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Understanding the policies and impact of African central banks during the recent global recession
Cases of Nigeria and South Africa

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Understanding the policies and impact of African central banks during the recent global recession

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ABREVIATIONS

BVAR: Bayesian Vector Auto-regressive

CBN: Central Bank of Nigeria

CDS: credit default swap

CE: Credit easing

CMP: Conventional Monetary Policy

DSGE: Dynamic Stochastic General Equilibrium

ECB: European Central Bank

ECOWAS: Economic Community of West African States

FDI: Foreign Direct Investment

G7: United States, Japan, United kingdoms, France, Germany, Italy and Canada

GDP: Gross Domestic Product

GFC: Global Financial Crisis

IMF: International Monetary Fund

ITTC: Inflation Targeting Technical Committee

MPC: Monetary Policy Committee

MPR: Monetary Policy Rate

QE: Quantitative easing

SA: South Africa

SACU: Southern Africa Custom union

SADC: Southern Africa Development Community

SARB: South African Reserve Bank

SOE: Small Opened Economy

SSA: Sub-Saharan Africa

SVAR: Structural Vector Auto-regressive

UMP: Unconventional Monetary policy

US: United States

VAR: Vector Auto-Regressive   WDI: World Development Indicators

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RESUME

The recession of 2009 originating from United States of America did not let indifferent the global economy. Developing countries were expected to be resilient to the crisis, but small exporting countries were more likely to be hit by the recession. The 2009 recession was transmitted to Sub-Saharan Africa through trade and financial channels. The onset of the recession made the trade volume and the commodity price collapse. Moreover, FDI, Remittances, and foreign aids were significantly affected by this crisis. The IMF only note the decline net portfolio investment in Sub-Saharan Africa. Countries less opened to global economy and those that were in good macroeconomic health were resilient to this shock. The goal of this paper, is to assess the impact of the 2009 recession on South Africa and Nigeria (two biggest African economies), evaluate the effectiveness of monetary policy to recover the economic activity and understand the impact of G7 monetary policy on these countries. Building on regression model, the paper analyzes the factors explaining macroeconomic fluctuations in South Africa and Nigeria. This model is based on three blocks, namely the international block (G7-countries), South African block and Nigerian block, to capture the effect of external shock on each country separately. The model is built on the assumptions that all external shocks coming from neighboring countries or from monetary and economic unions (which SA and Nigeria are part) are endogenous for Nigeria and South Africa, i.e these two countries do not respond to these shocks (Local cross-border shocks are endogenous). This assumption pushes to construct a model considering G7 shocks and domestic shocks. The results reveal that the monetary policy effect on GDP during the recession was significant in Nigeria, but insignificant in South Africa. The results also point out that macroeconomic fluctuations in Nigeria and South Africa are generally influenced by monetary policy shocks, credit shocks (domestic and G7) and the trade channel (food price, terms of trade, etc.).

Key word: Recession, financial channel, trade channel, monetary policy shock, credit shock, local cross-border shock

0. INTRODUCTION

According to the National Bureau of Economic Research's Business Cycle Dating Committee, a recession refers to *"a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in production, employment, real income, and other indicators"* (**IMF, 2009**). For the IMF, a global recession represents a decrease in real per-capita world GDP, sustained by a decline of other global macroeconomic indicators (industrial production, trade, capital flows, oil consumption, and unemployment).[1]

Neo-Classical economic theory underlines that during a recession, it is up to the economy to self-regulate to return to stability. On the other hand, Keynesian economists sustain the government intervention, i.e they argue that any government should apply policies that can project the economy to full employment and restore economic stability. However, government intervention can in some cases amplify the recession insofar as policymakers have not detected the causal factors of the economic slowdown and/or the mechanism through which these factors have poisoned the economy. Government interventions are generally related to fiscal policy, monetary policy, mixed policy, or structural reforms.

After the collapse of the American economy in 2009 owing to the global financial crisis (one year before), it could not let insensitive the rest of the world (with a world GDP share of 18%). **Adamu (2009)** argues that the financial crisis was followed by the collapse of important financial institutions which turned into economic contraction (2009's recession). Hence, all governments shaken by the crisis had to come up with rescue packages to reconstruct their financial systems. Agendas of countries affected were mainly focused on recovery strategies, market restoration, and social protection programs (**Kincaid et al, 2010**). The following figure highlights the way GDP growth of countries over the world evolved during the 2009 meltdown:

Figure 1 GDP Growth by the level of development, 2002-2011
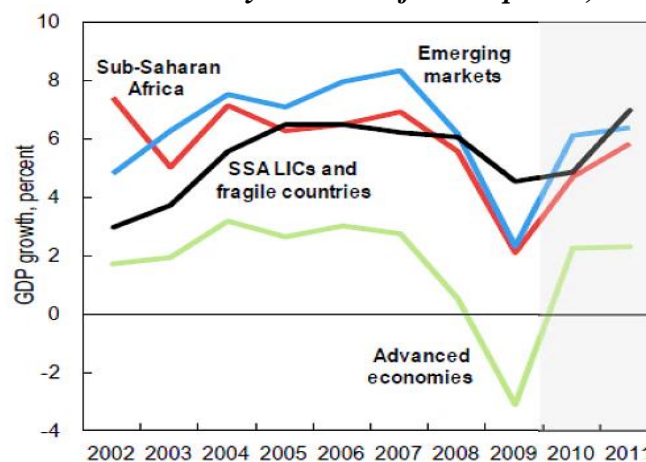
Sources: World Economic Outlook; and IMF, African Department database (IMF, 2011).

As can see in figure 1, high-income countries were more affected by the recession, because the latter was the source of the global economic slowdown. The least developed countries were less affected by the crisis, explained by the good macroeconomic trend in the pre-recession period and quasi-inexistence of factors that deepened the crisis (for instance the financial market). **Keeley and Love (2010)** explain that most low-income countries (Latin America, Africa, and Asia) felt the spillover effects of the 2009's

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[1] Bob Davis (senior editor on the wall street journal): What's a Global Recession? (Apr 22, 2009) on The Wall Street Journal (Economics) repeated on *https://blogs.wsj.com/economics/2009/04/22/whats-a-global-recession/*

recession, but countries less open to the global economy and those in the good macroeconomic run were not affected by the global calamity.

Sub-Saharan Africa was not spared from the shock despite its weak integration into the global market. The strong dependence of developing countries on advanced economies made Sub-Saharan countries more vulnerable vis-à-vis external shocks. Thus, the monetary and fiscal policies applied by developed countries could considerably affect developing countries.

Moreover, the impact of the 2009 global recession of advanced economies on Sub-Saharan Africa and other developing countries has been transmitted through different mechanisms. According to **Arieff et al (2010)**, and **Adamu (2009)**, Sub-Saharan African countries have been affected through the trade channel and the financial channel. Firstly, on the trade channel, the commodity prices (especially oil, ores & metals; and food prices) and the exports of goods and services slumped during the recent recession owing to the drop in global demand. The following figures show how commodity prices and exports evolved during the recession:

Figure 2 World Commodity Price Index
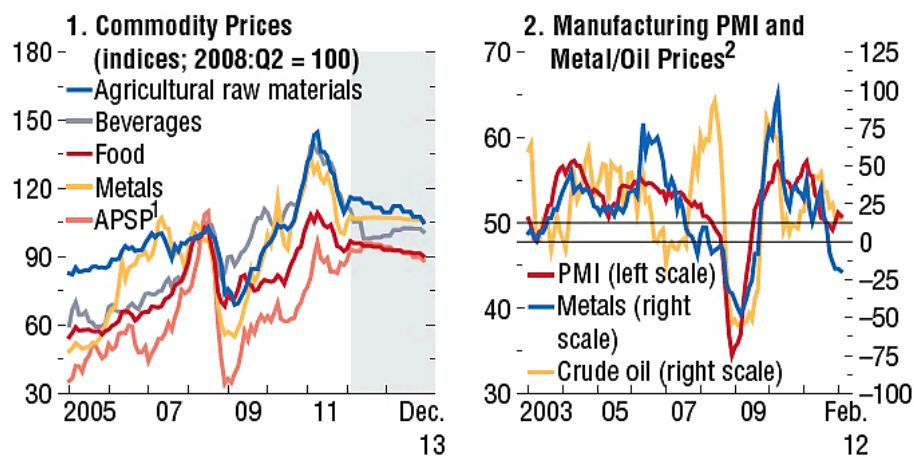
Sources: IMF, World Economic Outlook (2012)

Sub-Saharan Africa (SSA) exports are mainly focused on primary commodity goods (ores and metals, oil, and agricultural products) representing on average 56.66% of total exports[2]. Hence, the sharp decrease of commodity prices directly affects small open export-based economies by contracting real sectors (especially South Africa and Nigeria). The commodity price is supposed to be exogenous for a small open economy; i.e South Africa and Nigeria cannot exert any influence on it, the latter takes the price proposed by the world market. From 2012 to 2017, Nigeria represented 4.04% of World exports of oil (**Kolomeytseva, 2019**) and South African Platinum production accounted for 72% of World production (**Fischer-Kowalski et al, 2015**). Further, exports also follow the trend of commodity price by declining significantly during the 2009 recession, as one can see in the figure below:

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[2] World Integrated Trade Solution (WITS) platform: *Sub-Saharan Africa Trade Summary 2007-2018 Data*

https://wits.worldbank.org/CountryProfile/en/Country/SSF/StartYear/2007/EndYear/2018/TradeFlow/

Export/Indicator/XPRT-PRDCT-SHR/Partner/WLD/Product/stages-of-processing

Figure 3 Sub-Saharan Africa exports
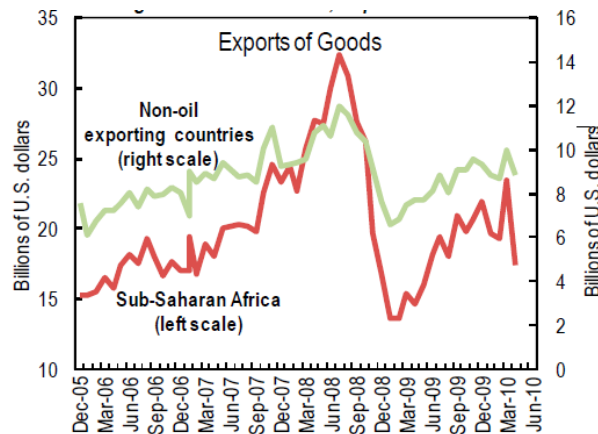
Sources: IMF, Direction of Trade Statistics; and IMF, International Financial Statistics (IMF, 2010)

The figure above shows how Sub-Saharan countries' exports declined during the 2009 recession and recovered again due to the policies applied for economic stabilization. The exports declined from 44.2% of GDP in 2008 to 33.2% of GDP in 2009 (**IMF, 2010**).

Secondly, SSA countries were affected through the financial channel, especially with a drop in Foreign Direct Investment (FDI), falling remittances from overseas workers, and cuts in foreign aid from developed countries (**Arieff et al, 2010**). On the other hand, the openness of capital inflow, financial market index, and private inflow & outflow in the percentage of GDP, could also induce the occurrence of global recession effects on developing countries.

Being the biggest African economies (in the African real GDP) and more connected to the global economy through trade and finance flows; Nigeria and South Africa were more likely to be hit by the global recession. On geographic view, the southern part of Africa was more affected by the global recession, specifically South Africa in 2009. Indeed, the slowdown of the external demand for oil, minerals and precious stones has strongly contributed to the slowdown of the African economies (**IMF, 2010**). Through quarterly analysis, we note that both SA and Nigeria have felt the crisis, but the SA meltdown were more drastic, as one can see in the figure below:

Figure 4 Evolution of Nigerian and South African GDPs
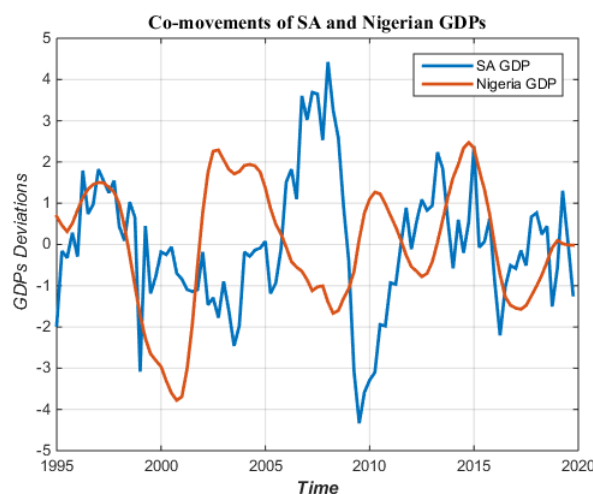
Source: Estimation with Matlab

According to **Houssa et al (2013, 2015, and 2019)**, the global shocks (demand, supply, commodity price, and credit shocks) play an important role in explaining macroeconomic fluctuations in South Africa. They indicate that external shocks account for 20 to 30% in macroeconomic variations in South Africa. In particular, the commodity price and the credit are the main channels through which foreign shocks (especially G7 countries) affect the South African Economy. For **Oladunni (2019)**, external shocks are transmitted to Nigeria trough trade channel (external demand shocks and oil price), financial channel (credit, funding, and non-banking channels) and the uncertainty channel (uncertainty occurs when agents are pessimistic or less optimistic regarding the tendency of domestic or/and global macroeconomic situation). He emphasizes that the global demand shock and oil price shock are the main foreign drivers of the Nigerian macroeconomic fluctuations. Indeed, the global demand shock drastically explains the evolution of the domestic GDP growth and inflation whereas oil price shock deploys high pressure on the domestic interest rate and the terms of trade.

Furthermore, the dominance of Nigeria and South Africa in African exports and financial integration, explains why we took these countries as the study case for analyzing the way African Central Banks ruled monetary policy to respond to the 2009's recession. It is crucial to note that the big part of African exports is oriented to Europe, one of the places hardly hit by the global recession.

The steady growth, the low inflation, the sustainable fiscal balances, the rising foreign exchange reserves, and the declining government debt made almost Sub-Saharan African Economies on a good track. Thus, when the recession happened there was room for these economies to apply countercyclical monetary and fiscal [3] policies to maintain macroeconomic stability (**IMF, 2010**). However, **Kraay and Serven (2013)** find that almost developing countries applied procyclical fiscal policy by decreasing government expenditures to cushion the effect of recession.

Being the cradle of the Global Financial Crisis (GFC), developed countries were more affected by the recession; thus, conventional monetary policy was not enough to fix the economic crisis, even at lower zero-bound rates. Therefore, advanced economies applied unconventional monetary policy to sustain the traditional monetary policy. **Kannan et al (2009)** evaluated the responses of G7 to the recession. They state that both expansionary fiscal and monetary policies conducted, tend to curtail the duration of recessions.

The Federal Reserve System and the European Central Bank played a main role in developed economies by decreasing the interest rate to lower zero-bound level. To sustain the lower zero-bound rates, the Federal Reserve System applied unconventional monetary measures, based on quantitative easing (QE)[4]. European Union was facing the global financial crisis and debt crisis. To supplement the classic monetary policy, the European Central Bank (ECB) implemented unconventional measures essentially focused on the banking system known as Enhanced Credit Support (credit easing) (**Ferreira, 2015**).

