices, exchange rate and inflation uncertainties. The variable *X* include bank-specific factors defined below while Π represents environmental factors that may affect banks' lending besides bank-specific conditions.

There are different ways to represent bank specific factors. For this study, we use non-performing loans (NPLs) as a share of gross loans to capture level of efficiency and/or risk tolerance and expect a priori a negative sign as increase in NPLs makes banks to hold back lending to minimise exposure to credit risk. Bank capital can influence ratings and signal to markets the credit worthiness of banks (Buch et al., 2015). The variable capital (ratio of regulatory capital to risk-weighted assets) captures the ability of banks to absorb shocks, such as impact of the global financial crisis or COVID-19 pandemic induced shock or regulatory intrusion. We expect a positive relationship between capital and bank lending. Security holdings (sum of treasury bills and government bonds) are used to assess the effect of banks' investment in risk-free assets on their willingness to lend to the private sector. This variable also captures the crowding out effect and we expect that increase in purchase of securities constrains banks from private sector lending. Environmental factors conditioning banks' lending activity include the 91-days Treasury bills yield rate TB_{it}, taken as a reference rate for setting of loan rates. We expect that the 91-days Treasury bills yield rate will help mitigate the uncertainty effects thus, returning a positive relationship with bank lending. We

[7] See Talavera *et al.* (2012) for details on estimation of loan interest rate equilibria, optimal credit borrowed by banks and loans advanced under uncertainty.

also interpret this to mean that high/low yield rate denotes tight/loose monetary policy stance. We also include a dummy variable on credit reporting to capture the effect of information sharing to mitigate the effect of uncertainty and expect a positive relationship with bank lending – that is, soft information on borrowers helps to alleviate credit risk. Uncertainty measure generated from the inflation rate picks out banks' responses to the evolution and preservation of asset values in real terms.

The uncertainty measure generated from copper price capture buoyance/weakness of foreign exchange earnings and the impact of external factors on local macroeconomic situation and policy stance. Depending on the direction of copper price, the coefficient on the uncertainty measure from copper price could be positive or negative. It is illustrative to note that a rise in international price of copper is characterised by inflow of foreign currency, and thus boosts market confidence on buoyance of the economy, subject to domestic public policy in response to use of the revenues from taxing of copper earnings. Overall, however, the pass-through from higher copper exports is good for banks' lending. Conversely, in bust times, the fall in copper price will adversely affect banks' lending. Higher international price of copper also leads to increase in foreign exchange inflows, boosting the local currency. We therefore argue that copper, which accounts for more than 60 percent of total export revenue, better explains the exchange rate uncertainty thus, offering better insights to evaluate the pass-through effect to the Zambian economy.

The exchange rate in Zambia is broadly seen as the key driver of investment decisions. Thus, the coefficient on the exchange rate will return a negative relationship with bank lending – meaning that an appreciation (or depreciation) (decrease or increase in local currency units to purchase unit of a US dollar) will induce banks to increase (or reduce) their lending. We also include GDP growth to control for buoyance of economic environment and expect a positive relationship with banks' lending. The dummy variables on COVID-19 and provision of stimulus package are also included. A priori, coefficients of these dummy variables are expected to be negative and positive, respectively, with banks' lending. The error term is denoted by ε while i and t refer to bank and time, respectively. The ϑ_i is a composite term of bank and year fixed effects. The bank fixed effects control for unobserved bank heterogeneity while β is the coefficient of interest delineating effect of uncertainty on banks' lending, which can be positive or negative, depending on source of uncertainty.

From the analytical framework, our results may suffer from an endogeneity problem, stemming from two potential sources (i) correlation between time varying variables and (ii) correlation between independent variables and unobserved shocks (error term). To mitigate against the identified endogeneity problem, we use lagged variables and several covariates in our empirical framework. This approach is an empirical regularity common in the literature. For example, Danisman et al., (2020) on credit growth and Xu and Li (2020) on impact of policy and green credit on debt financing argue that the use of lagged regressors mitigates endogeneity problem. Further, we follow Juach and Watzka (2016) by adjusting our baseline model in various ways to control for endogeneity (or reverse causality).

4.3 Data Set

We use quarterly data, gathered from different sources. The data on bank specific variables were gleaned from prudential statistical returns compiled by the Bank of Zambia. The variables include loans, total assets, equity, bank capital, liquidity and non-performing loans. Policy and environmental variables such as the 91-days treasury bill yield rate, inflation, exchange rate and copper prices were sourced from the Bank of Zambia statistics fortnightly. To capture the effect of COVID-19, we use a dummy variable and stimulus packages that were deployed during the pandemc. All variables are log transformed before analysis. To generate uncertainty measures, we first estimate a GARCH model using monthly data of inflation, exchange rate and copper price, to obtain an estimate of conditional volatility. We then average the resulting uncertainty measures to quarterly frequency for use in the estimation[8]. Appendix Table A1 provides descriptive statistics of the variables used in the estimation while Table A5 offers detailed explanation for the measurement of variables used in estimations.

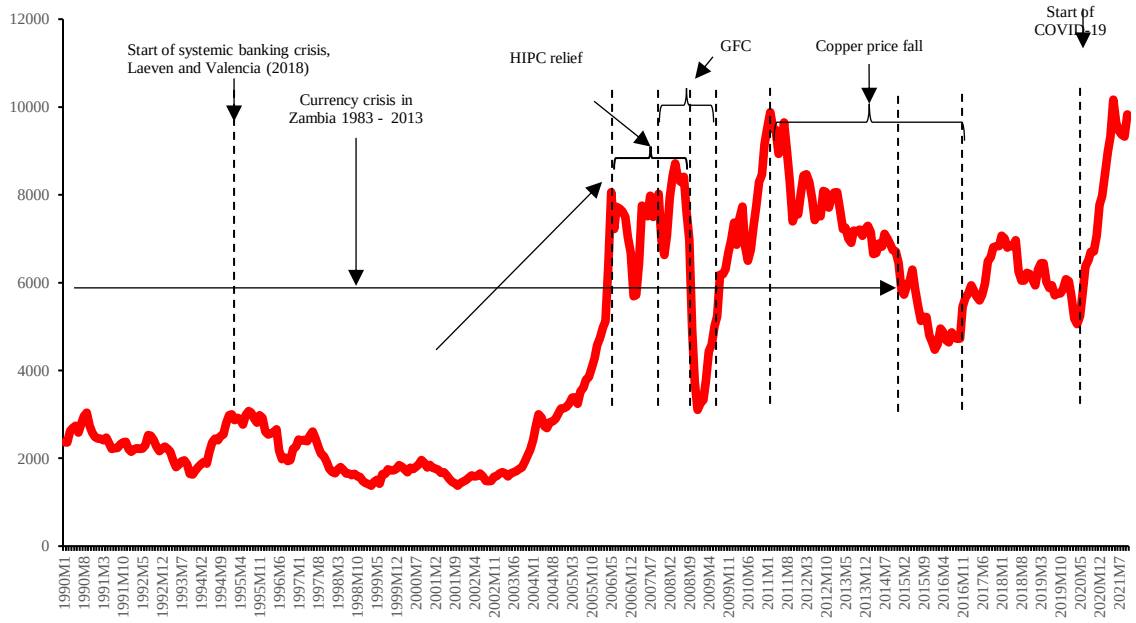
Like most commodities, the price of copper exhibits significant volatility. Figure 7 reports the macroeconomic developments and copper price changes from 1990 to 2021. In tandem with broad macroeconomic developments, Zambia's banking sector has also gone through significant challenges, the main one being the banking crisis in the mid-1990s (Laeven and Valencia, (2018); Maimbo (2000)). The positive impact of macroeconomic reforms preceding and during the HIPC reforms were reinfoced by the increase in copper prices. In contrast, the onset of the GFC unravelled these gains, as copper price sharply declined, lowering exports and setting off economy wide weaknesses and macroeconomic uncertainty.

Copper price recoverd in the aftermath of the GFC but the end of the commodity super cycle from 2011 – 2016 halted the rally, and increased banks' vulnerability to commodity price shocks. The same effect was felt as the unravelling health impact of COVID-19 spread to the rest of the economy[9]. It is illustrative to note that this paper considers the GFC and COVID-19 shocks due to their effect on the global economy and developing countries in particular. In the context of Zambia, the decline in copper prices during the GFC and COVID-19 negatively affected Zambia's export revenue leading to depreciation of the domestic currency. During GFC, the government abolished the windfall tax regime that penalised copper mines due to the negative price shock. In the same vein, to cushion impact of COVID-19 on banks' supply of credit the Bank of Zambia introduced a ZMW 10 billion pandemic financing package.

[8] It is important to note that bank lending is total lending – local and foreign currency loans.

[9] Following Laeven and Valencia (2020), in this paper the currency crisis refers to a depreciation of the Zambian currency relative to the US dollar. In Figure 7, currency depreciation is based on a threshold of 30 percent on a year-on-year and 10 percent higher depreciation of domestic currency in the current year compared to the previous year (Laeven and Valencia, 2020).

Figure 7: Macroeconomic development and Copper price evolution (1990 - 2021)



Source: Laeven and Valencia (2018) and authors' computations based on IMF commodity price database

4.4 Identifying commodity price shock and macroeconomic uncertainty

There are several ways in the literature used to identify uncertainties such as variances or standard deviation. In this paper, we follow Baum et al., (2006) to identify measures of commodity price shock and macroeconomic uncertainty using a Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model. Conditional variance is a better candidate for measuring uncertainty relative to unconditional variance. The conditional variance uses previous period information in determining current volatility outcomes, and thus is better suited as a proxy for uncertainty. The uncertainty of commodity price shock is generated from price of copper, Zambia's main export product. Macroeconomic uncertainty measures are computed using the exchange rate and inflation. Monthly uncertainty measures are computed using the GARCH model and averaged to quarterly frequency based on our sample for regression estimation and analysis. Table 3 reports the estimated GARCH model results used to determine different uncertainty proxy measures while Table A2 presents the correlation between different uncertainty variables. The estimates in Table 3 show significant ARCH and GARCH coefficients for the series. It is important to note that from Table A2, the correlation within variables is high while between variables is low which demonstrates the robustnesses of our findings.

Table 3: Proxies for commodity and macroeconomic uncertainties

	Copper price (US$/pound)	Exchange Rate (Kwacha/US$)	CPI Inflation (percent)
Constant	14.167	19.533[a]	0.050
AR	0.993[a]	0.976[a]	0.335[a]
Constant	79.951	18.192[b]	14.136[a]
ARCH (1)	0.209[a]	0.296[a]	0.765[a]
GARCH (1)	0.847[a]	0.284[a]	0.084[c]
Log Likelihood	1988.105	630.589	519.841
Obs.	286	266	143
Notes: The significant levels are denoted by [a, b, c] for 1 percent, 5 percent and 10 percent, respectively.			

5.0 Empirical Results and Discussion

5.1 Whole Sample Results

The baseline model (Equation 1.13) on the effect of commodity price and macroeconomic shocks on bank lending behaviour is estimated for the whole sample covering 1998-2021. Although there were 17 commercial banks in Zambia in 2021, we only use 13 banks for whole sample estimation for the following reasons. Since the primary focus of the analysis is on effect of banks' lending during the global financial crisis in the context of commodity price shock and other uncertainty conditions, we exclude banks that existed prior to 2008 but did not survive through and after the GFC. Similarly, we exclude from the sample all banks established after the GFC. This exercise is aimed at tracing policy implications induced by the effect of commodity price shocks and macroeconomic uncertainty before and after the GFC for the same sample units. As a rule of thumb, we consider banks that were in operation five years before and after the GFC. This yields 13 banks as the surviving units of analysis for the entire sample period. As noted earlier, in our estimation strategy we use both Fixed Effect (FE) and Pooled OLS (P-OLS) models. Table A6 reports the Hausman test results which confirms the use of the Fixed Effect as the most suitable estimation model. We acknowledge that the empirical strategy may suffer from serial correlation at individual banks. To control for serial correlation, we thus implement our empirical strategy using clustered standard errors by firms. Clustering at individual sample unit yields more robust estimation results. Results of the whole sample estimation are presented in Tables 4a and 4b for both FE and P-OLS.

Table 4a: Estimation Results of the Effect of Uncertainty on Bank Lending: Whole sample

	Fixed Effect			Pooled OLS		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.165[b]			0.095[c]		
	(0.057)			(0.044)		
GDP growth	0.032[b]	0.051[a]	0.036[b]	0.143[a]	0.145[a]	0.128[a]
	(0.014)	(0.016)	(0.014)	(0.044)	(0.047)	(0.032)
NPL	-0.035[c]	-0.048[c]	-0.047[c]	-0.053[b]	-0.055[b]	-0.051[c]
	(0.016)	(0.021)	(0.022)	(0.019)	(0.022)	(0.024)
Capital	-0.123[b]	-0.083[b]	-0.089[b]	-0.210[a]	-0.191[b]	-0.210[b]
	(0.059)	(0.041)	(0.043)	(0.067)	(0.068)	(0.069)
Security	-0.335[a]	-0.346[a]	-0.366[a]	-0.449[a]	-0.458[a]	-0.458[a]
	(0.083)	(0.089)	(0.067)	(0.067)	(0.158)	(0.159)
COVID-19 Dummy	-0.141[a]	-0.130[b]	-0.129[b]	-0.137[b]	-0.127[b]	0.124[b]
	0.038	0.062	0.064	0.068	0.059	0.057
COVID-19 Stimulus	0.089[b]	0.075[b]	0.079[b]	0.087[b]	0.077[b]	0.080[b]
	(0.037)	(0.032)	(0.031)	(0.036)	(0.030)	(0.034)
$COVID-19 \times Stimulus$	-0.089[b]	-0.070[b]	-0.066[b]	-0.081[b]	-0.063[b]	-0.059[b]
	(0.031)	(0.027)	(0.030)	(0.029)	(0.030)	(0.023)
EXC rate uncertainty		-0.021[c]			-0.019[b]	
		(0.009)			(0.009)	
Inflation uncertainty			-0.027[b]			-0.056[a]
			(0.012)			(0.019)
Constant	-65.933[a]	-61.672[a]	-60.324[a]	-2.463[a]	-1.431[a]	-2.612[a]
	(16.852)	(19.500)	(19.143)	(0.895)	(0.489)	(1.259)
Year FE	Yes	Yes	Yes	No	No	No
Observations	795	795	795	795	795	795
R-squared	0.472	0.445	0.448	0.402	0.396	0.401
Number of Banks	13	13	13	13	13	13

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a, b, c] denote significance levels at 1%, 5% and 10%, respectively.

Table 4b: Estimation Results of the Effect of Uncertainty on Bank Lending: COVID-19 Period

	Fixed Effect			Pooled OLS		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.213[b]			0.163[c]		
	(0.095)			(0.074)		
GDP growth	0.024[b]	0.031[a]	0.032[b]	0.033[a]	0.041[a]	0.023[a]
	(0.019)	(0.015)	(0.015)	(0.012)	(0.019)	(0.011)
NPL	-0.048[c]	-0.064[c]	-0.065[c]	-0.057[b]	-0.047[b]	-0.043[c]
	(0.019)	(0.027)	(0.022)	(0.018)	(0.022)	(0.021)
Capital	-0.135[b]	-0.096[b]	-0.098[b]	-0.213[a]	-0.195[b]	-0.191[b]
	(0.067)	(0.043)	(0.047)	(0.073)	(0.067)	(0.075)
Security	-0.346[a]	-0.368[a]	-0.356[a]	-0.413[a]	-0.452[a]	-0.413[a]
	(0.089)	(0.128)	(0.159)	(0.189)	(0.159)	(0.158)
COVID-19 Stimulus	0.169[b]	0.147[b]	0.156[b]	0.168[b]	0.148[b]	0.157[b]
	(0.058)	(0.051)	(0.057)	(0.055)	(0.044)	(0.052)
EXC rate uncertainty		-0.127[c]			-0.119[b]	
		(0.056)			(0.039)	
Inflation uncertainty			-0.113[b]			-0.102[a]
			(0.056)			(0.048)
Constant	-63.812[a]	-60.816[a]	-59.216[a]	-2.615[a]	-2.311[a]	-3.642[a]
	(16.945)	(20.156)	(16.913)	(1.300)	(1.121)	(1.495)
Year FE	Yes	Yes	Yes	No	No	No
Observations	795	795	795	795	795	795
R-squared	0.472	0.445	0.448	0.402	0.396	0.401
Number of Banks	13	13	13	13	13	13

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a, b, c] denote significance levels at 1%, 5% and 10%, respectively.

The whole sample findings show that commodity price shocks exhibit the highest effect relative to inflation and exchange rate uncertainty measures. A 1 percent positive commodity price shock translates to between 16.5 percent and 9.5 percent and statistically significant increase in bank lending in both FE and P-OLS, respectively. It should be noted that we have used copper price to compute uncertainty of the commodity price shock. Thus, intuitively, an increase in copper price represents a positive shock, interpreted as lower commodity price uncertainty. The transmission of such price shock to the local real economy ignites positive response from economic agents because it signals favourable prospects on export earnings and fiscal revenues, even when the exchange rate is held constant. This symmetrical response is also reflected in increased banks' lending. For banks exposed to the copper mining sector or sectors allied with the mining industry, the effect might even be stronger. A negative price shock will trigger higher uncertainty and elicit a credit slump, with copper sector exposed banks presumably bearing the largest burden of shrinkage in lending. Our finding is thus theoretically appealing and empirically consistent. Agarwa et al., (2018) offer further insight into the depressing effect of lower commodity prices on bank lending. Their study, which included Zambia (and index of copper price), shows that the effect of

commodity price sensitivity on bank lending is confined to low-income countries. Ftiti et al., (2016) find similar results for commodity exporting countries in sub-Saharan Africa, although noting that there is a strong association between the credit market and persistent commodity price shocks.