Considering the effect of advanced countries on developing countries, not only the recession in developed countries has affected low-income countries (SSA included), but also developed countries' responses impacted the latter during the recession and post-recession period. **Gurara and Ncube (2013)** find that the use of QE in developed countries has affected developing countries by exerting slight inflationary effects on developing economies putting pressure on exchange rate appreciation, through capital inflows. Further, **Megersa (2017)** explained that the announcement of unconventional monetary policy by the

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[3] The countercyclical fiscal policy specific to recession represents a fiscal policy which stimulates the economic growth by increasing fiscal deficit. And the countercyclical monetary policy, allows the increase of economic growth by decreasing the interest rate (Chauvin and Geis, 2011).

[4] The QE refers to an unconventional monetary policy consisting for the central bank to purchase debt securities, treasury bills or corporate bonds in order to increase money supply.

FED and ECB has affected the price of financial assets in South Africa by decreasing yields, lowering the interbank rate, lowering credit default swaps (CDS) spreads, increasing stock market indices and appreciation of the rand; owing to the fact that the purchases of assets by central bank forced investors to look for substitute assets abroad.

As part of this work we perform a comparative analysis. First, the present research evaluates the impact of the recession on South Africa and Nigeria. Second, it compares the two strong African economies in terms of the monetary policy conducted during the recession.

Globally, the present research aims to find out and understand the role of monetary policy in Nigeria and South Africa during the recession and the post-recession period, by explaining the contribution of the monetary policy to the road of recovery. It is difficult to capture the effect of the monetary policy; while different shocks hit these economies, mainly external shocks (Demand, supply, monetary policy, commodity and credit shocks) and other domestic shocks (Demand, fiscal policy, supply shocks, etc.). Hence, we need to evaluate the role played by each shock on macroeconomic fluctuations in SA and Nigeria. **Loayza and Raddatz (2006)**, **Bahmani and Toms (2015), Houssa et al (2013, 2015, 2019)**, and **Oladunni (2019)** underline different factors which explain the fluctuation in emerging and developing countries. We build a model capturing the impact of each factor on SA and Nigerian GDPs and finally see whether the results are similar to empirical studies.

This research focuses on 3 questions:

- *What is the impact of the 2009 global crisis on Nigeria and South Africa?*

All macroeconomic indicators show that both these two countries were affected by the global crisis. Sub-Saharan African countries responded to 2009's recession by easing procyclical fiscal and expansionary monetary policies. Thus, government expenditure declines after the occurrence of the great recession and increases when the economy recovered (positive co-movement between government expenditure and GDP). In response to the recession, policymakers lowered nominal interest rates quickly and by significant margins. When central banks tried to decrease the domestic interest rates in response to the economic slowdown, particularly in some countries with open capital accounts and floating exchange rate regimes, domestic interest rates often drifted upward because of rising external shocks (**IMF, 2010**).

Houssa et al (2019) applied historical decomposition in an SOE-DSGE model to capture how domestic and foreign shocks affect macroeconomic fluctuations in SA. **Oladunni (2019)** used a historical decomposition tool in a VAR model to explain business cycles in Nigeria. To capture the impact of the global recession on both these two countries, we use business cycle analysis based on the amplitude of the crisis and identify which country have been more affected. The co-movement analysis is done to see the linkage between the GDP cycle and trade channel, financial channel and monetary policy cycles. Further, using regression model the paper evaluates which variable significantly explain the change in GDPs.

- *Was the monetary policy applied by SARB and CBN[5] effective for economic growth?*

We analyze the effectiveness of monetary policy with respect to GDP growth i.e identify how strong the monetary policy affects economic recovery. The co-movement analysis can give an image the way the GDP evolved compared to the policy rate and see whether the change in policy rate did bring the improvement of GDP, knowing that the monetary policy frameworks of both countries are based on monetary and inflation targeting (Nigeria and SA respectively). The regression model brings more light on the impact of the monetary policy on the GDP growth.

- *How did SA and Nigeria respond to the advanced economies' policies?*

Using regression model, we will identify whether Nigerian and South African responded to external monetary policy. **Borensztein, Darius, and Kalemli-Ozcan (2019)** explained that the unconventional

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[5] SARB: South African Reserve Bank and CBN: Central Bank of Nigeria

monetary policy has destabilized the monetary policy implemented by developing countries as this policy has increased the capital inflow to developing countries exposing these countries to inflation tension.

The remaining part of this research is based on four other points, namely the point 1 focused on the economic background of SA and Nigeria, point 2 is based on the literature review, point 3 is related to modeling, methodology, and data; and point 4 is based on the empirical result.

1. BACKGROUND ON NIGERIA AND SOUTH AFRICA

The choice of working on South Africa and Nigeria is not random regarding the openness and economic of both these two countries in SSA. Hence, the major factors through which SSA countries were impacted are dominated jointly by South Africa (ores and metals exporter) and Nigeria (oil exporter). They also represent consequent share of SSA GDP and population.

1.1. Contribution of SA and Nigeria on African economies

Figure 5 South African and Nigerian share of SSA' real GDP (2000-2017)
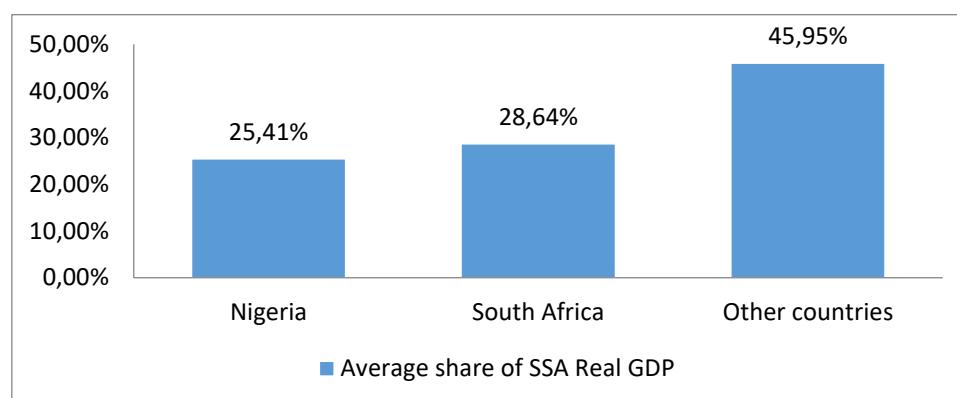
Source: Author's computation using UNCTAD data

From 2000 to 2017, both South Africa and Nigeria mainly represent 54.05% of SSA real GDP of all 44 countries. The dominant share of South Africa and Nigeria implies that when both these two economies collapse, all SSA economies are hurt.

Figure 6 South African and Nigerian share of SSA' population
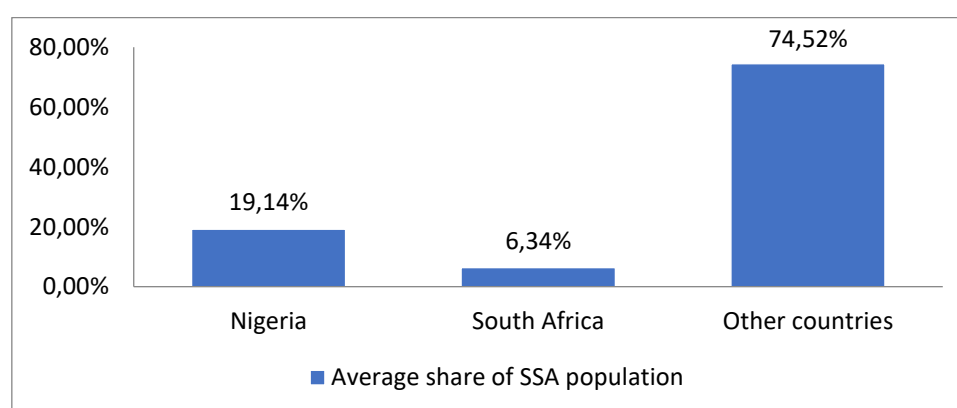
Source: Author's computation using UNCTAD data

Regarding the share of population, South Africa and Nigeria represent 25.48% of SSA population.

1.2. Determinants of Transmission of the crisis

The trade and financial channels are recognized as the main transmitters of shocks to developing countries, in this part we select some important variables.

The export shares of Nigeria and South Africa add up to more than half the total exports of SSA from 2000 to 2013 (see figure 7):

Figure 7 Goods and services export of SSA countries in %
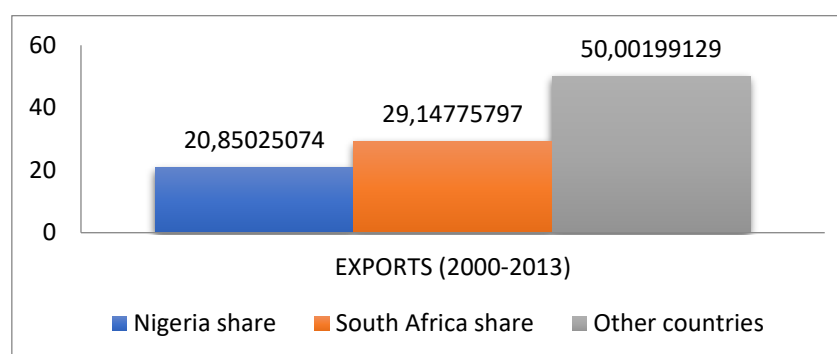
Source: Author's computation using UNCTAD data

From 2000 to 2013, the share of Nigeria in the exports of goods and services is on average equal to 20.85% and South Africa represents 29.15%; i.e both these two countries represent 50% of Sub-Saharan African exports of goods & services. Given the fact that exports were affected by the crisis, both economies were more likely to be shaken. **Houssa et al (2019)** state that South African exports of goods and services are mainly dominated by primary commodity goods (especially mining) valued for 40% of total exports in merchandises and services. On the other hand, **Oladunni (2019)** shows that fuel export (oil included) represents the preponderant share of Nigeria's trade with the rest of the world since it accounts for 80 to 95% of merchandise exports). Overall, the World Bank national accounts data and OECD National Accounts data files (2007-2017) reveal that trade represents on average 35.25% and 61.62% of GDP respectively in Nigeria and SA, this implies that SA is more open to trade channel.

Regarding the financial channel, Nigeria presents a higher degree of openness of capital inflow and financial market than SA, as we can see in the figures 5 to 6 below:

Figure 8 FDI Stock in African Countries (2017)
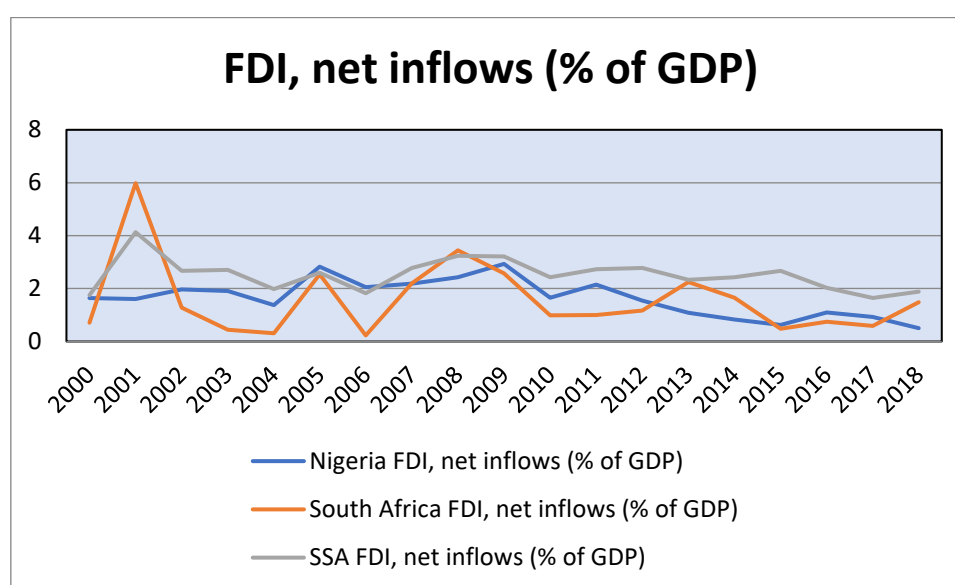
Source: Author's computation using World dataset

The recession has not as much affected the level of FDI Nigeria and South Africa represent, both the economies recorded a fall of FDI in percentage of GDP during 2010. This indicator is relevant to capture changes in financial synchronization between developed countries and developing countries.

Figure 9 Openness of Capital Inflows Index (1=fully liberalized) (Units)
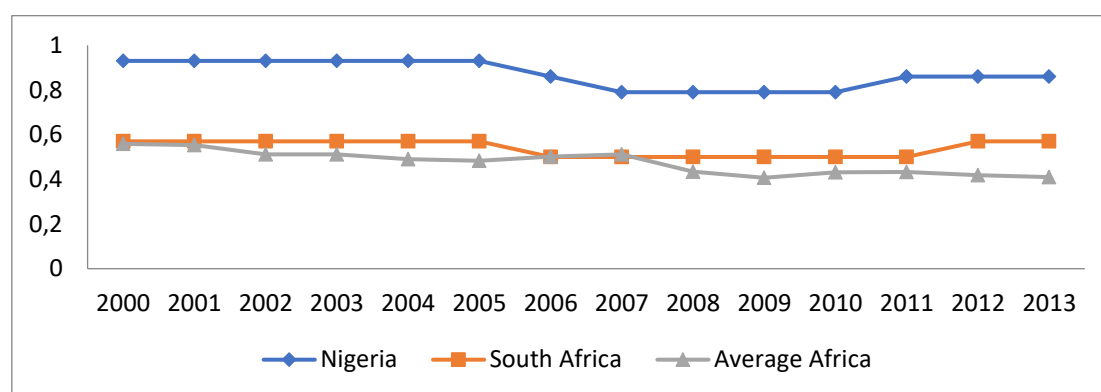
Source: Author's compilation using IMF data mapper[6]

The figure reports that the more the country is closed to 1 there is more capital openness. This indicator shows that Nigeria has less restriction on regulation of foreign inflows compared to South Africa (the index is closed to 1). The capital inflows are one of the main transmitters of external financial shocks to developing economies.

Figure 10 Financial Market Openness Index (equity, bond, money market, collective investment, derivate) 1= fully liberalized
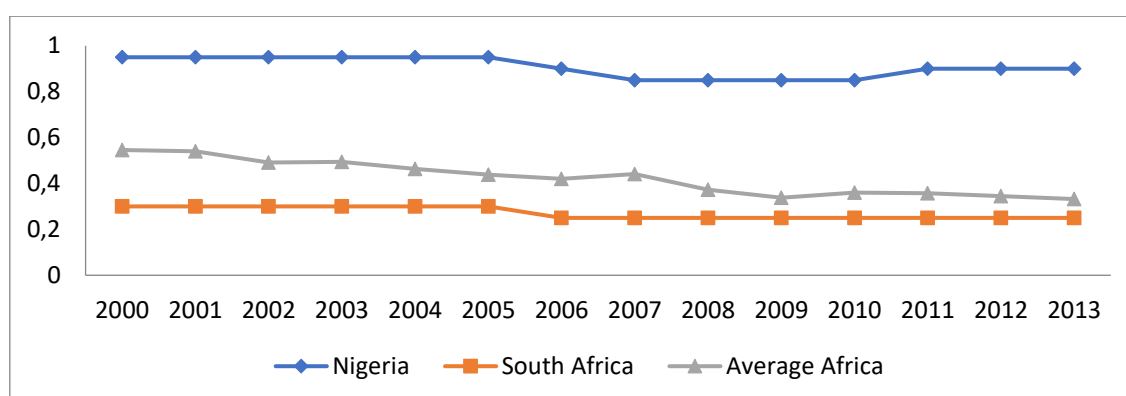
Source: Author's compilation using IMF data mapper

Moreover, the financial market openness index indicates that the Nigerian financial market is more liberalized than SA, and this index is flatter over time. Thus, this liberalization exposes the country to different external shocks that can occur in the financial market.