The coefficients on exchange rate and inflation uncertainty are negative and statistically significant. A unit increase in exchange rate uncertainty reduces bank lending by 2.1 percent and 1.9 percent in both FE and P-OLS. Similarly, a 1 percent increase in inflation uncertainty, and by extension, weakening macroeconomic conditions, translated into a reduction in bank lending by between 2.7 percent and 5.6 percent. The negative coefficients between bank lending with inflation and exchange rate uncertainty confirms the presence of the bank lending channel (or credit channel) and exchange rate channel in Zambia (see for instance, Chileshe (2018), Simpasa et al., (2015) and Mutoti (2005) and Simatele (2004)). In a bank based economy like Zambia with underdeveloped capital and bond markets, bank lending plays an important role in financing the real economy. Therefore, macroeconomic uncertainty would have strong credit market effects.

Interestingly, the coefficient on the ratio of non-performing loans (NPL), capital ratio and share of treasury securities holding, are negatively and statistically significant. A 1 percent increase in NPL ratio is correlated with a 3.5-5.5 percent reduction in bank lending. For the capital ratio, a 1 percent increase is associated by 8.53-21.0 percent reduction in bank lending. This finding seems counterintuitive since higher capital ratio is expected to create a buffer against lending shocks, and hence translate into increased credit supply. However, according to Diamond and Rajan (2000, 2001), higher minimum regulatory capital could lead to lower lending as banks reduces incentives for excessive risk taking. In underdeveloped credit markets characterised by information opacity, more capital cannot be a substitute for prudential screening of potential borrowers. Therefore, raising minimum regulatory capital would not automatically translate into higher lending [10]. Furthermore, a 1 percent increase in banks holding of treasury securities is correlated with 33.5-45.9 percent reduction in bank lending. This crowding out effect of government borrowing from the banking sector is consistent with empirical regularity. On the other hand, a 1 percent increase in economic growth is associated with 3.2 percent increase in bank lending, suggesting procyclicality of banks' lending in Zambia. In good times, banks lend more and retrench their lending in periods of economic stress.

Relatedly, the findings show that COVID-19 led to a reduction in banks' lending while the stimulus package implemented by the Bank of Zambia helped mitigate the pandemic shock in the credit market. An increase in COVID-19 pandemic shock is correlated with about 12.4-14.1 percent reduction in banks' lending. On the other hand, a 1 percent increase in the stimulus package is associated with about 7.5-8.9 percent increase in banks' lending. The interaction of COVID-19 dummy and the stimulus package shows a negative relationship

[10] Distinguin et al. (2013) argues that banks receive deposits that are advanced to borrowers. In this regard, banks will monitor the borrowers, thus, obtaining confidential information about borrowers leading to agency problem. The authors posit that the bank will ask for higher loan returns from depositors of which they will decline and become unwilling to make more deposits. Therefore, the bank adopts a fragile financial structure that attracts higher deposits elevating the negotiating power of banks. In the end, this framework increases bank capital and reduces bank lending.

with bank lending at 5.9-8.9 percent. This findings show the dominance of the COVID-19 pandemic on liquidity and the stimulus package was not enough to offset the negative effect.

Table 4a reports the estimation results for January 2020 to June 2022, capturing effect of COVID-19. The findings on the commodity and macroeconomic uncertainties are consistent with full sample results across all regressions – FE and Pooled OLS. However, unlike for the full sample estimates, the effect of uncertainty measures is larger during the COVID-19 period. For instance, a 1 percent increase in price of copper is correlated with about 16.3-21.3 percent increase in banks' lending. For the two measures of macroeconomic uncertainty, a 1 percent increase in exchange rate and inflation uncertainties is associated with 11.9-12.7 percent and 10.2-11.3 percent reduction in banks' lending, respectively. These findings are in line with the vulnerability of the macroeconomic situation in Zambia during the COVID-19 period. As expected, effect of the COVID-19 stimulus package turns out to be more effective in the regression exclusive for the pandemic period than in the full sample regression (see Table 4c). The imapct of a 1 percent increase in the stimulus package ranges from 14.7 to 15.6 and 16.9 percent increase in banks' lending across the three uncertainty measures – exchange rate, inflation and copper price, respectively. This finding is consistent with Aizenman et al., (2022) which shows that COVID-19 stimulus packages bolstered market liquidity under conditions of heightened pandemic risk, and helped maintain banks' lending activity. Our analysis also corroborates the finding that expansionary monetary policy in crisis period such as that induced by COVID-19 can be an important tool in forestalling credit retrenchment and enhance bank lending (Dermirguc-Kunt et al., (2021)).

Table 4c: Impact of Pandemic stimulus package on banks' lending

Regression conducted on					
Full Sample (1998 q1-2022q2)			COVID-19 Period (2020 q1– 2022q2)		
Uncertainty Measure	FE	P-OLS	Uncertainty Measure	FE	P-OLS
Copper price	0.089	0.087	Copper price	0.169	0.168
Exchange rate	0.075	0.077	Exchange rate	0.147	0.148
Inflation	0.079	0.080	Inflation	0.156	0.157

Source: Authors' computations based on estimated results reported in Table 4a and Table 4b

5.2 Sub-Sample Results

Full sample results have established the effect of commodity price and macroeconomic uncertainty on bank lending in Zambia. Results from sub-sample estimation on effect of uncertainty for pre- and post-global financial crisis periods are reported in Table 5. The results reconfirm full sample findings across all uncertainty measures for both periods. For commodity price uncertainty, a key message is that a higher/lower copper price yields lower/higher uncertainty, creating incentive/disincentive for banks' lending to the economy. The exchange rate and inflation uncertainty measures also exhibit negative and significant relationships with bank lending, reinforcing our conjecture about presence of the credit and exchange rate channels in Zambia. Further, the NPL, capital and security ratios exert negative and statistically significant effects on bank lending in the presence of commodity price and macroeconomic uncertainties. However, the effect is higher in pre –

GFC. For example, a 1 percent increase in NPL is associated with 8.5 percent and 3.3 percent reduction in bank lending in both pre-GFC and post-GFC, respectively. This is reflected in capital and bank security. As with the whole sample, the securities have the highest effect on bank lending compared to other bank related variables. The GDP growth remains positively correlated with bank lending with pre-GFC being more prominent relative to post-GFC.

Table 5: Estimation Results of the Effect of Uncertainty on Bank Lending: Global financial crisis

	Pre – Global financial crisis			Post – Global financial crisis		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.291[c]			0.229[c]		
	(0.062)			(0.060)		
GDP growth	0.097[a]	0.190[c]	0.178[b]	0.019[c]	0.024[a]	0.027[c]
	(0.046)	(0.059)	(0.057)	(0.008)	(0.013)	(0.013)
NPL	-0.085[c]	-0.085[c]	-0.077[c]	-0.033[b]	-0.019[c]	-0.018[c]
	(0.020)	(0.019)	(0.018)	(0.016)	(0.008)	(0.007)
Capital	-0.136[b]	-0.194[a]	-0.209[a]	-0.038[c]	-0.039[c]	-0.043[b]
	(0.067)	(0.103)	(0.106)	(0.018)	(0.017)	(0.015)
Security	-0.373[b]	-0.386[b]	-0.394[b]	-0.236[b]	-0.274[c]	-0.266[c]
	(0.122)	(0.134)	(0.135)	(0.036)	(0.040)	(0.041)
EXC rate uncertainty		-0.077[b]			-0.018[c]	
		(0.025)			(0.007)	
Inflation uncertainty			-0.157[b]			-0.007[c]
			(0.069)			(0.003)
Constant	-44.351	-116.599[c]	-82.949[a]	19.550	-21.063	-21.313
	(25.194)	(21.792)	(39.190)	(20.412)	(25.108)	(25.462)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	434	434	434	373	373	373
R-squared	0.449	0.402	0.390	0.373	0.337	0.334
Number of Bank	12	12	12	13	13	13

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent.

Table 6a reports of sub-sample estimations disaggregated by bank size. To investigate the effect of commodity price and macroeconomic uncertainty, we cluster banks into large and small banks. In doing so, we follow Talavera et al., (2012) and classify a bank as large when its average yearly assets are above the mean and below otherwise. Results of this exercise reconfirm earlier findings across uncertainty measures. The findings show that in presence of uncertainty from commodity price shock, large banks increase their lending by 18.1 percent compared to small banks at 17.3 percent. Although the results are qualitatively similar, the magnitude of the coefficient for small banks show their lending sensitivity response to commodity price uncertainty relative to large banks. The findings also show a negative association between bank lending for both inflation and exchange rate uncertainty. However, small banks are more sensitive to inflation uncertainty while large banks are sensitive to exchange rate uncertainty. The findings show that in presence of inflation uncertainty, small banks reduce their loan asset ratio by a higher degree of 12.5 percent compared to 11.5 percent for their large counterparts. Similarly, in presence of exchange

rate uncertainty, large banks reduce their loan asset ratio by 10.5 percent compared to 10.8 percent for small banks.