Regarding private inflow and out in percentage of GDP, we note a huge decline during 2008 in both the two countries, owing to the Global Financial Crisis. The World Bank defines the Gross private capital flows as "the sum of the direct, portfolio, and other investment inflows and outflows included in the balance of payments financial account, excluding changes in the assets and liabilities of monetary authorities and general government" (**Pham, 2010**). The figures 11 to 12 below show how private capital inflow & outflow evolved:

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[6] capital and financial openness: https://www.imf.org/external/datamapper/datasets/CL/1

Figure 11 Private Inflows excluding Direct Investment (% of GDP)
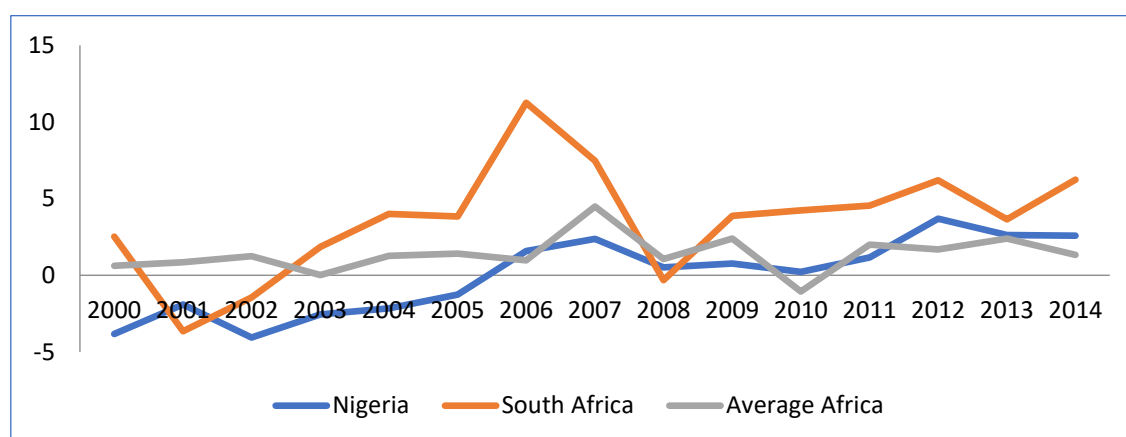
Source: Author's compilation using IMF data mapper

Through the figure we can see that SA private inflows were strongly hit by the GFC compared to Nigeria, despite the high capital openness of the latter. On the other hand, private outflows followed the same trend as inflows, by decreasing strongly in 2008 (especially in SA) as we can see in the graph below:

Figure 12 Private Outflows excluding Direct Investment (% of GDP)
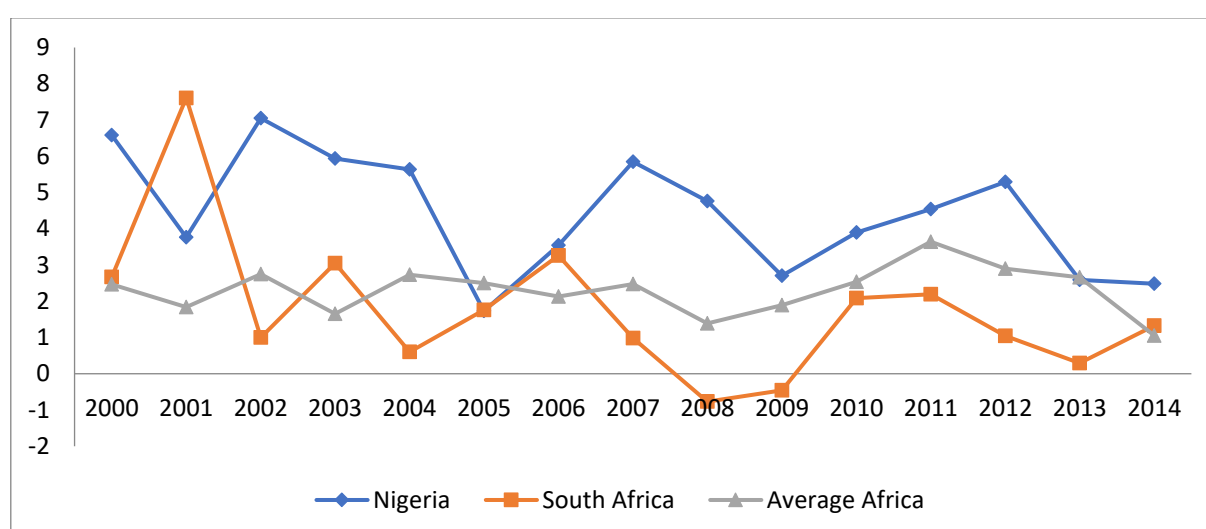
Source: Author's compilation using IMF data mapper

Based on the World Bank Global Financial Development Database (2007-2013), foreign banks among total banks (%) represent 19.43% and 23.43% of total banks in Nigeria and SA respectively. The foreign bank assets among total bank assets (%) value 12.14% and 22.86% in Nigeria and SA. The two indicators give more light on the degree of financial openness of these two countries and how they were financially exposed to the global recession as long as the foreign financial institutions could trigger the crisis through sudden stops by refinancing native countries or/and spillover effects of stock market decline. Further, one more important indicator is the domestic credit to the private sector in the percentage of GDP, the index allows finding the role of domestic banks in financing the economy. Hence, we note that the SA economy is strongly financed by domestic credit compared to Nigeria's real sector (15.87% and 147.24%, respectively to Nigeria and SA).

1.3. Responses to the meltdown
1.3.1. Nigerian response

Nigeria is among those SSA countries which experienced positive annual GDP growth during the recession. The crisis happened when the country had a low level of inflation, fiscal deficit, and a high

policy rate. These facts allowed Nigeria to apply both procyclical fiscal and countercyclical monetary policies. The following graph highlights how Nigeria responded by increasing fiscal deficit (Figure 13):

Figure 13 Nigerian Fiscal Deficit (Percent of GDP) 2003–2011
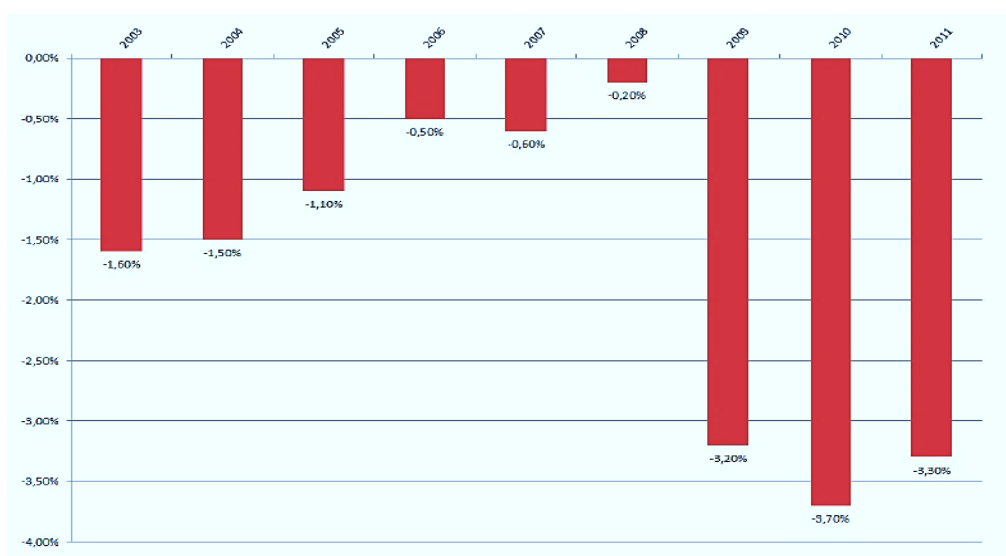
Source: Central Bank of Nigeria (Ozsoz, 2017).

To reach recovery, the Central Bank of Nigeria implemented the expansionary monetary policy by decreasing the policy rate to facilitate credit access and improve economic activity. Through the figure 10, we can see the way central Bank of Nigeria managed the policy rate to improve financial conditions:

Figure 14 Nigerian Monetary Policy Rate 2007–2010
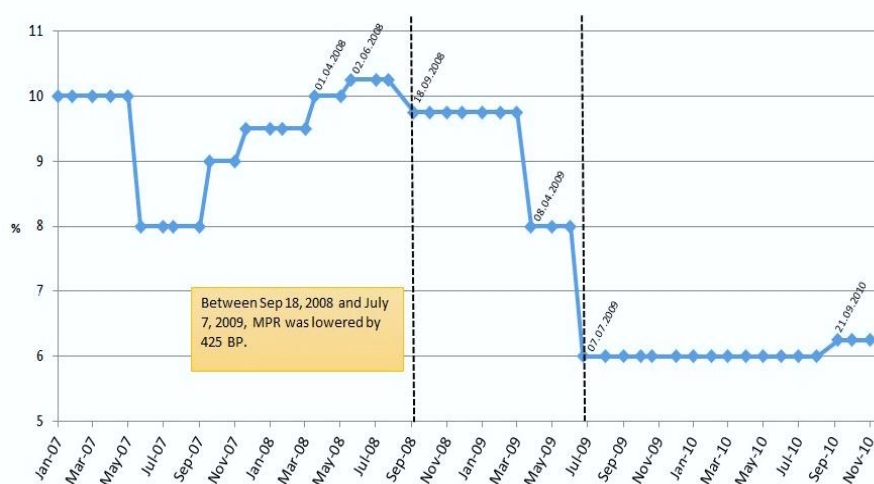
Source: Central Bank of Nigeria (Ozsoz, 2017).

The recovery of Nigeria did not take many quarters to be reached as the country was economically stable before the onset of the recession.

1.3.2. South African response

South Africa is among the country seriously hit by the 2009's recession in terms of negative GDP growth, unemployment, trade shocks, portfolio investment, FDI, etc.

Figure 15 South Africa Consolidated Fiscal Balance÷(% of GDP)
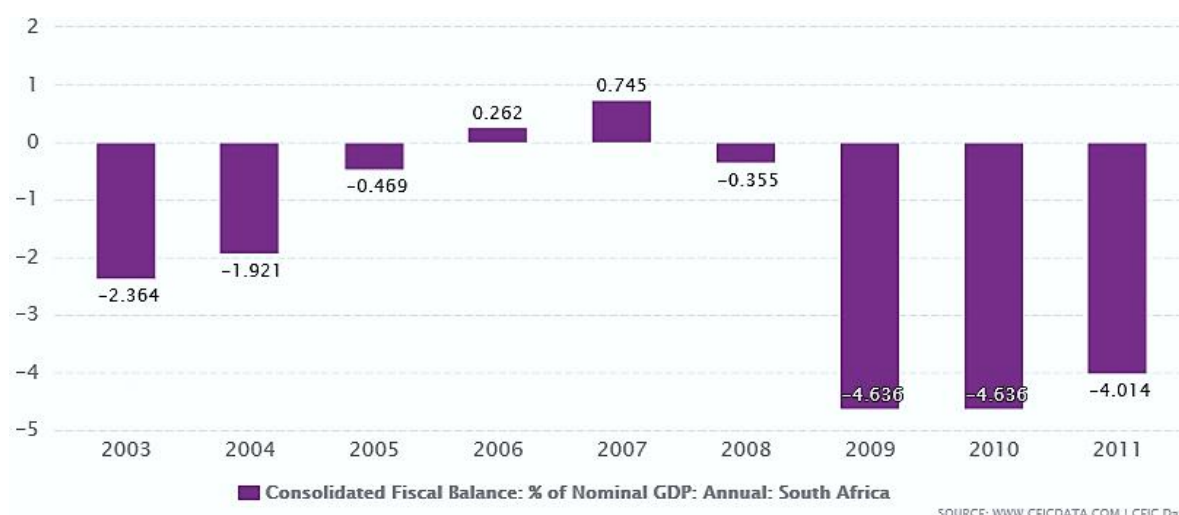
Source: South African Reserve Bank Data (www.ceicdata.com/en/indicator/south-africa/short-term-interest-rate)

Looking at South Africa and Nigeria's fiscal deficit before the onset of the recession, they both had space to apply expansionary fiscal policy. However, Nigeria has more room to apply expansionary fiscal policy as the fiscal deficit was set low compared to South Africa. Nigerian fiscal deficit in 2008 was equal to -0.20% of GDP and increased to -3.20% in 2009, while in South Africa the fiscal deficit increased from -0.355% to -4.636% of GDP from 2008 to 2009. But in the periods preceding the global financial crisis, South Africa was on a good track compared to Nigeria regarding fiscal deficit.

Figure 16 South Africa Short term Interest Rate
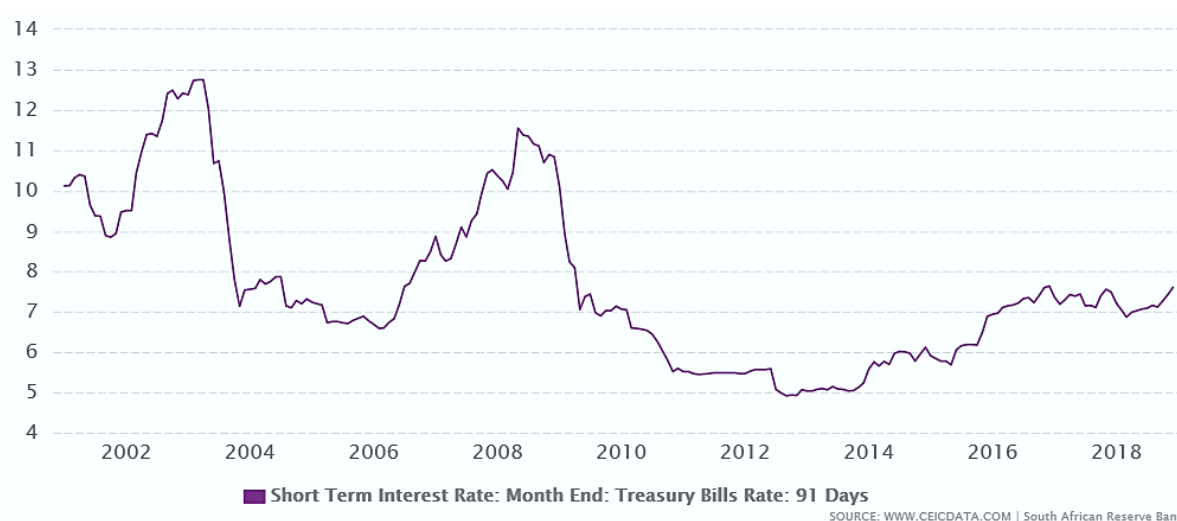
Source: South African Reserve Bank Data (www.ceicdata.com/en/indicator/south-africa/short-term-interest-rate)

Concerning monetary policy, South Africa presents a policy rate tending to 5% while Nigeria's fund rate tended to 6% after the recession. Hence, South Africa used slightly more loosened monetary policy compared to Nigeria.

2. LITERATURE REVIEW
2.1. Theoretical Literature

Understanding the impact and policy of the African Central Bank during a recession requires first defining how central banks intervene using monetary policy to stabilize the economy. In this section, we aim to present different concepts related to monetary policy by explaining the instruments of monetary policy, the effects of each instrument on the economy and the monetary policy framework in South Africa and Nigeria. The present theoretical framework is essentially focused on approaches used by the central bank to manage economic indicators (inflation, recession, unemployment).