The results with COVID-19, both for the full sample, and specifically for the COVID-19 period, are qualitatively similar, confirming the adverse effect of exogenous shocks and increased uncertainty in banks' lending. However, as shown in Table 6a, we observe a differentiated huge impact of COVID-19 on small banks, suggesting that the lending focus of this group of banks oriented towards small and medium enterprises and households (Simpasa et al., 2015) exposed them to the severity of the pandemic shock. In Zambia, like other countries, small and medium enterprises (SMEs) were the most affected by the pandemic and lenders with significant exposure to this segment of the credit market cut down on lending. For this reason, policy interventions largely focused on alleviating credit frictions among the SMEs. These findings are buttressed by the interaction of COVID-19 pandemic and the stimulus package (see Table 6a) showing that the pandemic dominated and negatively affected credit supply. In Zambia, we see a positive and significant impact of the policy intervention that helped keep the flow of credit to the economy. Table 6b reports estimation results of the large and small banks after controlling for the stimulus package provided to cushion banks' exposure to COVID-19 induced credit risk. The findings confirm the positive influence of the stimulus package on easing credit constraints during the period 2020 – June 2022, with smaller banks experiencing larger impact than their large counterparts at the height of the pandemic.

Table 6a: Estimation Results of the Effect of Uncertainty on Bank Lending: Whole sample period

	Large Banks			Small Banks		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.181[b]			0.173[a]		
	(0.059)			(0.074)		
GDP growth	0.043[c]	0.042[c]	0.047[c]	0.029[c]	0.038[c]	0.031[b]
	(0.016)	(0.019)	(0.023)	(0.012)	(0.017)	(0.015)
NPL	-0.089[c]	-0.048[b]	-0.054[c]	-0.043[b]	-0.047[c]	-0.048[c]
	(0.042)	(0.019)	(0.020)	(0.021)	(0.018)	(0.021)
Capital	-0.215[a]	-0.218[a]	-0.205[a]	-0.168[b]	-0.271[b]	-0.276[b]
	(0.103)	(0.108)	(0.100)	(0.081)	(0.069)	(0.111)
Security	-0.320[b]	-0.322[b]	-0.316[b]	-0.345[a]	-0.243[c]	-0.224[a]
	(0.129)	(0.087)	(0.120)	(0.113)	(0.116)	(0.112)
COVID-19 Dummy	-0.162[b]	-0.147[b]	-0.131[a]	-0.211[b]	-0.189[b]	-0.171[b]
	(0.058)	(0.065)	(0.054)	(0.065)	(0.066)	(0.062)
COVID-19 Stimulus	0.092[b]	0.081[b]	0.075[b]	0.121[b]	0.087[b]	0.098[b]
	(0.034)	(0.031)	(0.026)	(0.041)	(0.027)	(0.035)
$COVID-19 \times Stimulus$	-0.063[b]	-0.060[b]	-0.054[b]	-0.071[b]	-0.065[b]	-0.058[b]
	(0.027)	(0.025)	(0.020)	(0.028)	(0.022)	(0.019)
EXC rate uncertainty		-0.105[c]			-0.108[b]	
		(0.050)			(0.028)	
Inflation uncertainty			-0.115[b]			-0.125[c]
			(0.039)			(0.032)
Constant	-61.214[b]	-36.841[b]	-45.318[b]	-79.314[c]	-90.129[c]	-89.481[c]
	(22.782)	(14.031)	(22.154)	(34.236)	(43.205)	(41.061)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	297	297	297	498	498	498

R-squared	0.535	0.503	0.501	0.513	0.501	0.502
Number of Banks	5	5	5	8	8	8

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent.

Table 6b: Estimation Results of the Effect of Uncertainty on Bank Lending: COVID-19 Period

	Large Banks			Small Banks		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.154[b]			0.146[a]		
	(0.047)			(0.064)		
GDP growth	0.036[c]	0.031[c]	0.036[c]	0.039[c]	0.033[c]	0.034[b]
	(0.018)	(0.010)	(0.014)	(0.018)	(0.015)	(0.015)
NPL	-0.076[c]	-0.068[b]	-0.060[c]	-0.068[b]	-0.062[c]	-0.064[c]
	(0.022)	(0.018)	(0.029)	(0.024)	(0.028)	(0.028)
Capital	-0.193[a]	-0.215[a]	-0.231[a]	-0.261[b]	-0.270[b]	-0.241[b]
	(0.090)	(0.105)	(0.170)	(0.100)	(0.106)	(0.062)
Security	-0.360[b]	-0.381[b]	-0.342[b]	-0.375[a]	-0.313[c]	-0.314[a]
	(0.058)	(0.180)	(0.142)	(0.143)	(0.108)	(0.125)
COVID-19 Stimulus	0.174[b]	0.153[b]	0.172[b]	0.195[b]	0.179[b]	0.193[b]
	(0.054)	(0.052)	(0.049)	(0.059)	(0.058)	(0.073)
EXC rate uncertainty		-0.135[c]			-0.118[b]	
		(0.056)			(0.058)	
Inflation uncertainty			-0.102[b]			-0.145[c]
			(0.046)			(0.062)
Constant	-60.314[b]	-52.141[b]	-75.181[b]	-41.114[c]	-50.519[c]	-71.181[c]
	(24.779)	(24.026)	(32.158)	(18.176)	(23.215)	(33.160)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	297	297	297	498	498	498
R-squared	0.541	0.532	0.511	0.520	0.533	0.541
Number of Banks	5	5	5	8	8	8

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent.

Table 7 reports pooled OLS results of the effect of uncertainty on bank lending. The results largely confirm the findings from the FE framework. The results show that both the large and small banks in Zambia are influenced by commodity price and macroeconomic uncertainty. However, there is substantial variation on the effect of uncertainty measures and bank size category. Commodity price shocks exhibit the highest effect on bank lending than other measures of uncertainty, ranging from 5.1 percent for large banks to 5.5 percent for small banks. This finding supports the hypothesis that an increase in copper prices strengthens the probability of income and profitability of banks exposed to the copper sector, thereby creating an incentive to increase their lending to the sector. From a macroeconomy perspective, higher copper prices signal favourable prospects given the importance of the red metal in Zambia's economy. However, the benefits of high copper prices accrue more to large banks relative to small banks. We argue that in Zambia, investment in copper industry is skewed in favour of large banks, a majority of whom are foreign owned with better

liquidity position and expertise that allows them to respond with increased lending in presence of favourable price shocks and retrench credit supply under a reversal of conditions. Inflation and exchange rate uncertainty also have expected negative and statistically significant influence on bank lending, oscillating between 1 percent and 2.6 percent. These findings indicate that an increase in prices due to inflation elevates the demand for bank credit in favour of small banks. The small banks focus market is on households and small businesses that are negatively affected on high degree by inflation, thus increasing their bank lending. Interestingly, the increased banking lending in small banks increases the non-performing loans at 6.5 percent.

Table 7: Estimation Results of the Effect of Uncertainty on Bank Lending (Pooled OLS)

	Large			Small		
Variables	Copper	EXC	INF	Copper	EXC	INF
	(1)	(2)	(3)	(4)	(5)	(6)
Security	-0.102[c]	-0.098[c]	-0.098[c]	-0.030[c]	-0.037[b]	-0.031[b]
	(0.008)	(0.013)	(0.012)	(0.014)	(0.015)	(0.013)
NPL	0.046[a]	0.053[a]	0.053[a]	0.065[b]	0.064[c]	0.064[c]
	(0.019)	(0.021)	(0.021)	(0.011)	(0.012)	(0.012)
Capital	-0.103[a]	-0.107[a]	-0.107[a]	-0.086[b]	-0.087[b]	-0.087[b]
	(0.043)	(0.044)	(0.043)	(0.036)	(0.036)	(0.036)
Copper price uncertainty	0.055[b]			0.051[b]		
	(0.017)			(0.018)		
EXC uncertainty		-0.026[b]			-0.022[b]	
		(0.009)			(0.008)	
Inflation uncertainty			-0.011[c]			-0.014[b]
			(0.005)			(0.005)
Constant	-5.284[b]	-5.466[b]	-6.640[b]	-26.370[b]	-25.422[a]	-25.393[a]
	(2.128)	(1.995)	(2.949)	(10.768)	(11.181)	(11.145)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	361	361	361	608	608	608
R-squared	0.427	0.396	0.396	0.202	0.195	0.195

Note: Each column presents a separate Pooled OLS regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a, b, c] denotes significance at 1 percent, 5 percent and 10 percent, respectively.

5.3 Robustness Check

The literature in recent years has grown emphasizing the role of country risks (debt unsustainability, commodity price volatility, financial risks and political risks) on bank lending with effects permeating through multiple channels. Fu et al., (2014) find significant impact of the GFC on developed countries with varied results on developing countries. Further, during the HIPC period the banking industry in Zambia faced significant challenges in meeting the intermediary role of bank lending. This period was characterised by low liquidity and increased cost of borrowing. Table 8 reports the findings of the effect of HIPC period on bank lending in presence of uncertainty. During this period, Zambia implemented significant reforms that culminated in receiving the debt relief. The debt relief peaked between 2006 and 2008. As such, in our analytical framework, we test the efficacy of relief funds receive during this period on the banking sector. Interestingly, the debt relief under the HIPC arrangement helped bring stability in the banking industry. Our findings show a positive and statistically significant effect of HIPC support on bank lending in Zambia in

presence of different measures of uncertainty. During the HIPC period, bank lending increased by between 2 percent and 7 percent in presence of uncertainties.