During the 2009 recession, central banks all over the world used different tools to respond to this economic disaster; here we describe what the theory says about monetary policy tools. Hence, two points are developed respectively the central bank and monetary policy, and the joint use of monetary policy tools (empirical evidence).

2.1.1. Central Bank and Monetary Policy

The monetary policy refers to the instrument used by the central bank to respond to economic necessity in each country; it can be used for economic recovery goals or inflation stability.
According to **Warin (2005)** and **Epstein (2002)** monetary policy is the procedure of controlling a country's money supply to achieve specific goals, for instance cushioning inflation, or reaching full employment. **Blanchard (2009)** explains that the primary tool of monetary policy is based on open market operations. He emphasizes that open market operations consist of the central bank to buy or sell securities to decrease or increase the money supply. The purchase of securities directly expands the money supply and decreases the level of interest rate, while the sale of securities contracts the money supply and increases the level of the interest rate. Moreover, the type of open market operation will depend on the goal the central bank wants to achieve. For instance, to dampen the recession the central bank needs to apply an expansionary monetary policy to finance the economic activity; on the other hand to reduce the inflationary pressure, the contractionary monetary policy (sale of securities) can be the right to tool to stabilize the price level.

To conduct monetary policy, the central bank uses different instruments to reach its target (regarding what the central bank is aiming to fight). The central bank can use two types of instruments to conduct monetary policy, namely conventional and unconventional monetary measures.

The conventional monetary policy tool is the central bank's control of the nominal interest rate; hence, the interest is lowered to create a facility of access to credit, which in return finances economic activities. However, unconventional monetary policy can be described as an additional category of monetary policy related to any other type of intervention conducted by the central bank, which has nothing to do with the interest rate control (**Sheedy, 2017**).

A. Conventional monetary policy instrument
The main instrument of conventional monetary policy is the control of a short-term interest rate; variations in the policy rate affect financial conditions (the availability and cost of funding) and the macroeconomic aggregates (public and private consumption, output, and inflation).

Conventional monetary policy is transmitted from the policy rate to Economic activities comprising intermediary stages related to short-term funding markets, to longer-maturity bonds and bank funding and lending markets, exchange rates, and equity markets (**Committee on the Global Financial System, 2019**). This transmission mechanism can hold under some conditions. First, it requires room for the policy rate to change in the favorite direction and not to face the constraint of the lower bound. Second, commercial banks must adjust the lending rate to changes occurred in the policy rate, otherwise, the effect will not be transmitted to households. For instance, during the recession, household activities are riskier, and then commercial banks are tempted to keep the lending rate high or put more restrictions on

credit access despite the policy rate cut. This situation can be a strong brake for the transmission of the policy rate cut to economic activity.

B. Unconventional monetary policy instruments

At a certain level the conventional monetary policy can be unable to stop the economic slowdown. Hence, the unconventional monetary policy can be implemented to make monetary policy effective. Unconventional monetary policy instruments include balance-sheet policies (quantitative easing and credit easing policies), emergency lending programs, and subsidized access to credit, macro-prudential policies, negative interest rates (**Sheedy, 2017**).

a. Balance-sheet policies

The balance-sheet policies refer to the increase of the central bank assets by purchasing bonds and other securities to widen the liquidity access in the economy. Numerous instruments can be used to stimulate credit access, for instance, quantitative easing, credit easing, etc.

Blinder (2010) explains that the Quantitative easing (QE) represents the variation in the composition and/or size of a central bank's balance sheet planned to facilitate liquidity and/or credit conditions. The goal of QE is to improve economic conditions by increasing the money supply through the central bank's purchase of securities. **Williamson (2016)** adds that QE is mainly focused on purchasing long-term government securities than short-term government securities. The reverse of this policy can be called quantitative tightening referring to the contraction of liquidity and credit access. The credit easing consists of the central bank to purchase credit bond (treasure bills, mortgage-backed securities, etc.) to facilitate interbank credit connection. During the recession the Fed applied the quantitative easing to accompany conventional monetary measures, while the Euro-zone used the credit easing to stimulate interbank credit connection as numerous banks were drastically affected by liabilities. However, the Euro-zone shifted to QE in 2015, as this unconventional measure previously implemented did not bring to successful outcomes.

b. Subsidized credit and Macro-prudential policies

The unconventional monetary policy can be related to subsidized credit access from either the central bank or government. This policy is financed by lump-sum taxes. To avoid the increase in credit risk, macro-prudential policies provide limitations on credit access above and beyond the value of the housing collateral. This restriction is defined as a maximum loan-to-value ratio for borrowers (**Sheedy, 2017**).

c. Negative interest rate

Williamson (2016) underlines that after the 2009's recession; some central banks over the World applied negative nominal interest rates to mainly sustain the increase of inflation. For instance, the Swedish Riksbank, the European Central Bank, the Swiss National Bank, and the Bank of Japan, lowered their nominal interest rates below zero.

2.1.2. The joint application of conventional and unconventional monetary policies: stylized facts

To fight the recession in 2009, central banks of developed countries mostly combined conventional monetary policy and balance-sheet policies, especially quantitative easing and credit easing, while, in developing countries (SSA in particular), Central banks conducted conventional monetary policy by cutting the nominal interest rate.

The magnitude of the recession faced by developed countries (G7 in particular) made the interest control unable to cushion the global recession. The Fed, the Bank of England, and the European Central Bank started by decreasing the policy rate until near zero-bound rate but the monetary policy remained ineffective, they resorted to the balance-sheet policy to stabilize their economies (**Joyce et al, 2012**).

The figures below expose how conventional and unconventional monetary policies were jointly conducted in the US and the Eurozone. Through these graphs we can note that the balance-sheet policy and the policy rate were negatively co-moved in advanced economies, i.e during the pre-recession period balance sheets of central banks in advanced economies were low while the policy rate is high; when the

recession occurs, the balance sheets of central banks started increasing through the purchase of securities while the policy rate decreased down to near zero-bound.

Figure 17 US Federal Reserve Policy Rate and Balance Sheet
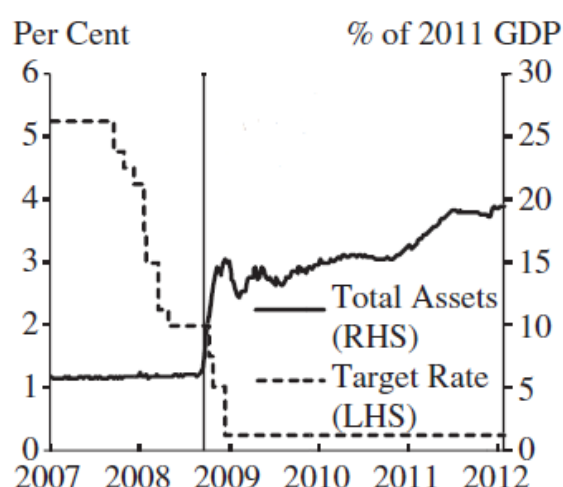
Sources: Bloomberg, Thomson Reuters DataStream, Federal Reserve, and Bank of England calculations (Joyce et al, 2012).

Farmer (2012) shows that the balance-sheet of the Fed increased by approximately 800 to over 2,000 billion dollars from 2007 to 2008. Through the figure above, we can also note the huge decrease in policy rate down to near zero bound. The Federal Reserve also applied "Operation Twist"; it consisted of the Fed to sell short-term government bonds and buy long-term bonds. The goal was not to raise the size of the balance sheet of a central bank but to affect non-standard interest rates (**Warin, 2005**).

Figure 18 European Central Bank Policy Rate and Balance Sheet
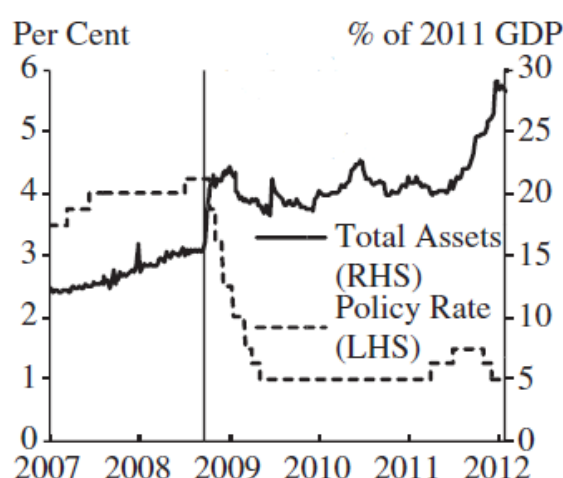
Sources: Bloomberg, Thomson Reuters DataStream, European Central Bank, and Bank of England calculations (Joyce et al, 2012).

Regarding the figure above, we note that the ECB increased its balance sheet by 2.5% to 30% from 2007 to 2012, while the policy rate declined from 3.5% to near 1%. However, despite the joint application of CMP and UMP, the recovery of Europe delayed compared to the US. This could be explained by the type of unconventional tool chosen by the ECB (credit easing) and the debt crisis in the Euro-zone.

It is important to note that the effects of the monetary policy applied by developed countries did not let open small economies indifferent; more opened SSA economies were affected. Rather than only respond to the global recession, they were also constrained to respond to spillover effects of the monetary policy conducted in developed economies.

2.1.3. Monetary policy frameworks in Nigeria and South Africa
A) Central Bank of Nigeria Monetary policy frameworks
a. The Mandate of the CBN (CBN Act 2007)

The central bank of Nigeria Act 2007 gives the charge for modeling and running monetary policy in Nigeria to the CBN. So far, the function was exerted by the CBN supervised by the Ministry of Finance in complicity with the President of the Federal Republic of Nigeria. Under the 2007 CBN Act, the Bank performs its monetary policy functions through the Monetary Policy Committee (MPC). The MPC was established by the CBN in 1999 to anchor the task of monetary policy formulation (**CBN, 2016**). Specifically, the Act provides that the MPC will help to facilitate the attainment of price stability; and support the economic policy of the Federal Government.

b. The Objectives of Monetary Policy in Nigeria

The monetary policy in Nigeria aims to attain price stability, maintain external payments equilibrium, promote employment and output growth, and sustain economic development. Where the stability of the financial system is vulnerable, these short- and long-term objectives could be subordinated to the essential objective of reaching financial stability (**CBN, 2011**).

Given the CBN Act 2007, the main goal of monetary policy is to ensure monetary and price stability. Generally, the monetary policy of the CBN is attached on four main pillars: Inflation as a monetary phenomenon; the public's expectation of future inflation (allows people to better plan future investment and consumption); proactive and rule based monetary policy; and independence of the central bank to fix monetary policy.

c. Instruments of Monetary policy in Nigeria

Policy instruments are mainly based on the interest rate, this indicator is used by the CBN to achieve its goals. The interest rates currently used in monetary policy by the CBN include *the interbank discount rate, the treasury Bill rate, the saving deposit rate, the fixed deposit rate, the lending rate, and Monetary Policy Rate (MPR), with the MPR serving as the anchor rate* (**IMF, 2019**). The Central Bank of Nigeria through the Monetary Policy Committee (MPC) conducts monetary policy using the instruments available which in turn impact the supply of money. This will finally reach the goal by affecting inflation, exchange rate, economic growth, etc.

d. Evolution of CBN's Monetary Policy strategies

The Nigerian monetary policy has evolved over time through different monetary policy framework, building on exchange rate targeting in 1959-1973 and monetary targeting (direct era from 1973 to 1993 and indirect era in 1993-date). Central banks work under well-defined methods and techniques to reach the ultimate purposes of monetary policy. Theses goal can be related to different factors: ultimate (inflation, nominal GDP, exchange rate, etc.) or intermediate variables (the money supply and market interest rate), etc. (**CBN, 2016**)

i.   Exchange Rate Targeting (1959-1973)

The exchange rate targeting is also called exchange rate peg. It is related to the fixing of the value of the domestic currency in respect of another low inflation currency. This strategy started in the pre - World War I era, when the gold standard was in use. In this period, the almost countries' currencies were converted to gold at fixed exchange rates (**CBN, 2011**).

In recent era, exchange rate targeting implies fixing the value of a domestic currency to another called the anchor currency. Choosing the foreign currency anchor generally be subject to the relative stability and low rate of inflation of that country as well as the relative weight of its trade in the anchoring country's international trade with the anchored country's currency.

The implementation of this monetary policy framework in Nigeria during the colonial period was mainly conducted under economic conditions in Britain. The framework began with fixing the exchange rate between the Nigerian currency and the British pound (**Nnanna, 2001**). The challenge of finding the right anchored currency, pushed the CBN to shift to monetary targeting (in 1967 when the British pound devalued, the CBN switched to US dollar and once again in 1970s when the US dollar depreciated, the British pound became the anchored currency).

ii.   *Monetary Targeting (1973-Date)*

From 1970, the economy faced a major structural change that impacted the management of monetary policy. The Oil dominance in the export basket, representing 57.6% of total export in 1970 and over 96% from 1980. Whereas non-oil exports (mainly agriculture) dropped speedily from 42.4% in 1970 to 16.9% in 1973. The requirement to finance post-war developments also led to a drastic growth in public spending has increased inflationary pressures. Given this situation, the monetary authorities adopted a new monetary policy framework. The monetary targeting in Nigeria involved the use of market (indirect) and non-market (direct) instruments (**Nnanna, 2001**). This strategy aims to control monetary aggregates and builds on the assumption that the inflation is basically a monetary phenomenon.

❖ **Direct Control, 1973-1993**

The major objective of monetary policy during this period was to promote rapid and sustainable economic growth. Indeed, the monetary authority imposed quantitative interest rate and credit ceilings on the deposit money of banks and prescribed sectoral credit allocation to the various sectors of the economy. Different sectors, such as agriculture, manufacturing and construction, were targeted for the most favored treatment, in terms of generous credit allocation and a below-market lending rate (**Nnanna, 2001**).