Table 8: Estimation Results of the Effect of Uncertainty on Bank Lending: HIPC period

	Fixed Effect			Pooled OLS		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.203[a]			0.133[c]		
	(0.054)			(0.061)		
GDP growth	0.029[b]	0.046[a]	0.038[b]	0.133[a]	0.142[a]	0.124[a]
	(0.013)	(0.013)	(0.014)	(0.024)	(0.027)	(0.025)
NPL	-0.041[b]	-0.041[c]	-0.042[c]	-0.007[b]	-0.004[c]	-0.005[b]
	(0.018)	(0.021)	(0.021)	(0.003)	(0.002)	(0.002)
Capital	-0.104[c]	-0.089[b]	-0.091[b]	-0.198[a]	-0.190[b]	-0.191[a]
	(0.052)	(0.032)	(0.042)	(0.063)	(0.062)	(0.062)
Security	-0.335[a]	-0.353[a]	-0.357[a]	-0.440[a]	-0.448[a]	-0.455[a]
	(0.070)	(0.063)	(0.064)	(0.062)	(0.058)	(0.059)
HIPC dummy	0.066[b]	0.066[b]	0.060[b]	0.069[b]	0.017[c]	0.007[b]
	(0.025)	(0.026)	(0.021)	(0.032)	(0.008)	(0.002)
EXC rate uncertainty		-0.014[b]			-0.017	
		(0.006)			(0.021)	
Inflation uncertainty			-0.021[c]			-0.041[a]
			(0.010)			(0.011)
Constant	-65.532[a]	-63.167[a]	-62.471[a]	-2.776[a]	-2.390[a]	-2.542[a]
	(14.656)	(13.836)	(13.904)	(0.347)	(0.315)	(0.296)
Year FE	Yes	Yes	Yes	No	No	No
Observations	795	795	795	795	795	795
R-squared	0.474	0.449	0.451	0.404	0.396	0.401
Number of Banks	13	13	13	13	13	13

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent.

Turning to the disaggregation of banks, we find similar results with varying effects (see Table 9). The findings show that during the HIPC period, copper price uncertainty was lower, translating into a positive effect, which was highest on small banks. Reduced macroeconomic uncertainty associated with low inflation and more stable exchange rate exerted the highest positive effect of 13 percent and 12.6 percent, respectively on large banks. The other results largely reconfirm the whole sample findings with NPL, capital and security ratios depicting similar coefficients as in previous estimations. As noted earlier, the copper price declined from 2011-2016. We test for this change on bank lending, by examining the trend of price fall between 2011Q3 and 2016Q1. Table 10 reports results of this experiment. The results suggest that a decrease in copper prices (interpreted as higher price uncertainty) reduced bank lending in Zambia. Table 11 reports results of the same exercise, after controlling for bank size. The findings corroborate those in Table 10. The fall in copper prices had a higher effect on small banks than on their large counterparts. This could imply the strong signalling impact of commodity price shocks that is more amplified for smaller banks which have limited risk mitigating and coping strategies. Results on the differential effect during the Global Financial Crisis (GFC) period are report in Table 12. These results show that lower copper prices uncertainty was more beneficial for large banks' lending than their small

peers. During this period, macroeconomic uncertainty had varied effect on banks' lending. The highest negative impact, at 37 percent, was with the inflation uncertainty measure on large banks.

Table 9: Estimation Results of the Effect of Uncertainty on Bank Lending: HIPC Banks disaggregated.

	Large Banks			Small Banks		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.182[c]			0.225[b]		
	(0.076)			(0.065)		
GDP growth	0.060[a]	0.075[a]	0.072[a]	0.013[a]	0.032[b]	0.021[b]
	(0.011)	(0.006)	(0.006)	(0.004)	(0.012)	(0.009)
NPL	-0.069[c]	-0.053[b]	-0.055[c]	-0.046[a]	-0.056[c]	-0.055[c]
	(0.030)	(0.019)	(0.027)	(0.022)	(0.025)	(0.025)
Capital	-0.229[a]	-0.257[a]	0.250[a]	-0.155[a]	-0.142[c]	-0.145[c]
	(0.039)	(0.029)	(0.026)	(0.068)	(0.068)	(0.067)
Security	-0.378[b]	-0.413[b]	-0.401[b]	-0.282[a]	-0.298[a]	-0.304[a]
	(0.117)	(0.114)	(0.112)	(0.066)	(0.054)	(0.057)
HIPC dummy	0.051[b]	0.176[a]	0.167[c]	0.121[c]	0.015[c]	0.011[b]
	(0.021)	(0.070)	(0.067)	(0.060)	(0.007)	(0.004)
EXC rate uncertainty		-0.035[b]			-0.018[b]	
		(0.010)			(0.007)	
Inflation uncertainty			-0.019[b]			-0.027[b]
			(0.008)			(0.012)
Constant	-53.286[b]	-55.970[b]	-53.878[b]	-82.731[a]	-77.938[a]	-77.488[a]
	(17.445)	(18.808)	(18.341)	(18.611)	(18.050)	(18.181)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	297	297	297	498	498	498
R-squared	0.528	0.503	0.499	0.518	0.492	0.494
Number of Banks	5	5	5	8	8	8

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [a] denotes significance at 10 percent.

Table 10: Estimation Results of the Effect of Uncertainty on Bank Lending: Copper price fall (2011 – 2016)

	All Banks			Large Banks			Small Banks		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Copper price uncertainty	0.204[a]			0.234[b]			0.200[b]		
	(0.058)			(0.077)			(0.072)		
GDP growth	0.014	0.038[b]	0.028[c]	0.044[b]	0.072[a]	0.065[a]	0.003[b]	0.025[b]	0.014[b]
	(0.006[b])	(0.015)	(0.015)	(0.011)	(0.006)	(0.006)	(0.001)	(0.012)	(0.005)
NPL	-0.027[c]	-0.038[a]	-0.038[c]	-0.059[c]	-0.034[b]	-0.037[c]	-0.029[b]	-0.032[a]	-0.052[a]
	(0.013)	(0.012)	(0.021)	(0.027)	(0.015)	(0.018)	(0.013)	(0.015)	(0.025)
Capital	-0.063[b]	-0.055[c]	-0.058[b]	-0.189[a]	-0.243[a]	-0.235[a]	-0.103[c]	-0.106[b]	-0.110
	(0.028)	(0.027)	(0.026)	(0.039)	(0.033)	(0.031)	(0.047)	(0.043)	(0.041)
Security	-0.323[a]	-0.342[a]	-0.348[a]	-0.371[b]	-0.411[a]	-0.404[b]	-0.269[b]	-0.284[a]	-0.291[a]
	(0.073)	(0.062)	(0.062)	(0.107)	(0.086)	(0.088)	(0.074)	(0.057)	(0.057)
Copper dummy	-0.179[a]	-0.119[b]	-0.119[b]	-0.138[a]	-0.084	-0.085[c]	-0.170[a]	-0.104	-0.112[b]
	(0.040)	(0.046)	(0.045)	(0.018)	(0.041)	(0.038)	(0.076)	(0.075)	(0.053)
EXC rate uncertainty		-0.012[b]			-0.032[b]			-0.022[a]	
		(0.005)			(0.014)			(0.009)	
Inflation uncertainty			-0.026[b]			-0.019[b]			-0.038[b]
			(0.010)			(0.006)			(0.015)
Constant	-62.030[a]	-58.522[a]	-58.024[a]	-47.013[c]	-51.215[b]	-49.193[b]	-80.877[b]	-74.946[d]	-74.725
	(15.133)	(14.124)	(14.252)	(17.996)	(18.197)	(18.056)	(19.169)	(19.193)	(19.320)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	795	795	795	297	297	297	498	498	498
R-squared	0.492	0.455	0.457	0.545	0.473	0.473	0.525	0.497	0.499
Number of Banks	13	13	13	5	5	5	8	8	8

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent.

Table 11: Estimation Results of the Effect of Uncertainty on Bank Lending during Copper price fall: Pooled OLS

	All Banks			Large Banks			Small Banks		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Copper price uncertainty	0.102[b]			0.168[c]			0.123[b]		
	(0.043)			(0.068)			(0.053)		
GDP growth	0.015[b]	0.025[c]	0.023[b]	0.048[b]	0.063[a]	0.064[a]	0.012[b]	0.014[b]	0.011[b]
	(0.006)	(0.011)	(0.009)	(0.013)	(0.006)	(0.006)	(0.005)	(0.006)	(0.004)
NPL	-0.351[a]	-0.405[a]	-0.402[a]	-0.164	-0.269	-0.272	-0.333[c]	-0.409[b]	-0.400[b]
	(0.065)	(0.074)	(0.071)	(0.141)	(0.161)	(0.159)	(0.148)	(0.162)	(0.161)
Capital	-0.124[b]	-0.122[b]	-0.122[b]	-0.141	-0.140	-0.134	-0.104[c]	-0.106[c]	-0.107[c]
	(0.045)	(0.046)	(0.046)	(0.096)	(0.095)	(0.094)	(0.051)	(0.056)	(0.056)
Security	-0.269[a]	-0.252[a]	-0.253[a]	-0.340[a]	-0.332[a]	-0.320[a]	-0.239[c]	-0.211[c]	-0.218[c]
	(0.073)	(0.075)	(0.073)	(0.043)	(0.022)	(0.027)	(0.122)	(0.105)	(0.103)
$Copper\ dummy_{2011-2016}$	-0.192[a]	-0.170[a]	-0.170[a]	-0.150[b]	-0.121[b]	-0.121[b]	-0.211[b]	-0.188[b]	-0.186[b]
	(0.035)	(0.038)	(0.038)	(0.037)	(0.038)	(0.037)	(0.061)	(0.065)	(0.065)
EXC rate uncertainty		-0.002[c]			-0.033[c]			-0.013[b]	
		(0.001)			(0.014)			(0.044)	
Inflation uncertainty			-0.005[c]			-0.007[b]			-0.012[b]
			(0.002)			(0.003)			(0.005)
Constant	-79.886[a]	-82.383[a]	-81.934[a]	-62.876[b]	-74.512[b]	-73.186[b]	-89.748[a]	-90.822[a]	-90.252[a]
	(10.251)	(9.906)	(9.891)	(22.513)	(23.552)	(23.554)	(9.843)	(9.676)	(9.736)
Observations	795	795	795	297	297	297	498	498	498
R-squared	0.530	0.524	0.524	0.554	0.529	0.526	0.530	0.523	0.523
Number of Banks	13	13	13	13	13	13	13	13	13

Note: Each column presents a separate Pooled OLS regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent.

Table 12: Estimation Results of the Effect of Uncertainty on Bank Lending: Global Financial Crisis

	All Banks			Large Banks			Small Banks		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	-66.001[a]	-61.888[a]	-61.302[a]	-74.727[a]	-124.439[c]	-35.387[c]	25.229[b]	-5.569[b]	-6.480
	(14.964)	(14.400)	(14.453)	(10.046)	(39.491)	(15.459)	(11.000)	(1.605)	(31.912)
Copper price uncertainty	0.170[b]			0.206[b]			0.144[b]		
	(0.062)			(0.091)			(0.060)		
EXC rate uncertainty		-0.013[b]			-0.014[b]			-0.022[b]	
		(0.005)			(0.006)			(0.010)	
Inflation uncertainty			-0.019c			-0.371[b]			-0.011[b]
			(0.009)			(0.113)			(0.004)
GDP growth	0.031[b]	0.045[a]	0.038[b]	0.055[b]	0.100[b]	0.128[c]	0.044[a]	0.002	0.015[b]
	(0.011)	(0.013)	(0.014)	(0.026)	(0.046)	(0.054)	(0.012)	(0.011)	(0.006)
NPL	-0.039[c]	-0.040[c]	-0.041[c]	-0.066[b]	-0.062[a]	-0.057[b]	-0.084[b]	-0.078[c]	-0.077[c]
	(0.018)	(0.020)	(0.019)	(0.029)	(0.024)	(0.020)	(0.034)	(0.035)	(0.035)
Capital	-0.104[b]	-0.099[b]	-0.101	-0.090[b]	-0.083	-0.045[b]	0.080[b]	-0.017[c]	-0.022[b]
	(0.052)	(0.043)	(0.062)	(0.037)	(0.176)	(0.016)	(0.037)	(0.008)	(0.010)
Security	-0.339[a]	-0.341[a]	-0.344[a]	-0.406[c]	-0.455[b]	-0.465[b]	-0.313[a]	-0.331[c]	-0.333[a]
	(0.073)	(0.068)	(0.069)	(0.128)	(0.138)	(0.135)	(0.076)	(0.080)	(0.081)
GFC dummy	-0.045[b]	-0.124[b]	-0.117[b]	-0.034[b]	-0.074	-0.127[b]	-0.063[b]	-0.104[b]	-0.113[c]
	(0.021)	(0.048)	(0.047)	(0.016)	(0.048)	(0.057)	(0.027)	(0.045)	(0.056)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	795	795	795	170	170	170	242	242	242
R-squared	0.472	0.455	0.456	0.569	0.540	0.553	0.540	0.535	0.534
Number of Banks	13	13	13	5	5	5	8	8	8

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent.

Due to the opacity of borrowers, especially small businesses and less net worth households, many developing countries have institutionalized credit risk screening mechanisms through the establishment of credit reference bureau. Studies have shown that presence of credit reference bureau, credit registries or collateral registries and similar borrower information collecting setups, help improve financial intermediation and strong predictive power of default (Pagano and Jappelli (1993); Galindo and Miller, 2001; Kallberg and Udell (2003); Triki and Gajigo, (2014)) banks' lending. In Zambia, like many developing countries, collateral requirements can be very onerous, preventing many borrowers for approaching banks for credit. To address this problem, the government enacted the Movable Property (Security Interest) law in 2016. The law provides for the creation of security interests in movable property (GRZ, 2016). To further enhance credit culture and cover all forms of credit transactions, the Credit Reporting Act 2018 was enacted that unifies the collateral registration system (GRZ, 2018). The institutionalization of credit reporting helps to ameliorate the problem of information asymmetry and capturing these arrangements could buttress the analytical underpinning of the macroeconomic shocks on banks' lending.

We therefore perform robustness by interacting policy variables with our uncertainty measures. This process enables us to establish the influence of policy in mitigating the effects of uncertainty to bank lending in Zambia. The second policy variable we use is a dummy variable to capture effects of institutionalised credit reporting arrangements on banks' lending.

Table A3 reports the policy variable interactions with uncertainty measures. As a policy measure, we use the 91-day treasury bill rate, which until the adoption of the monetary policy rate in 2012, served as an indicator of the stance of monetary policy. Most banks still benchmark their lending to the 91-day treasury bills rate, given that their lending is short-term. The findings show the importance of monetary policy in cushioning banks' lending against growing macroeconomic uncertainty and the effect is only positive in fixed effects estimations. These findings are in line with Nguyen et al., (2022) that expansionary monetary policy mitigated increase in inflation during COVID-19 period. For the P-OLS estimation, the effect of policy in mitigating impact of commodity price shock is positive but negative in presence of exchange rate and inflation uncertainties. In all three cases, this is only at lower significant level.

Table A4 reports analysis results of the robustness checks after controlling for establishment of credit reporting system. We use credit reporting as a dummy when the policy was introduced. The findings show that institutionalised credit reporting improves borrower information signalling, thereby positively influencing banks' lending. Interacting this with uncertainty measures shows that policy to improve quality of borrower information mitigates effect of uncertainty bank lending in Zambia.

Table A5 reports the interaction of COVID-19 pandemic shock with Bank of Zambia stimulus package. The interaction of these variables helps to assess the impact of the stimulus package in mitigating the effects of COVID-19 pandemic on the banking sector. The findings show a positive relationship of the interaction of COVID-19 and stimulus package on bank lending.

This shows that the provision of stimulus package eased the effect of the pandemic allowing banks to perform their intermediary role of credit advance in the loan market.

6.0 Conclusion

This paper investigates the effect of commodity and macroeconomic uncertainty on bank lending. Banks maximise their total assets to advance their investments and credit to enhance their profits. As such the bank value optimization hypthesis is examined in this paper. Their has been limited literature on the effect of uncertainty on bank lending in developing countries and in particular Zambia. This is partly due to limited bank level data in developing countries. Our study fills this gap by using raw data from the Bank of Zambia to assess the effect of uncertainty on bank lending. In this study, we also assess the different periods that have impacted on the Zambian economy such as the HIPC and commodity prices shocks. Although Zambia has had a total of 22 banks between 1998 and 2020, some of the banks have been merged or closed. Currently there are 17 banks in operation. In this study we focused on 13 banks that were in operation for at least five years before the GFC and have remained in operation upto 2020.

Our results, based on the analysis of a panel of 13 banks in both fixed effect and pooled OLS suggest that commodity and macroeconomic uncertainty influence bank lending. An increase in commodity uncertainty increases bank lending. This results remain robust when the banks are characterised according to size. However, the impact is more prominent in large banks compared to small banks. On the contrary, an increase in inflation and exchange rate uncertainty reduces bank lending. The small banks experienced a higher effect during inflation uncertainty while large banks are highly affected by exchange rate uncertainty.

More interestingly, for pre-GFC the commodity uncertainty has a higher positive influence on bank lending compared to the post-GFC period. This results remain the same although with a negative effect for inflation and exchange rate uncertainty. Further, the HIPC period confirms its negative influence on the banking industry in Zambia. The findings are also corroborated when we control for commodity price. Our findings also show that monetary policy and improved credit information reinforces the view that proper signalling and easing information frictions can unlock banks' credit by mitigating adverse impact of macroeconomic uncertainty. The effect of COVID-19 on banks' lending lends credence of the vulnerability of the banking sector to global exogenous shocks. The findings show that COVID-19 has negatively affected banks' credit supply but policy intervention through the central bank's pandemic stimulus package helped alleviate effect of the shock on the banking sector credit. The effect was large for small banks compared to their large counterparts, mainly because COVID-19 impacted SMEs and households, a significant market segment for small banks.