❖ **Indirect monetary control (1993 to date)**

The indirect monetary policy required the use of market instruments to regulate the growth of major monetary aggregates. Under this framework, only the operating variables, the monetary base or its components are targeted, while the market is left to determine the interest rates and allocate credit. These instruments are related to open market operations, reserve requirement, discount window operations and moral suasion (**Nnanna, 2001**). This indirect monetary policy is focused on inflation targeting as a nominal anchor. As the final target for all regimes was to guarantee the price stability, the graph below highlights the way the inflation evolved under the 2 different types of monetary policy framework:

Figure 19 Headline Inflation under Different Monetary Frameworks in Nigeria
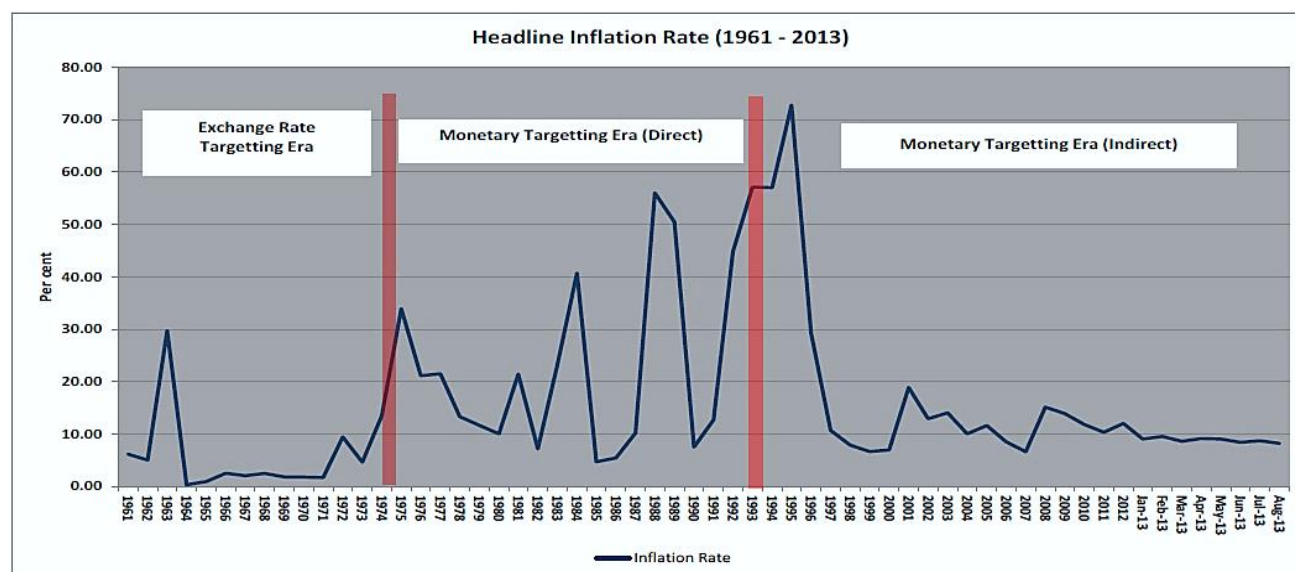
Source: Mordi and Adebiyi (2014)

The up-mentioned figure displays that the Nigerian monetary policy framework switched from exchange rate targeting with low inflations to a direct monetary targeting characterized by high price volatility. Looking at the headlines of inflation, the shift from direct monetary policy to indirect monetary policy brought the inflation from more than 70% to less than 20%. This can be related to the implicit attention of the indirect control of monetary policy on price stability. However, we cannot only attribute the change in inflation to the monetary policy framework, as different factors may behind these changes.

    e.   **Challenge to monetary policy in Nigeria**

The challenges to the effective implementation of monetary policy in Nigeria includes the following:

-    *Operating cost*: this mainly refers to the cost of liquidity management. The capacity of the central bank to preserve certain level of liquidity in the economy would require some interest payments and cost of liquidity management.
-    *Fiscal dominance*: this is related the level at which the monetary policy finance fiscal deficit. As a member of Economic Community of West African States (ECOWAS), the monetary policy is required to finance 10% of public deficit. The Nigeria always face the challenge of meeting this threshold.
-    *Structural rigidities*: this challenge refers to factors that constrain the mobility of resources between producers and consumers. The present phenomenon leads to the artificial price increases that have not arisen because money supply grows faster than the production of goods and services.
-    *External shocks*: the Nigerian Monetary policy is in fact affected by external shocks through the foreign exchange rate of the Naïra. The crude oil price shocks at the international oil market makes the exchange rate depreciation limits monetary policy's capacity to fix the price stability goal. The depreciation of Naïra will lead to the rise of the price of imported goods, which turns to increase the domestic price level.

B) Central Bank of South Africa Monetary policy framework

The section 224 of the South African Constitution and the section 3 of the South African Reserve Bank (SARB) Act state the central bank must exert its function in all independence. The primary objective pursued by the SARB is to achieve and maintain price stability; empower and ensure a healthy banking sector. Moreover, it is up to the central bank to guarantee, the maintenance of the value of local currency.

    a.   **Monetary policy in South Africa (1965-1994).**

The Apartheid in South Africa during this period increased International pressures, this required to implement some financial repressive policies to prevent capital outflows and to keep economic stability. Indeed, monetary policy was mainly used driving to control the financial sector (**Muyambiri and Odhiambo, 2014**).

Since the 1960s there have been three broad monetary policy frameworks. The first framework was a *liquid asset ratio-based system* with quantitative controls on interest rates and credit, and

operated until the early 1980s. some reforms were applied from the early 1980s focused *cash reserves-based system* followed the recommendations of the de Kock Commission Reports (1978, 1985). After changes on assets requirements, and redefining the role of the discount rate, this second regime started functioning in the mid-1985. The supply of credit was influenced by open market operations. The monetary policy framework targeting M3 started in the early 1986 (**Aron and Muellbauer, 2006**).

    b.   **The monetary policy framework of South African Reserve Bank in the 1990s**

During this period, the goal of central bank was to ensure the value of the South African currency, to finally pull down the rate of inflation. The process of stabilizing general price level faced a complex transmission mechanism, time consuming and consequently difficult to manage. Hence, South African monetary authorities preferred to achieve intermediate targets (money supply, exchange rate, etc.), which will turn into the ultimate target achievement (price stability). In South Africa, the monetary policy regime (monetary targeting framework) in the 1990s incorporated the use of money supply targets up until 1998.

Moreover, any the money supply targeting is focused on the belief that the inflation is a monetary phenomenon. The effective control of the rate of growth of the money supply over time, will turn to the inflation control. The Publication of targets may provide some reference lines to the business community, consumers and labor interests concerning future expectation on money and price. On the other hand, targets on the money supply can also be crucial in restricting the propensy of governments to spend public funds, as the central bank can recommend to politicians that public expenditure in excess of certain

levels could entail exceeding the money supply targets if such spending is financed by resort to bank credit. The money supply-targeting policies, which were first appeared in 1988 in respect of the De Kock Commission of Inquiry into the Monetary System and Monetary Policy in South Africa (**SARB, 2011**).

The broad monetary aggregate M3 was recognized as the most appropriate for money supply-targeting by the South African reserve Bank. For instance, the target growth range for M3 for 1995 was fixed at between 6% and 10%. Progressively, lower targets for the growth in M3 had been applied since monetary targeting was first introduced in South Africa in 1988. Between 1989 and 1993, we can note a decline in the growth of broad money explained by the contraction of the economy during this period. Finally, monetary targeting was rejected in South Africa early in 1998 and moved the inflation targeting.

Further, several challenges were related to the application of this monetary policy regime:

- There was no insurance that the relationships between the money supply and total demand, and the money supply and inflation would in any way be stable or predictable.
- There were uncertainties about the unavoidable time lags that existed between changes in the money supply and the rate of inflation, i.e the change in broad cannot immediately transmit to the change in inflation. According to **SARB (2011)**, empirical analyses in some other countries suggested that this time lag could be two years or more.
- Instability in the demand for money affect the attainment of the level money targeted;
- Choice of monetary measure to target: Another problem with money supply targeting concerned the choice of an appropriate monetary measure to use for targeting purposes. It was not easy to determine a permanently suitable measure of the money supply that could be employed. In South Africa, we note the problem of the central bank to reach the broad money targeted (**SARB, 2011**).

c. Inflation targeting regime

Adopted in 2000, the inflation targeting pursued to improve policy transparency, accountability and predictability. Presently, the inflation target aims to attain a rate of increase in the overall consumer price index, excluding the mortgage interest cost (the so-called CPIX), of between 3 and 6 percent per year. CPIX is defined for metropolitan and urban areas and has a wider coverage of households (80 percent) than CPI (metropolitan), with only 40 percent coverage. However, modelling and forecasting with CPIX (metropolitan and urban) is complicated by the fact that it is published back only to 1997.

The target range was initially fixed by the Ministry of Finance but is now set by the National Treasury (a department of the Ministry of Finance), after discussion with the SARB. The *Inflation Targeting Technical Committee* (ITTC) was established in 2001, with National Treasury and SARB representation, to address technical issues.

However, SA is a small open economy, subject to exogenous shocks which have impact on inflation. For instance, a sudden rise in oil prices or a drought impacting food prices may cause a deviation from the target, over which monetary policy has little immediate influence. Monetary policy can be expected to react to the second-round effects, and apparent changes induced in inflationary expectations (**Aron and Muellbauer, 2006**). The inflation targeting design is presented in the down-mentioned graph:

Figure 20 The Inflation Targeting Framework
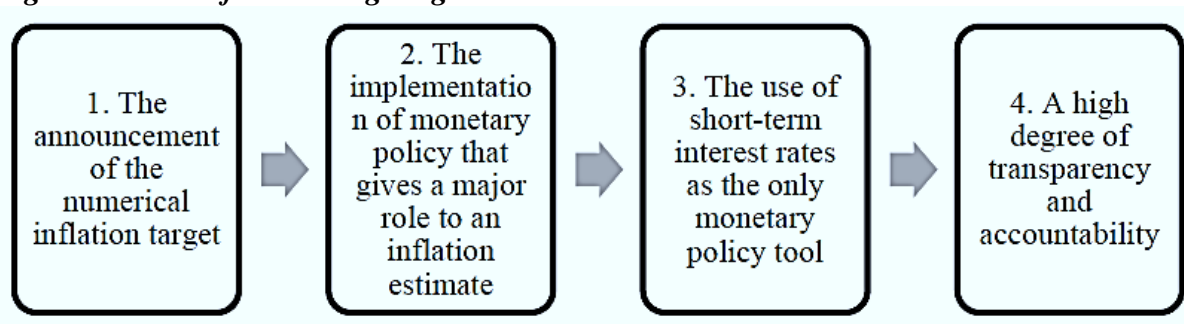
Source: Meyer, Chipeta and Camel (2018)

According to **Meyer, Chipeta and Camel (2018)**, different empirical studies have revealed the efficiency of inflation targeting in addressing macroeconomic issues in South Africa and maintaining macroeconomic stability compared to the previous monetary policy frameworks. The CPIX decreased from double-digit levels in early 1990s to single digits, reaching the target of 3 to 6% in 2001. Thereafter, in 2002 the CPIX raise to double digit levels again owing to a sharp depreciation of the currency but returns once again on the target range. From 2007 inflation raised mainly explained by external food and oil prices shocks. In 2009, the inflation decreased due the fall in output level (**Kearney and Odusola, 2011**). The repo rate is the main instrument used by the SARB to control the inflation.

2.2. Empirical literature

The present section is mainly focused on empirical findings related to the recession, its impact on African economies; evaluation of main drivers of macroeconomic volatility in developing and emerging market, and policy responses to economic crisis.

The existing literature explains that the recession did not affect developing countries at individual level, but in terms of global impact, low-income countries (LICs) were slightly affected. As one of the main cradles of developing economies, the impact of the global recession on African countries was expected to be low, given its weak integration to international trade and financial markets. **Osakwe (2010)** shows the evident existence of global recession's impact in all categories of African countries (oil-exporting, middle-income, low-income and economies strongly based on agriculture). This author explains that when the recession happened, the number of countries with negative GDP growth rates increased from 2 to 8. According to the **IMF (2010)**, among the five biggest SSA economies (South Africa, Nigeria, Angola, Ethiopia, and Kenya) representing two-thirds of the region's output, only South Africa experienced a negative GDP growth in 2009. This can be explained by its exposure to the global economy through trade, financial market, and capital inflows.

Indeed, **Loayza and Raddatz (2006)**, **Bahmani and Toms (2015), Houssa et al (2013, 2015, 2019)**, and **Oladunni (2019)** emphasize that macroeconomic fluctuations of developing and emerging countries are jointly explained by internal and external shocks (financial and trade shocks). These authors applied different approaches to explain the way countries' economic volatilities are affected through foreign and domestic shocks. For instance, the dynamic stochastic general equilibrium (DSGE) model, the vector autoregressive (VAR), and regression model are generally used to capture the main conductors of macroeconomic fluctuations in emerging market and developing countries. These approaches differ on assumptions, modeling and analytical point of view. DSGE and VAR models allow the capturing the amplitude of different shocks hitting the economy (these approaches require the establishment of strong assumptions regarding the time of the occurrence of shocks' impact and countries' characteristics), while regression model establishes a possible linkage the economy and different exogenous factors.

In the spirit of assessing the vulnerability of countries to external shocks, **Loayza and Raddatz (2006)** evaluate the way country's specific structural characteristics affect the impact of the terms of trade shocks on the aggregate output. Thus, an econometric methodology built on semi-structural vector auto-regressions was conducted. This model focused on the identification assumption that domestic shocks are endogenous to external variables (especially the terms of trade). This paper used annual panel data of 90 countries (36 low-income countries, 36 middle-income countries, and 18 high-income countries) for the period 1974-2000. On the other hand, the country's domestic structural characteristics are mainly related to *trade openness, financial development, capital account openness, labor flexibility, and firm entry flexibility for country*.

They find that the higher trade openness is, the more the impact of terms-of-trade shocks on the output will be higher. However, higher financial depth appears having no effect on the impact of terms-of-trade shocks (this is the reverse of the theoretical expectations which suppose the financial depth to be a remedy for external vulnerability). The raise of financial openness exerts a negative effect on the impact of a terms-of trade shock, though a modest margin. The firm entry flexibility has a slight increasing effect of

terms-of-trade shocks, while it is not statistically significant. Finally, the increase in labor market flexibility reduces drastically the impact of the terms-of-trade shocks on per capita GDP.

However, authors analyze the effect of external shocks on the GDP remaining focused on one aspect through which countries can be affected by external shocks. Terms of trade is not enough to explain external vulnerability of a countries. IMF (2010) stressed different channels through which international macroeconomic shocks can affect a developing economy, namely through trade and financial channels. **Loayza and Raddatz (2006),** did not consider the financial channel (external credit to private sector, FDI, portfolio investment, foreign aids, remittance, etc.), while they selected financial domestic characteristics (capital openness & financial development) to explain the impact of the terms-of-trade on the output. There is a stronger linkage between foreign financial shocks and these domestic financial characteristics selected, than the possible relation between the latter and the terms of trade. The transmission of external shock through trade channel, is mostly done though the terms of trade, the price of commodity exported by the country and the volume of trade. However, these authors, took a single postulate of trade channel (the terms of trade). Thus, to have a complete view of the impact of the external shocks on the GDP, it would be crucial to also consider the external financial shocks in their model as control variables.

Further, to address the question related to the role of external financial shocks in the macroeconomic fluctuations of developing & emerging countries, **Houssa et al (2013)** study the effects of global and domestic credit supply shocks in macroeconomic fluctuations for Emerging Markets (especially the South Africa). To observe the possible credit effects, the paper run a set of zero and sign restrictions[7] based on a medium-scale Bayesian Vector Auto-Regressive (BVAR) model.

The results from **Houssa et al (2013)** show that shocks related to G7 countries play an important role in the fluctuations of real activity in South Africa. Moreover, three types of G7-shocks (G7- credit shocks, G7- productivity shocks, G7- demand) have contributed significantly to the 2007-2010 recession, while South African real activity were mainly driven by productivity shocks in the 1990-1992 recession episode. Overall, the trade and the credit shocks are the main transmission channels of international shocks hitting South Africa in 2007-2010, while in 1990-1992 the commodity price channel dominated external shocks.

Moreover, the previous paper did not address the two-country comparison in the evaluation of determinants of macroeconomic fluctuations on developing countries. Indeed, **Houssa et al (2015)** evaluate the role of global and domestic shocks to explaining macroeconomic fluctuations in Ghana compared to South Africa. Particularly, this paper studies the impact of exogenous shocks (productivity, credit supply, and commodity price shocks) on the South African and the Ghanaian economies. To capture these shocks, a Vector Autoregressive (VAR) model was used, estimated through Bayesian methods. Hence, the identification of shocks is applied by imposing of sign and recursive restrictions of Uhlig (2005) jointly for credit and productivity shocks. Quarterly data from Ghana, South Africa and G7-countries are used from 1985: Q1- 2010: Q3.