This findings are immensely beneficial to monetary authorities and other policy planners, especially in developing and net commodity exporting countries. First, the study shows the importance of the bank lending and exchange rate channels in Zambia and other developing countries. To this end, monetary authorities should anchor their policy interventions on addressing fundamental sources of uncertainty.

Second, the role of banks monitoring remains central to ameliorating information asymmetry and reducing the probability of default. To mitigate the agency problem in the banking sector, the Bank of Zambia should scale up the supervisory role to buttress the effects of credit registries in deepening the credit market, at any level of risk.

Third, this study highlights that fiscal prudence is paramount in ensuring sustained bank lending channel to benefit small and large firms in developing countries. As elements of fiscal unsustainability and lower fiscal space negatively influences bank lending and the effect is more pronounced on small banks that are central to household and small firms lending. The authorities should design fiscal sustainability mechanisms to alleviate distress in the bank lending channel. Therefore, a collaborative approach between fiscal and monetary authorities will narrow fiscal distress and improve bank lending in Zambia. Importantly, reducing fiscal recourse to the banking sector will crowd-in private sector credit.

Fourth, the present efforts of monetary policy interventions and legislation supporting credit reporting, critical to unlocking credit, are gaining traction. Institutionalising credit reporting through the reference bureaus and setting this in law have created a new layer of screening potential borrowers, reducing incentives for default, thereby increasing banks' lending. Our analysis shows that such policy support is empirically powerful in mitigating adverse effect of uncertainty in Zambia's credit market. In particular, given the dominance of commercial banking in Zambia, the credit reference bureaus (CRB) are crucial to mitigating the proliferation of non-performing loans. Therefore, reforms on quick resolution of disputes arising from CRB reports and transparency of the system operation will enhance its efficacy and operation within the banking sector. Furthemore, traction of the movable assets as collateral will enhance access to finance, especially for small businesses and households that are shut out from the formal credit market because of burdensome collateral requirements. Thus, the supervisory role of the central bank should be reinforced by close collaboration with the CRB to enhance transparency and reduce deliquency in the credit market.

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APPENDIX

Appendix A:

Table A1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Loan to Asset	1,128	-1.317717	1.039235	-6.926818	1.825161
Capital	1,134	11.13705	1.559804	6.51959	14.63392
Loans	1,128	12.10003	2.310792	4.248495	15.80828
Total Assets	1,145	13.35571	1.780919	8.285513	16.72262
Liquidity	1,146	12.18968	2.154583	3.73767	16.98838
Shareholders' Equity	1,137	11.30696	1.64944	7.332369	14.81871
SEC	1,135	11.66156	1.941148	3.367296	15.30079
NPL	1,001	9.650553	2.17759	.6931472	14.12066
Deposits	1,141	12.94885	1.927735	5.010635	16.46513
HIPC Dummy	1,148	.1358885	.3428195	0	1
Comm. x HIPC	1,124	.5492106	1.373484	0	4.358962
EXC x HIPC	1,124	.4218809	1.076615	0	4.144439
Inf x HIPC	1,124	.7115303	1.773549	0	5.288845
Comm. Dummy	1,148	.1358885	.3428195	0	1
Comm. x Copper	1,124	.4314249	1.075785	0	3.255507
EXC x Comm	1,124	.4635421	1.202871	0	5.286329
Inf x Comm.	1,124	.671202	1.767411	0	8.957452
com1_dum	1,148	.2038328	.4030216	0	1
Bank Size	1,148	.6080139	.4884064	0	1
Commodity volatility	1,124	3.365774	.3984129	2.955476	4.358962
Inflation volatility	1,124	4.815832	.8710565	3.876168	9.235467
EXC volatility	1,124	2.836428	.6502019	2.006686	5.286329

Notes:

Table A2: Correlation of commodity and macroeconomic uncertainties

	Copper	Inflation	EXC
Commodity volatility	1.000		
Inflation volatility	0.268	1.000	
EXC volatility	0.164	0.242	1.000
Notes:			

Table A3: Estimation Results of the Effect of Uncertainty on Bank Lending

	Fixed Effects			Pooled OLS		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.146[b]			0.184[c]		
	(0.057)			(0.091)		
EXC rate uncertainty		-0.062[b]			-0.091[b]	
		(0.028)			(0.035)	
Inflation uncertainty			-0.002			-0.072[c]
			(0.010)			(0.016)
GDP growth	0.025[b]	0.018[c]	0.012[b]	0.091[c]	0.112[c]	0.107[c]
	(0.010)	(0.006)	(0.005)	(0.017)	(0.021)	(0.020)
NPL	-0.037[a]	-0.039[a]	-0.040[a]	-0.024[c]	-0.028[b]	-0.016[c]
	(0.018)	(0.020)	(0.020)	(0.007)	(0.008)	(0.007)
Capital	-0.103[c]	-0.086[b]	-0.093[c]	-0.145[b]	-0.136[b]	-0.138[b]
	(0.051)	(0.039)	(0.043)	(0.050)	(0.053)	(0.052)
Security	-0.338[c]	-0.346[c]	-0.354[b]	-0.453[c]	-0.463[c]	-0.463[c]
	(0.072)	(0.065)	(0.065)	(0.062)	(0.056)	(0.056)
COVID-19 Dummy	-0.101[b]	-0.087[b]	-0.093[b]	-0.091[b]	0.090[b]	0.097[b]
	(0.027)	(0.042)	(0.039)	(0.037)	(0.033)	(0.041)
Copper price X TBR	0.013[b]			0.056[c]		
	(0.004)			(0.012)		
EXC rate X TBR		0.037[b]			-0.048[c]	
		(0.011)			(0.012)	
Inflation X TBR			0.027[a]			-0.028[c]
			(0.009)			(0.009)
Constant	-75.300[c]	-90.579[c]	-65.30[c]	-2.780[c]	-2.199[c]	-2.300[c]
	(11.381)	(14.829)	(12.935)	(0.323)	(0.271)	(0.231)
Year FE	Yes	Yes	Yes			
Observations	795	795	795	795	795	795
R-squared	0.473	0.452	0.453	0.473	0.451	0.449
Number of Banks	13	13	13	13	13	13

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent.

Table A4: Estimation Results of the Effect of Uncertainty on Bank Lending controlling for credit reporting

	Fixed Effects			Pooled OLS		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.127[b]			0.233[c]		
	(0.050)			(0.087)		
EXC rate uncertainty		-0.054[b]			-0.086[b]	
		(0.023)			(0.037)	
Inflation uncertainty			-0.008[c]			-0.057[c]
			(0.003)			(0.017)
GDP growth	0.023[b]	0.024[c]	0.014[b]	0.072[c]	0.105[c]	0.115[c]
	(0.009)	(0.009)	(0.006)	(0.018)	(0.031)	(0.034)
NPL	-0.037[a]	-0.047[a]	-0.035[a]	-0.024[c]	-0.019[b]	-0.009[c]
	(0.012)	(0.019)	(0.015)	(0.009)	(0.008)	(0.004)
Capital	-0.116[c]	-0.075[b]	-0.082[c]	-0.105[b]	-0.107[b]	-0.127[b]
	(0.053)	(0.031)	(0.037)	(0.046)	(0.051)	(0.047)
Security	-0.314[c]	-0.313[c]	-0.341[b]	-0.441[c]	-0.451[c]	-0.421[c]
	(0.067)	(0.056)	(0.071)	(0.067)	(0.059)	(0.065)
COVID-19 Dummy	-0.113[b]	-0.107[b]	-0.095[b]	-0.100[b]	-0.091[b]	-0.086[b]
	(0.046)	(0.038)	(0.032)	0.044)	0.031)	0.027)
Copper price X TBR	0.021[b]			0.033[c]		
	(0.009)			(0.015)		
EXC rate X TBR		0.023[b]			0.037[c]	
		(0.008)			(0.012)	
Inflation X TBR			0.020[a]			0.026
			(0.007)			(0.008)
CRep	0.034[b]	0.013[b]	0.017[c]	0.0304[b]	0.014[b]	0.023[c]
	(0.016)	(0.004)	(0.006)	(0.009)	(0.007)	(0.009)
Copper X CReP	0.014[b]	0.016[b]	0.021[c]	0.017[c]	0.022[b]	0.013[c]
	(0.006)	(0.007)	(0.009)	(0.008)	(0.009)	(0.005)
EXC rate X CReP	0.031[b]	0.014[b]	0.018[c]	0.013[c]	0.011[c]	0.019[c]
	(0.014)	(0.006)	(0.007)	(0.006)	(0.005)	(0.009)
Inflation X CReP	0.023[b]	0.012[c]	0.021[b]	0.018[c]	0.017[c]	0.021[c]
	(0.008)	(0.006)	(0.009)	(0.009)	(0.008)	(0.009)
Constant	-71.312[b]	-82.579[c]	-45.368[c]	-3.780[b]	-8.199[b]	-5.300[b]
	(11.381)	(12.829)	(10.935)	(0.056)	(0.271)	(0.211)
Year FE	Yes	Yes	Yes			
Observations	795	795	795	795	795	795
R-squared	0.433	0.411	0.440	0.461	0.443	0.461
Number of Banks	13	13	13	13	13	13

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a] denotes significance at 1 percent, [b] denotes significance at 5 percent and [c] denotes significance at 10 percent. Abbreviations; TBR: Treasury Bill Rate, CReP: Credit Reporting.

Table A5: Whole sample Estimation Results on Interaction of COVID-19 and Stimulus package

	Fixed Effect			Pooled OLS		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.167[b]			0.091[c]		
	(0.058)			(0.043)		
GDP growth	0.034[b]	0.052[a]	0.039[b]	0.145[a]	0.147[a]	0.131[a]
	(0.013)	(0.018)	(0.016)	(0.046)	(0.045)	(0.037)
NPL	-0.033[c]	-0.045[c]	-0.051[c]	-0.050[b]	-0.052[b]	-0.047[c]
	(0.014)	(0.020)	(0.023)	(0.020)	(0.022)	(0.021)
Capital	-0.125[b]	-0.082[b]	-0.087[b]	-0.213[a]	-0.197[b]	-0.214[b]
	(0.057)	(0.033)	(0.041)	(0.061)	(0.077)	(0.070)
Security	-0.314[a]	-0.317[a]	-0.353[a]	-0.401[a]	-0.408[a]	-0.411[a]
	(0.081)	(0.080)	(0.061)	(0.052)	(0.101)	(0.141)
COVID-19 Dummy	-0.132[a]	-0.127[b]	-0.119[b]	-0.126[b]	-0.116[b]	0.104[b]
	0.038	0.051	0.047	0.045	0.037	0.041
COVID-19 Stimulus	0.087[b]	0.073[b]	0.081[b]	0.086[b]	0.079[b]	0.084[b]
	(0.037)	(0.032)	(0.031)	(0.036)	(0.033)	(0.039)
$COVID-19 \times Stimulus$	0.093[b]	0.082[b]	0.087[b]	0.091[b]	0.084[b]	0.083[b]
	(0.041)	(0.034)	(0.038)	(0.039)	(0.038)	(0.036)
EXC rate uncertainty		-0.017[c]			-0.015[b]	
		(0.006)			(0.006)	
Inflation uncertainty			-0.022[b]			-0.051[a]
			(0.009)			(0.017)
Constant	-62.903[a]	-60.170[a]	-61.324[a]	-2.412[a]	-1.401[a]	-2.612[a]
	(16.852)	(19.500)	(19.003)	(0.875)	(0.471)	(1.041)
Year FE	Yes	Yes	Yes	No	No	No
Observations	795	795	795	795	795	795
R-squared	0.472	0.445	0.448	0.402	0.396	0.401
Number of Banks	13	13	13	13	13	13

Note: Each column presents a separate FE regression with LTA as the dependent variable. Our selection of variables emerges after consecutive exclusion of insignificant variables following general to specific. Clustered standard errors are in parentheses [a, b, c] denote significance levels at 1%, 5% and 10%, respectively.

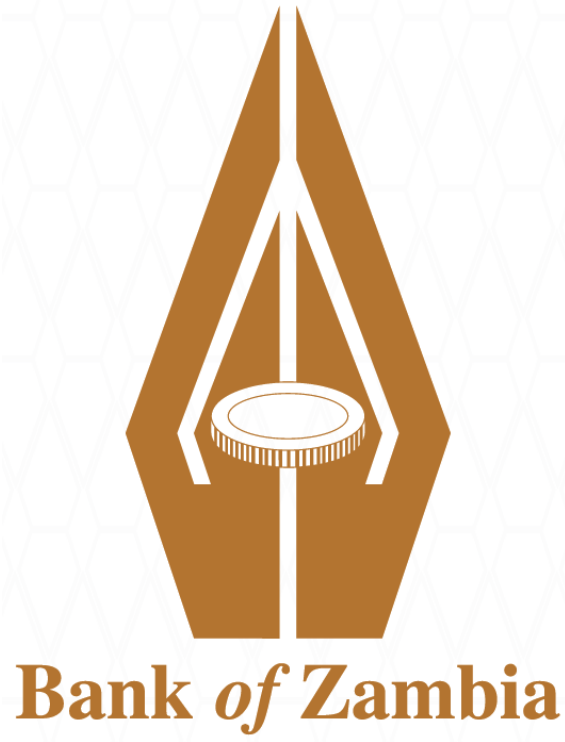
Table A6: Hausmann Test for Fixed Effect and Random Effect using the Whole sample

	Fixed Effect			Random Effects		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Copper price uncertainty	0.163[b]			0.084[c]		
	(0.058)			(0.040)		
GDP growth	0.033[b]	0.053[a]	0.035[b]	0.145[a]	0.146[a]	0.129[a]
	(0.014)	(0.017)	(0.014)	(0.043)	(0.045)	(0.030)
NPL	-0.038[c]	-0.047[c]	-0.049[c]	-0.055[b]	-0.056[b]	-0.053[c]
	(0.015)	(0.020)	(0.021)	(0.017)	(0.023)	(0.021)
Capital	-0.124[b]	-0.081[b]	-0.089[b]	-0.212[a]	-0.193[b]	-0.209[b]
	(0.058)	(0.034)	(0.040)	(0.065)	(0.065)	(0.068)
Security	-0.331[a]	-0.356[a]	-0.366[a]	-0.451[a]	-0.461[a]	-0.457[a]
	(0.080)	(0.086)	(0.065)	(0.064)	(0.160)	(0.153)
COVID-19 Dummy	-0.141[a]	-0.130[b]	-0.131[b]	-0.138[b]	-0.129[b]	0.125[b]
	(0.036)	(0.060)	(0.062)	0.061	0.058	0.055
COVID-19 Stimulus	0.089[b]	0.077[b]	0.079[b]	0.088[b]	0.078[b]	0.081[b]
	(0.034)	(0.032)	(0.030)	(0.033)	(0.031)	(0.033)
$COVID-19 \times Stimulus$	-0.091[b]	-0.074[b]	-0.066[b]	-0.082[b]	-0.065[b]	-0.059[b]
	(0.032)	(0.026)	(0.028)	(0.027)	(0.027)	(0.021)
EXC rate uncertainty		-0.023[c]			-0.021[b]	
		(0.009)			(0.009)	
Inflation uncertainty			-0.029[b]			-0.058[a]
			(0.013)			(0.017)
Constant	-63.813[a]	-62.712[a]	-58.400[a]	-21.403[a]	-19.111[a]	-20.102[a]
	(17.072)	(18.410)	(19.403)	(4.561)	(5.891)	(4.539)
Year FE	Yes	Yes	Yes	No	No	No
Observations	795	795	795	795	795	795
R-squared	0.472	0.445	0.448	0.412	0.396	0.401
Number of Banks	13	13	13	13	13	13
Hausmann Test	**17.812**	**16.421**	**18.091**			
$\boldsymbol{P-Value}$	**0.000**	**0.000**	**0.001**			

Note: Columns 1-3 and 4-5 presents Fixed Effect (FE) and Random Effect (RE) regressions with LTA as the dependent variable. Clustered standard errors are in parentheses [a, b, c] denote significance levels at 1%, 5% and 10%, respectively.

Table A7: Definitions of variables

S/No	Variable	Measurement/definition
1	lta	Ratio of loans to total assets
2	Copper uncertainty	Conditional volatility of copper prices
3	Inflation uncertainty	Conditional volatility of inflation
4	Exchange rate uncertainty	Conditional volatility of exchange rate
5	91Tbills	91 Treasury Bills yield rate
6	COVID-19	Dummy for COVID-19 Period
7	HIPC	Dummy for HIPC period
8	Copper dummy	Dummy variable for fall in copper prices between 2011 to 2016
9	GFC	Dummy for Global Financial Crisis of 2008 to 2009
10	COVID-19 stimulus	Stimulus package offered to banks by the Bank of Zambia
11	GDP growth	Gross domestic product growth
12	Capital	Bank capital
13	Security	Bank security
14	NPL	Non-performing loans
15	$Copper\ price\ X\ TBR$	Interaction of copper price uncertainty and 91 days treasury bills
16	$EXC\ rate\ X\ TBR$	Interaction of exchange rate uncertainty with 91 days treasury bills
17	$Inflation\ X\ TBR$	Interaction of inflation uncertainty with 91 days treasury bills
18	CRep	Dummy for introduction of credit reporting
19	Copper X CReP	Interaction of copper price uncertainty and dummy for credit reporting
20	EXC rate X CReP	Interaction of exchange rate uncertainty and dummy for credit reporting
21	Inflation X CReP	Interaction of inflation uncertainty and dummy for credit reporting


Bank of Zambia

REGISTERED OFFICES

Head Office
Bank of Zambia, Bank Square, Cairo Road
P.O. Box 30080, Lusaka, 10101, Zambia
Tel: +260 211 399 300
E-mail: info@boz.zm, Website: www.boz.zm

Regional Office
Bank of Zambia, Buteko Avenue,
P.O. Box 71511, Ndola, Zambia
Tel: +260 212 399 600
E-mail: info@boz.zm, Website: www.boz.zm