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[7] *Zero restrictions permit to distinguish domestic from international shocks (this supposes that developed countries do not respond to shocks originating from emerging markets), while sign restrictions allow differentiating credit supply shocks from credit demand shocks (credit demand shocks are addressed to endogenous responses of indicators of credit market to fundamental shocks while credit supply shocks are not related to fundamentals).*

The results suggest that the South African output has strongly responded to the global credit supply shocks, reversely to Ghana. On the other hand, the credit supply shock decreases commodity prices in South Africa, while increasing them in Ghana. The effects of the credit shock bring to an increase in interest rates in Ghana and South Africa (the impact is only significant for a short period). The commodity price shocks are also more significant for South Africa than for Ghana. Ghana's integration to global economy passes more through trade channels, and less through financial channels. Finally, the paper finds that commodity shocks are an important explainer of macroeconomic fluctuations in both countries.

Houssa et al (2013,2015) are complementary papers, the particularity of Houssa et al (2015), is the comparison spirit between developing and emerging countries holding different degrees of capital and trade openness. Through this paper, one can see that the output of the country financially integrated to global economy is more likely to suffer from global credit supply shock occurrence (South Africa).

Furthermore, **Houssa et al (2019)** focus on a small open economy dynamic stochastic general equilibrium (SOE-DSGE) model to capture the business cycle linkage between an emerging economy (South Africa) and advanced economies. Primary commodity, manufacturing, intermediate inputs, and credit are fundamental to explain the amplitude and the transmission chain of domestic as well as foreign shocks[8] shaking the developing economies. Shocks which cannot clearly be defined as foreign or domestic, are denoted SOE shocks. This paper estimates the SOE-DSGE model with Bayesian methods based on quarterly data on South Africa, the US and G7 on the period 1994Q1-2017Q4.

Houssa et al (2019) suggest that foreign shocks explain 20% of macroeconomic fluctuations in South African real economy over the 1994 to 2017 period. These shocks explain in fluctuations of GDP (24%), consumption (21%), investment (22%), mining exports (18%) and the risk-free rate (17%), labor compensations (26%), spread (37%), imports (6%), exports (12%), consumer price index (14%) and nominal exchange rate (11%). SOE shocks contribute about 77% on fluctuations in the exchange rate, 83% in imports and 69% in exports. Domestic shocks represent the main explainer of economic fluctuations (explain two-third of variations in GDP, consumption and investment and about half of changes in CPI and the risk-free rate). Domestic shocks also account for 72% fluctuations in mining output owing to domestic commodity supply shocks. On the other hand, the fluctuations in imports (11%), exports (19%) and the exchange rate (11%) are weakly explained by domestic shocks.

Comin et al (2010) remain in the same perspective of explaining the linkage between developed and developing countries' macroeconomic fluctuations, they analyze the way the diffusion of technology influences the productivity in developing countries. Thus, based on a two-country asymmetric DSGE model with two characteristics: endogenous and slow diffusion of technologies from the developed to the developing economies, and adjustment costs to investment flows, this work used annual data on the period 1990-2008 to explain the linkage business cycle fluctuations. The goal is to apply a model able to explain the amplitude and persistence of the effect that U.S. shocks have on Mexico's real economy and display different drivers of macroeconomic fluctuations in developing countries.

The findings suggest that U.S. business cycle fluctuations affect the speed of diffusion of technologies to Mexico and this channel drives the medium-term level of intrinsic productivity. This paper particularly underlines the effect of developing country shock on developed economy owing to cross-borders activities. Hence, Mexican shocks account for 2% to 3% of U.S. fluctuations over the medium-term cycle. However, U.S. shocks are important source of macroeconomic fluctuations in Mexico (over the medium-term cycle, U.S. shocks account for 66% of the volatility in Mexican GDP).
The particularity of this paper is twofold. It exposes the possible role that developing countries can play in explaining volatility in advanced economies, and the diffusion of technology on developing countries'

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[8] These shocks are related to Aggregate supply, aggregate demand, monetary policy, credit, primary commodity

productivity. However, compared to **Houssa et al (2013, 2015, 2019)**, **Comin et al (2010)** show a strong influence of external shocks on developing country due to neighboring linkages.

As found by **Houssa (2015, 2019)**, the commodity price is among the main drivers of foreign shocks on developing countries. Hence, the food, mining product and oil prices are especially the main catalyzers of Sub-Saharan countries' external vulnerability. **Oladunni (2019, p20-67)** analyzes the external vulnerability of oil-export country. He uses a sign restricted Bayesian structural vector autoregressive (BSVAR) to explore how three external shocks, respectively: global demand, oil price and the US monetary policy shocks impact on the Nigerian macroeconomic fluctuations. Quarterly data were used for analysis from 1982: Q1 to 2016: Q1 for first sample and the second sample covers 1982: Q2 to 2007Q4 (the second excludes the GFC period to 2016: Q1 to verify whether the GFC affects significantly the results). Findings suggest that the global demand shock and oil price shock are the main foreign shocks that affect Nigerian macroeconomic fluctuations. Hence, the global demand shock affects more the evolution of the domestic GDP growth and inflation, whereas oil price shock affects more the domestic interest rate and the terms of trade. Further, the Global Financial Crisis raised inflation volatility.

Obviously, the foreign monetary policy shock is one of the main instruments of financial channel of the transmission of external shocks. Houssa et al (2013, 2019) underline the role of credit shock and monetary policy shock on developing countries' macroeconomic volatility. However, there is no stress on the possible role of unconventional monetary policy shock in macroeconomic volatility of developing countries during the crisis and post-crisis period. **Megersa (2017, p63-110)** explores how recent unconventional monetary policies in advanced economies impacted the returns on South African assets. Specifically, this study evaluates the effect of the joint announcement of unconventional monetary policies (UMP) applied by the Federal Reserve (Fed) and European Central Bank (ECB) when the global financial crisis occurs, on South African Assets. Based on daily data from the Jan 01, 2007 to June 30, 2016 period, this analysis considers besides the announcement of unconventional monetary policies (ECB and Fed), conventional local monetary policy [South African Central Reserve Bank (SARB) policy] as control variables. To estimate this impact, the paper applies an econometric model similar the one run in **Fallagiarda et al. (2015)**, **Fratzscher et al. (2016)**; **Chen et al (2014)** and **Szczerbowicz (2015)**. This regression model captures how the variation of the return on a set of South African financial assets [9] is explained by the announcement of UMP[10], the Fed Fund rate, the ECB's policy rate, the SARB policy rate, the market volatility as well as the news and publication of relevant South African financial and macroeconomic data.

The announcement of unconventional monetary policy such as QE is transmitted to South African Assets price & yield through four main channels, respectively the International Portfolio Rebalancing, Confidential, sovereign credit and credit bank channels. Regarding international portfolio channel, the results reveal that announcements of QE by the Fed have led to some financial inflows to SA equities and bonds. On the other hand, announcements of the contraction of QE program implied outflows, particularly in SA equities. In addition, the ECB's publication of QE for asset purchases does not significantly affect South African Assets. The Liquidity provision program demonstrates a statistically significant inflow into SA bonds, whereas the collateral easing program notes some inflows to equities. However, the aggregate inflows or outflows on QE announcements (for both Fed and ECB) were small given the total foreign funds invested in South Africa (represent less than 1% of total foreign investments in SA's financial assets).

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[9] Financial assets are mainly based on the yield on bilateral exchange rates (Rand-USD and Rand-Euro), JSE stock market indices, 3 month interbank rate, sovereign bond yields of 5 and 10 years, credit default swap (CDS) of 5 and "10 years"; and foreign investment flows in to equities and bonds.

[10] The announcement of UMP is defined as Dummy variable which takes the value "1" on the days of announcement and "0" otherwise.

The results suggest that unconventional policies of the Fed have decreased on South African Sovereign Yields (5 years maturity) by 0.0535 percentage point. the ECB's UMP announcement has decreased the SA Sovereign Yields (5 years maturity) by 0.0093 percentage point. Further, the UMP announcements induced overall appreciation of the domestic currency, reduction of sovereign bond yields and credit default swap (CDS) and increase in key stock market indices.

It would be important for the paper to visit whether the Fed and ECB UMP have affected the SA real economy significantly (GDP, employment, etc.). To fill this gap, in our work, we will evaluate the way the unconventional monetary applied in G7 countries affected the South African and Nigerian real GDPs.

The unconventional monetary policy can turn to capital inflows to developing countries. As found by **Megersa (2017)**, the unconventional monetary policy applied by US and EU made the SA currency appreciate, this can have positive effect on attracting capital inflows. Thus, **Mishra, Montiel, and Spilimbergo (2010)** indicate that an economy driven under flexible exchange rate and open capital account can attract capital inflows through change in value of the exchange rate (uncovered interest parity condition).

Bahmani and Toms (2015) remain in the same perspective of defining the possible role of unconventional monetary policy on capital inflows to developing countries. This paper evaluates the impact of quantitative easing applied by Federal Reserve, on the level of US foreign direct investment in Brazil, through ordinary least squares approach. The analysis has required the resort to control variables such as global national production, the official exchange of US dollars to Brazilian real and the domestic inflation rate. To measure quantitative easing, the authors used "total amount of the currency in US that is either circulating amongst the public or is in it's the commercial bank deposits held by the federal reserve". To conduct analysis, the paper used secondary annual data on the period 1982-2012. The results reveal that one percentage point increase in Brazilian Global National Product induces the FDI to increase by 0.40169%. The appreciation of Brazilian Real implies the FDI increase by 0.03537% and the raise of US quantitative easing by one percentage-point implies an improvement of 0.45523% of FDI to Brazil. However, one percentage point increase in inflation declines the FDI inflow by 0.01176%.

The results of the authors respond to the theoretical expectations, but it would be important to integrate the capital openness indicator in order to see the role played by this indicator in attracting capital inflows. Linking **Bahmani and Toms (2015)** and **Megersa (2017)**, it is crucial for the latter to capture the impact of UMP of Fed and ECB on SA real economy and visit the way capital inflows evolved after announcement of UMP (FDI and portfolio investment).

To deal with domestic and foreign shock, governments and central banks conduct policies to respond effectively and maintain economic stability. For instance, different papers reported on the responses of countries during the recession of 2009. They indicate that to respond to the recession countries over the world have conducted countercyclical monetary and fiscal policies to bring their economies to steady state.

Alam (2015) examines the effectiveness of the monetary policy in Bangladesh. This paper resorts to the Structural Vector Autoregression models with short run restrictions on the response of output, price and exchange rate to an exogenous monetary-policy Bangladesh.
The analysis is conducted on quarterly data based on the period 1995-2011.

It follows that an exogenous rise in the 3-month T-bill rate, the output starts falling from the 2nd quarter, the lowest level occurs around the 5th quarter. The effect starts disappearing after 10th quarter. The price declines on the 2nd quarter, improves on the third quarter to reach the high level on the 5th quarter. However, the increasing trend starts disappearing from the 10th quarter. Regarding the contractionary monetary policy, Taka rises against the USD starting from the 3rd quarter and the effect vanishes after the 14th quarter. In terms of variation in percentage point, there statistical significance, for all variables.

Hence, this explains though the variance decomposition that T-bill cannot explain percent of the short run changes of any of the variables. The authors stressed that prevalence of microcredit and government domestic borrowing might be the drivers of lack of effectiveness in monetary policy transmission.

IMF (2010) analyze the effectiveness of monetary policy on SSA, based on bivariate regression, with the goal of identifying how changes in interest rate and money reserve impacted deposit and lending rate. Moreover, the paper analyzes the way the monetary policy affects output variables (economic growth, inflation, broad monetary aggregates and exchange rate) through VAR model using monthly data on the period 2000:1-2009:12. The IMF (2010) also disentangles the effect of monetary policy on countries with fixed and floating exchange rate regimes. Once the African economy fell into recession, policymakers decreased quickly and significantly nominal interest rates. In some SSA countries, the recession has frozen the action commercial banks to decrease the lending rate, as the recession implies the increasing risk related to economic activities and the incentives for commercial banks to increase their profit margins. The lending rate did not decrease as much as the policy rate decreased in some SSA economies, but it follows the same trend as the policy rate.

The results show that the connection from interest rates to economic activity and inflation are weaker. Nevertheless, the IMF found that in many sub-Saharan African countries, monetary transmission mechanism to real economy was constrained by different factors, respectively an excess liquidity in the financial system, weak development of financial markets, and substantial monetary policy financing of fiscal deficits (fiscal dominance). This result is similar to **Alam (2015)** statement**,** explaining that the lack of effectiveness of monetary policy in developing is explained by local economic and financial features.
Borensztein, Darius and Kalemli-Ozcan (2019), summed up the assistance offered by the IMF to Brazil, Mexico, South Africa, and Turkey, to deal with the spillover effects related to unconventional monetary policies implemented in most developed countries which can be noted through financial inflows to emerging and developing countries. To respond to unconventional monetary measures from advanced economies, **Darius (2019)** reports that the onset UMP restored stability of financial conditions and global demand induced by positive effect on South African capital inflows, but it also created dilemma in terms of policy to be implemented. Central Bank authorities decided not to apply any tightened monetary policy until they identify the effects of UMP on inflation pressures.

Through this empirical review, we note that negative external shocks are harmful for small open economies, pointing the importance of commodity price and credit shocks in transmitting the global shocks. Moreover, in terms of responses to the recession almost responding developing countries applied countercyclical monetary measures and procyclical fiscal policy. Overall, **Houssa et al (2013, 2015 and 2019)** and **Oladunni (2019)** underline the important role plaid by the commodity price shock in transmitting foreign shocks to SA and Nigerian macroeconomic fluctuations using different models (BVAR and SOE-DSGE). Particularly the 4 papers emphasize the relevance of considering external shocks in explaining macroeconomic evolution in small open economy, as they all show the important role played by these shocks. Our research will complete these papers by capturing the impact of external and internal shocks (particularly during the 2009 recession) on SA and Nigeria (using narrative analysis); and evaluate whether the monetary policies applied by these countries were effective. Finally, using a regression model we will evaluate how the real economies of these two countries responded to conventional and unconventional policy of G7 countries (part of external shocks).

3. METHODOLOGY

This chapter focuses on 2 essential points. First, the estimation of cyclic components of the output and financial variables through the Hodrick-Prescott filter and cross-correlation analysis we identify co-movements between fundamental macroeconomic variables explaining the change in macroeconomic fluctuations of developing countries. Secondly, the conception of a regression model based on the shocks affecting developing economies as stated in our literature review (external and internal shocks).

3.1. Estimation of business cycles of macroeconomic variables via HP Filter

The point represents a crucial step in the process of macroeconomic shock analysis. The analysis of business cycle is relevant to evaluate and compare fluctuations and volatility of output variables in real terms (GPD, consumer price index, consumption, investment, government expenditures, trade and financial variables) across country. In fact, the business cycle analysis gives a picture on South African and Nigerian macroeconomic evolution and allows seeing in which country, macroeconomic factors were more volatile and which country has more persistent shocks in output.

Each time series is composed of a seasonal component (captures all seasonal changes that may affect the variable), a trend component (long-term trend of the variable) and the business cycle (captures all of the fluctuations that have occurred in the time series). Mathematically, a time series can be presented as follows:

$$y_t = y_t^{cyclical} + y_t^{trend} + y_t^{season} \qquad (1)$$

With $y_t^{cyclical}$:Business cycles or cyclical components, y_t^{trend}:Long run trend or trend components and

y_t^{season}:seasonal components

In fact, before defining the business cycle of the series, we can seasonally adjust the time series using X-13ARIMA-SEATS method through Macrobond. However, **Hodrick-Prescott (1980, 1997)** filter represents a mathematical tool applied to a series in order to capture cyclical component of a series, assuming that the trend component is smooth over time (**Marcet and Ravn, 2003**). To extract the cyclical component, we proceed by minimizing the following equation (2):

$$\min_{\{y_t^{trend}\}} \left\{ \sum_{t=1}^{T} \left(y_t - y_t^{trend} \right)^2 + \lambda \sum_{t=2}^{T-1} \left[\left(y_{t+1}^{trend} - y_t^{trend} \right) - \left(y_t^{trend} - y_{t-1}^{trend} \right) \right]^2 \right\} \qquad (2)$$

In the function (2), λ represents a positive fixed parameter penalizing the variance of the trend component, the higher will be the value of λ, and the smoother the trend component will be (Hodrick and Prescott, 1997). The value of λ depends up on the frequency of time series data under study. Hence, annual data require λ be equal to100, quarterly data implies that $\lambda= 1600$ and for monthly data $\lambda= 14400$. The present research is based on quarterly data; this implies that the penalizing parameter of the variance of trend λ equals to 1600.

The business cycle analysis will be associated to cross-correlation analysis. It is question of the co-movement analysis between the GDP and trade and financial variables (Terms of trade, real credit, etc.). As the 2009 recession was transmitted to developing countries through trade and financial channels, it is important visit the wait the cyclical components of different variables are correlated to African countries' GDP.

3.2. Empirical studies and estimations

The empirical studies consulted have underlined the main factor which explain the change in macroeconomic variables. Indeed, the crisis from external origins is transmitted to developing world through trade and financial. Then we estimate a regression model build on external variables (financial, monetary policy and trade shocks) and internal variables (monetary policy, credit shock, etc.).

Our model is based on three blocks, namely the international block (G7-countries), South African block and Nigerian block, to capture the effect of external shock on each country separately. Note that the 2

last blocks are small opened economies characterized by exports based on mining products and oil respectively.

Moreover, this model is built on the assumptions that all external shocks coming from neighboring countries or from monetary and economic unions (which SA and Nigeria are part) are endogenous for Nigeria and South Africa, i.e these two countries do not respond to these shocks (Local cross-border shocks are endogenous). For instance, ECOWAS (Economic community of West African States) shocks are endogenous for Nigeria. SACU (Southern Africa Custom union) and SADC (Southern Africa Development Community) shocks are endogenous for South Africa. According to World Development Indicators[11], South Africa represents on average 91,76% of SACU's GDP in the period 2009-2019, while Nigeria represents 72% of ECOWAS's GDP. Given the dominance of these countries at local level, we consider that both countries only respond to shocks originating from developed countries (especially G7 countries) to maintain internal stability. This assumption pushes us to construct a model considering G7 shocks and domestic shocks.

In the spirit of **Loayza and Raddatz (2006)**, **Houssa et al (2013, 2015, 2019)**, **Oladunni (2019)** and **Megersa (2017),** we build a regression model assuming that the Nigerian and South African macroeconomic fluctuations are explained by domestic shocks (monetary policy, trade, credit supply, capital net flows, demand shocks[12], commodity production shock, etc.) and foreign shocks originating from G7 countries (foreign monetary policy, foreign credit supply, demand and commodity price shocks). This model focuses on the financial and trade variables as variables of interest; they are assumed to be the main transmitters of the 2009 recession. Thus, the main purpose is to know the way the GDP was affected by the external shocks and the role played by the domestic monetary policy to sustain the economic stability.

Further, **Loayza and Raddatz (2006)** consider the terms of trade as a driver of external shocks to GDP in emerging markets. In **Houssa et al (2013, 2015, 2019)**, domestic and global productivity shock, credit supply shock, monetary policy, trade (terms of trade and trade in volume), demand shock, etc. mainly explain the change in macroeconomic volatility in South Africa. For **Oladunni (2019)**, the oil price and global demand play an important role in the change of GDP of small opened oil exporting country.

The model framing is inspired from **Megersa (2017)**, his model stated the way interbank rate, security prices, return on assets and return on bilateral exchange rate responded to announcement of unconventional monetary policy in US and EU. This empirical model is presented as follows:

$$\Delta Y_t = \alpha + \beta UMP_t^F + \gamma_1 \Delta IR_t^F + \gamma_2 \Delta IR_t^{SA} + \theta_1 \Delta MKTVolatility_t + \theta_2 News_t + \varepsilon_t \quad (3)$$

With Y_t assets price and returns, UMP_t^F the announcement of unconventional monetary policy (by Fed and ECB), IRt^F the foreign policy rate (Fed fund and ECB interest rate), IR^{SA}, MKTVolatility the financial market volatility and News are news on macroeconomic indicators. We derive from this model the following one which captures GDP responses to the change in internal and external variables:

$$\Delta Y_t = \alpha + \beta UMP_t^{G7} + \eta_1 \Delta IR_t^{G7} + \eta_2 \Delta RC_t^{G7} + \eta_3 \Delta NCF_t^{SA/NIG} + \eta_4 \Delta CP_t^W + \eta_5 \Delta ToT_t^{SA/NIG}$$
$$+ \eta_6 \Delta EV_t^{SA/NIG} + \eta_7 \Delta IR_t^{SA/NIG} + \eta_8 \Delta RC_t^{SA/NIG} + \gamma CRISIS_t^{SA/NIG} + \varepsilon_t \quad (4)$$

With **Y** = GDP, **UMP** the unconventional monetary policy applied in G7 countries to cushion the effects of the global recession. This variable takes the value 1 for all period where this policy was applied to alleviate the 2009 recession and 0 for other periods. **IR G7** represents the average of interest rates of G7 countries (average shadow rates including the application of UMP) and **IR SA/NIG** are the policy rate fixed by SARB and CBN. RC represents the real credit in developed countries (G7) and South

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[11] GDP constant price (2010=100)

[12] Domestic Demand shocks are related to all shocks happened in household consumption, government spending and investment.

Africa/Nigeria. **NCF** refers to the net capital flow to domestic economy, **CP**[13] represent the commodity price on world market, **TOT** is the domestic terms of trade and **EV** is the export volume. Finally, **CRISIS** refers the periods when the global financial crisis started hitting Nigeria and South Africa turning to recession. It takes the value 1 for all period 2009. The crisis started showing drastic effects on developed countries in the fourth quarter of 2008 and overflows to emerging and developing economies with some lags. CRISIS takes value 0 for other periods.

In the above-mentioned model, the partial domestic demand shock (government final consumption, investment and household final consumption) and the production shock were not integrated owing to the possible endogeneity problem between these variables and the output (the co-movement analysis will be used to see whether GDP and commodity production followed the same trend. It is crucial to cross the monetary policy rate with the crisis variable to see the way the shift to the recession made the policy rate affect the GDP. We can also cross the shadow rate with UMP to see the way GDP was affected during the recession by the shadow rate during the unconventional monetary policy phase.

The model will be:

$$\Delta Y_t = \alpha + \eta_1 \Delta IR_t^{G7} * UMP_t^{G7} + \eta_2 \Delta RC_t^{G7} + \eta_3 \Delta NCF_t^{SA/NIG} + \eta_4 \Delta CP_t^{W} + \eta_5 \Delta ToT_t^{SA/NIG}$$
$$+ \eta_6 \Delta EV_t^{SA/NIG} + \eta_7 \Delta IR_t^{SA/NIG} * CRISIS_t^{SA/NIG} + \eta_8 \Delta RC_t^{SA/NIG} + \varepsilon_t \quad (5)$$

Particularly, **Megersa (2017)** details information on the announcement and application of unconventional monetary policy in US and EU from the last quarter of 2008 to 2017, we use this information to build the variable UMP. Thus, the lack of robustness of the economic growth after the onset of the first unconventional monetary policy, pushed developed economies to apply the UMP in different phases to reach the sustained economic recovery (see the Table 1). Episodes of UMP can be resumed in the following table:

Tableau 1 Phases of UMP in United States and Euro-zone

Periods	**Fed**	**ECB**
4th quarter 2008-2009	QE1	CE
2010-2011	QE2	CE
2012-2014	QE3	CE
2015-2016	-	QE

Source: Author's compilation

3.3. Data and adjustments

To construct data for the present research, we use different data sources namely the IMF financial data, World Development Indicators data, Reserve Bank of New Zealand and national resources (CBN,

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[13] For Nigeria, oil price is considered as commodity price of reference, owing to its influence on the Nigerian economy. While for SA, commodity price is framed from simple average of world prices of the main miming exported by South Africa (coal, platinum, silver and aluminum) as specified by **Houssa et al (2019)**. Due to data availability we use the metals except gold price index like a proxy for mining products price index. We also apply the food world price index for both countries.

Nigerian Institution of statistics, SARB and SA statistics institution). Hence, quarterly 14 series are considered to evaluate the evolvement of these economies for the 1995-2019, cancelling the previous periods dominated by low openness of South Africa to global economy due to the Apartheid. These data are related to domestic and foreign blocks:

3.3.1. Foreign block
This block is mainly focused on data related to the following variables:
The shadow rates
Wu and Xia (2016), explain that during the crisis central banks interest rate in developed countries were on zero-lower bound and the quantitative easing was applied to sustain interest rates cut. They suggest capturing the quantitative easing through interest rate, hence they built negative interest rates called shadow rates reflecting the amplitude of quantitative easing applied in advanced countries. Concerning G7, we use monthly shadow rates data from the University of Chicago (United Kingdom shadow rate on Macrobond) and the Reserve Bank of New Zealand[14] (US, Euro-zone, Japan, and Canada shadow rates), which we transformed in quarterly data. This information on G7 countries allows building an average shadow rate for G7 countries.
The real credit
To measure real credit in G7 countries, we use data from World Bank on world development indicators. We consider the aggregate value of domestic credit to private sector (in % of gdp) in G7, which are transformed to quarterly data using Chow & Li interpolation from Matlab. We used aggregate G7 GDP (in US dollars) in quarterly data to interpolate the real credit, assuming that the GDP can predict the real credit to private sector. All variables expressed in USD are transformed in local currencies, to facilitate uniformity.
World commodity price indexes (2016=100)
We use monthly data on world commodity prices constant price (2016=100), transformed in quarterly data for analysis goal (these data are found on the IMF Commodity Data Portal)[15]. The commodity prices concerned are ***Food price index, all metals excluding gold price index and the crude oil price index***; there are considered as the main commodity prices which affected the Sub-Saharan economies during the downturn of 2009 as their exports are based on primary food and mining products (minerals and oil).
3.3.2. Domestic block
The domestic block is based on 2 panels (SA and Nigeria) and consider the following variables: GDP, CPI, Net capital flows, government consumption, credit supply, policy rate, lending rate, exports in volume, term of trade, export, import. All domestic variables are expressed in local currencies (SA in Zar and Nigeria in Naïra).
a. South Africa
GDP and its components (2010=100)
Data on SA GDP and its components constant price (2010=100) are found from macrobond. These quarterly data on real GDP, real government expenditure, real exports and real imports are seasonally adjusted.
The Real Consumer price index (2010=100) in quarterly data found from IMF International Financial Statistics (IFS). The *nominal exchange rate* in daily data were converted into quarterly and seasonally adjusted (data from macrobond). Finally, the production of metals in tons (crude steel) as a proxy for primary commodity production (the minerals are the important primary commodity exported by the SA).
Terms of trade constant price (2010=100)
Using macrobond as a bridge, we found quarterly data on Terms of trade seasonally adjusted from South African Reserve and South African Statistics. The export volume index (2000=100) from World

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[14] Reserve Bank of New Zealand: https://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy/comparison-of-international-monetary-policy-measures

[15] IMF Commodity Portal: https://www.imf.org/en/Research/commodity-prices

Development Index (WDI) in yearly data was interpolated based on exports from Southern African countries (South Africa & BLNS[16]).

🔸 *Financial variables*

First, monthly data on *Claims on private sector*, transformed in quarterly data and seasonally adjusted (data from SARB). Second, quarterly data on *policy rate, lending and deposit rates* from IMF International Financial Statistics (IFS); the net portfolio investment in quarterly is seasonally adjusted (from SARB). Finally, the foreign direct investment in % of GDP (annual data from World Bank Dataset). The FDI in % of GDP is converted to quarterly data through Chow & Li tool, referring to quarterly data of nominal exchange rate (expressed in US dollars). The idea of this perspective is that the appreciation of exchange rate attracts more FDI inflows, reason why the exchange rate is used to predict the FDI in quarterly data.

b. Nigeria

🔸 *GDP and its components (2010=100)*

GDP and its components are annual (data from National Bureau of Statistics via macrobond), we applied Chow and Li interpolation to convert them into quarterly data. Considering that the Nigerian economy relies on the oil activities. Thus, we used *Crude oil price/Bonny Light* in Naïra (monthly data converted to quarterly and seasonally adjusted through macrobond) to interpolate GDP and its components. The quarterly Real Consumer price index (2010=100) from IMF International Financial Statistics (IFS). The daily *nominal exchange rate* is converted to quarterly and seasonally adjusted (data from macrobond). We use the production of crude oil and other liquids (in barrels/day) to approximatively measure the production of primary commodity, assuming that all commodity production followed the same trend after the onset of the recession.

🔸 *Trade variables*

The *real exports (2010=10)* in annual are converted to quarterly data through Chow & Li tool, referring the nominal exchange rate. The depreciation of exchange rate can have positive effect on the level of exports. For the *real imports (2010=100),* it is interpolated by using consumer price index as a benchmark. Moreover, monthly commodity terms of trade data from IMF data converted to quarterly for analytic purpose. For the export volume, we use *the export volume index* from WDI. Monthly data from Energy Information Administration on Nigeria Petroleum & Other Liquids Production (valued in Barrels/day; transformed to quarterly and seasonally adjusted) are used to interpolate the export of crude oil in volume.

🔸 **Financial variables**

First, monthly M3 broad money (from Central Bank of Nigeria via macrobond) converted to quarterly and seasonally. Second, real credit represented by domestic credit on private sector (in % of gdp) which is transformed to quarterly data through Chow & Li tool, referring to quarterly M3. The idea is that the increase of broad money can predict the improvement of domestic credit. Third, quarterly data on monetary policy rate, the lending and deposit rates from IMF International Financial Statistics (IFS). Finally, net FDI and net portfolio investment in % GDP (annual) are interpolated using the nominal exchange rate and transformed into local currency values (in Naïra).

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[16] BLNS is an abbreviation for Botswana, Lesotho, Namibia and Swaziland (Eswatini).

4. EMPIRICAL RESULTS

4.1. Co-movement and business cycle analysis of South Africa and Nigeria

4.1.1. Co-movement between real GDP and Price level

The co-movement analysis of the GDP and price reveals that the South African Economy was dominated by aggregate supply chocks given the negative co-movement between the GDP and Price (1995: q1- 2019: q4). The pre-recession period shows high amplitudes in the fluctuations of GDP and Price, while the post-recession period, the economy become more stable. In the recession of 2009, the GDP growth decrease by 8 percentage points and the inflation increased by 5 percentage points. The mechanism behind is that, when the world commodity price declined, this pushed the supply of primary commodity to decline as the exporting price dropped. Moreover, the lack of commodity supply on domestic South African market increases the price level and decline in local demand, which finally turns to a decline of GDP. This explains why the recession was associated to an increase of inflation in South African economy as it was related to supply shock. The cross-correlation coefficient of -0,6611 (Appendix 1) reveals that the consumer price index is countercyclical. It is also leading the South African GDP at Lag 4. Nigeria presents a reverse situation, the right part of the figure below shows that the pre-recession period was dominated by aggregate demand shocks, given the positive co-movement between the GDP and the inflation. However, in the post-recession one can see the dominance of aggregate supply shocks. Overall, Nigerian economy was dominated by aggregate demand shocks, it can be seen through the positive cross-correlation coefficient 0,3157 (Appendix 1) between the GDP growth and the inflation. This explain a part why the Nigerian economy faces high inflationary pressures in the pre-recession period compared to South Africa, as one can see in the graph below:

Figure 21 Co-movement between the real gross domestic product and the consumer price index
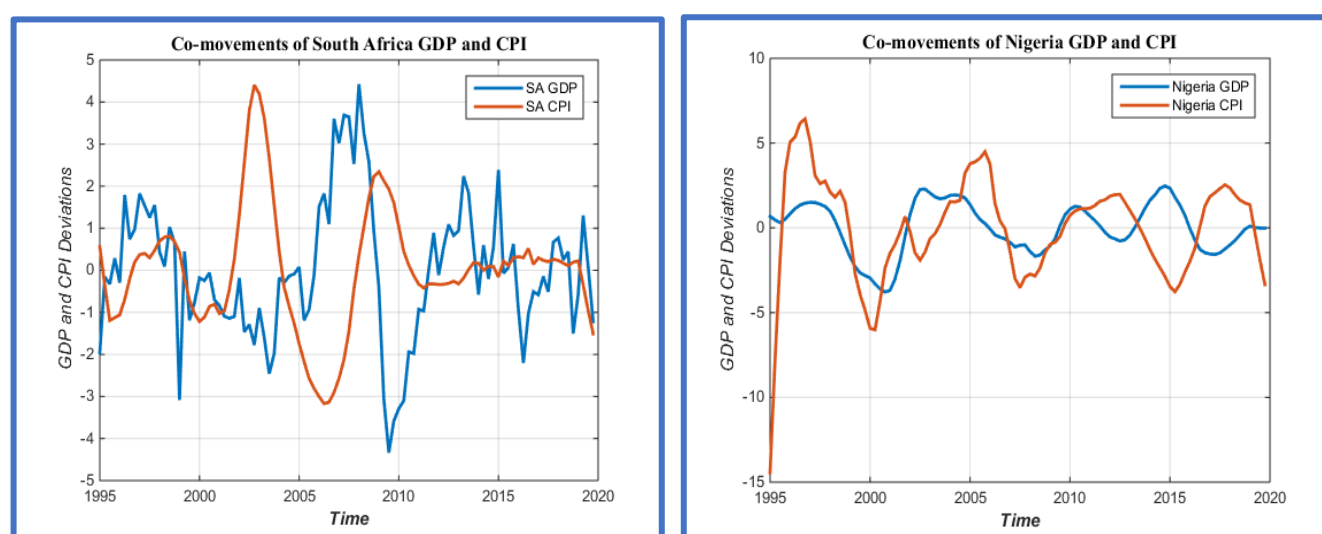
Source: Estimation with Matlab

4.1.2. Central banks efficiency and Banking system
A. Central banks and commercial banks interest rates

IMF (2010) states that the efficiency of the central bank can be seen through the way the banking system respond to central bank bank's action on policy rate and how the real economy reacts to the change in the banking system lending rate. Through the figure below one can see the way central policy rate evolved compared to lending rate in the two countries:

Figure 22 Co-movement between the central bank policy rate and lending rate
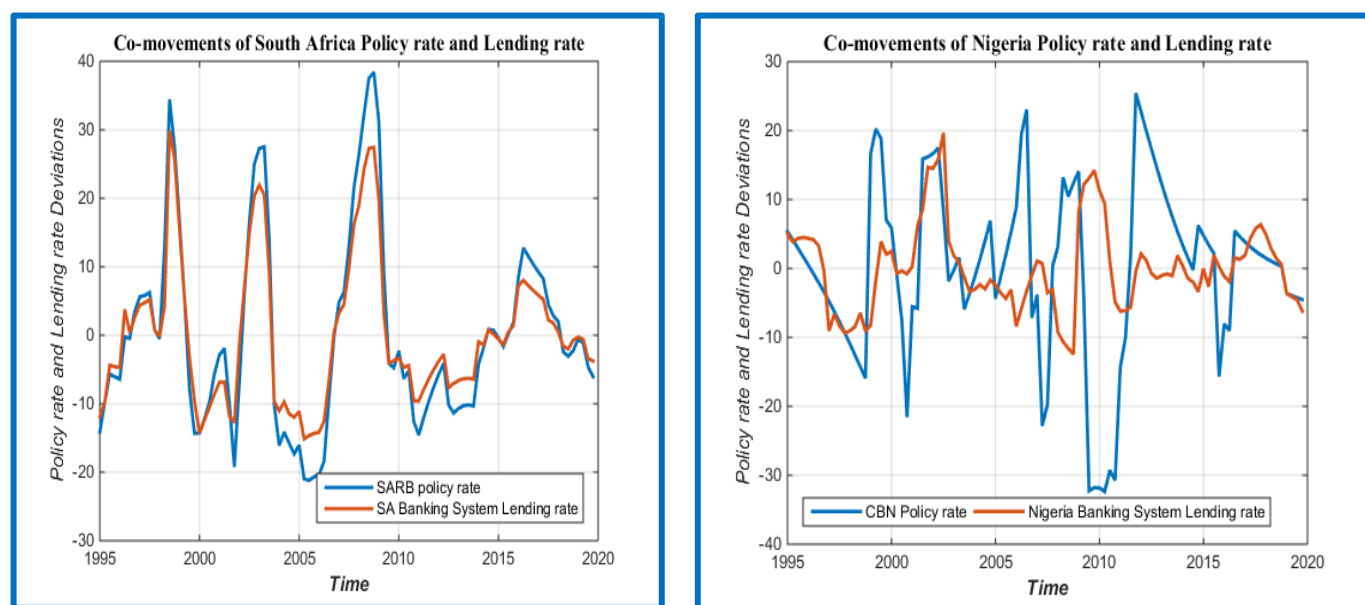
Source: Estimation with Matlab

The left part of the above-mentioned graph shows the way the South African baking system perfectly react to central bank adjustment, this situation exposes that SARB is effective in controlling commercial banks as the policy rate and lending rate follow perfectly the same trend. On the right part, the Nigerian banking system has some difficulties to proportionally follow the policy rate change. **IMF (2010)** explains that some Sub-Saharan banking systems face constraints to perfectly adjust the lending rate to the monetary policy rate due the increase of risk during meltdown periods and the pursuit of high margin of profits. Overall, through the figure above, we can note that the SARB is more effective in influencing the change in lending rate of commercial banks than the CBN. The Nigerian economy is hugely dependant on crude oil price, all shocks in crude oil price are directly linked with Nigerian economic crisis. Take for instance the commodity price shock of 2009 and the oil shock of 2016 turned to recession, for these periods the change in lending rate were smaller than the change in policy rate, this shows the rigidity of commercial banks to adjusted lending cut to policy rate change. The South African commercial banks' lending rate is perfectly positively co-moved to SARB's policy rate at lag 0 (0,9835). However, for Nigeria the cross-correlation result of -0,2915 at lag 2, shows a negative co-movement between the monetary policy rate and the lending rate (Appendix 2). This means, that during the meltdown, commercial banks increase the lending rate, given the intensification of risk related to real activity or keep the lending constant while the policy rate has declined. At the end the private sector will have get difficulty to have credit access.

B. Central banks and domestic credit to private sector

The absence of financial markets in developing countries pushes the central bank to lean the lending channel. The goal for the central bank to adjust the policy rate during the crisis, is to ease access of private sector to credit. The increase of domestic credit to depend on the way commercial banks are flexible to follow central bank adjustments. The following figure shows the way the policy rate and real credit cycle evolved in SA and Nigeria:

Figure 23 Co-movement between Central Bank policy rate and domestic credit to private sector
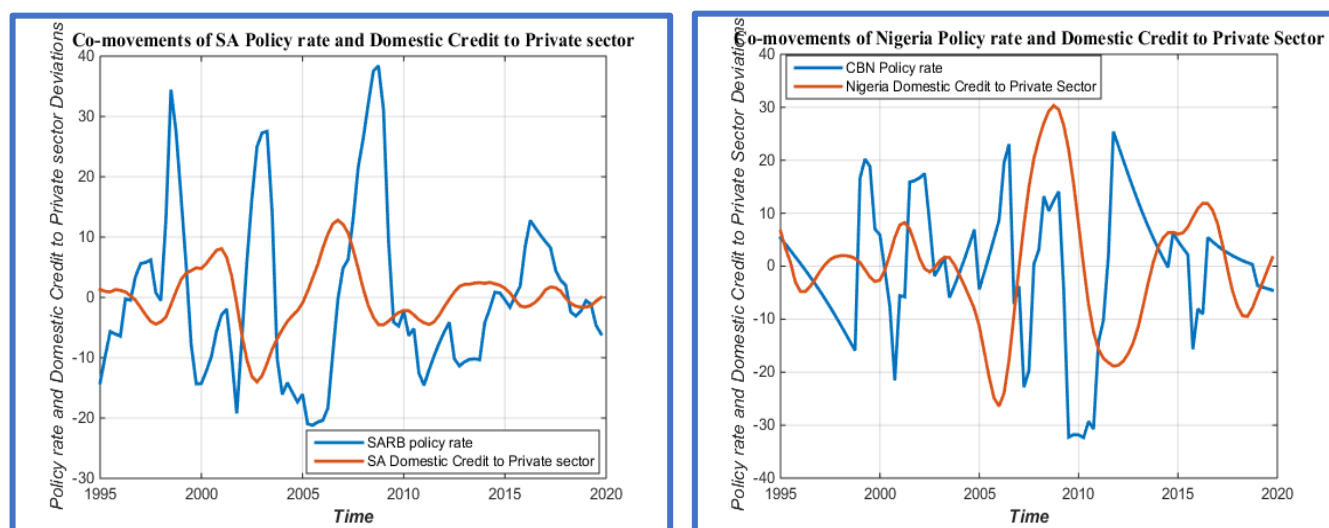
Source: Estimation with Matlab

On the left part of the figure above, one can note that the domestic credit to South African private sector is countercyclical, i.e any decrease (or increase) of policy rate is associated to an increase (or decrease) of private credit. with negative cross-correlation coefficient of 0,3563 at lag 2, meaning that domestic credit responds to the policy rate cut after 2 quarters in South Africa. Regarding the Nigeria, the result shows that le domestic credit to private sector is leading the change in policy rate, with negative correlation of -0,3568 at lag 4 (Appendix 3). In the 2009 recession, the fluctuations in policy rate and domestic credit present high amplitude compared to other periods meaning that this shock was among the greatest crisis faced by these countries. The onset of this crisis first declines the level of domestic credit to private sector for the both countries; the expansionary monetary policy applied by SA and Nigeria in the first quarter of 2009 made some improvements in the domestic credit to private sector. Particularly, in the post-recession the Nigerian domestic credit to private sector increased more than the one of SA. According to the Article IV consultation staff report IMF on Nigeria of 2014, public and private sector relies more on domestic debts than external debts, as the lending rate remained slightly rigid even when the policy rate increased (from 2011 to 2015).

The idea is to see whether the local monetary policy is capable to improve funding of private sector, the negative linkage identified between the policy rate and the domestic credit to private sector displays the possible existing effectiveness of monetary policy to stabilize economic activity. Any expansionary monetary policy is associated to improvement in credit growth. The case of Nigeria let us skeptical regarding the fact that the domestic credit to private sector is leading the policy rate why, it could be the reverse as the policy ate is the exogenous factor adjusted to improve credit access. In this sense, the lack of access to credit always push CBN to cut interest rate for easing liquidity access.

4.2. Determinants of macroeconomic fluctuations in South Africa and Nigeria during the crisis

Different authors found that the recession was related transmitted to Sub-Saharan African countries through the trade and financial channel. Based on co-movement analysis, we evaluate shapes of the GDP growth and different financial and trade factors to capture which business is more similar to GDP cycle.

4.2.1. Transmission of crisis through trade channel

Food price and metal price (except gold) index were the main transmitters of external commodity shock during the 2009 recession on South Africa, while Nigeria was affected through food and crude oil prices. Moreover, terms of trade display the effect of external trade on domestic policy, the higher the terms of

trade, the higher the entry of foreign currency. The figure below highlights the way GDPs of African countries co-moved to different trade parameter:

Figure 24 GDP, Commodity price and Terms of trade
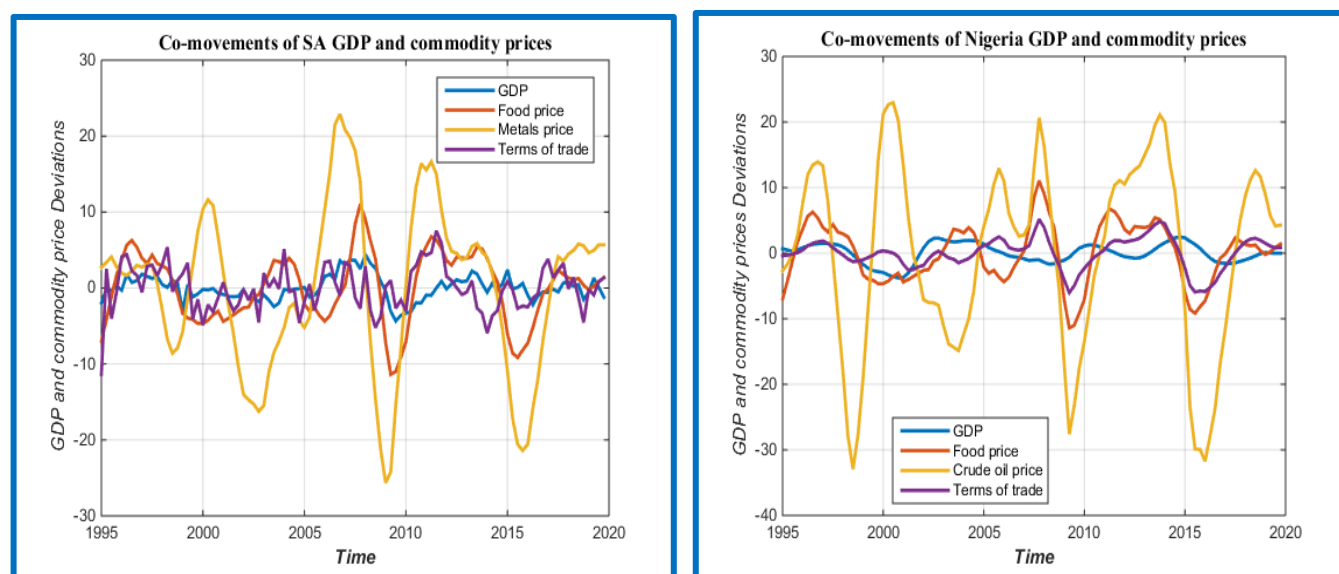
Source: Estimation with Matlab

On the left side of the figure above, we can see the approximation of GDP growth shape, food price and terms of trade cycles. The 2009 and 2016 crises are related to commodity price shocks, show a huge decline in metal price as the shocks led the drop of raw materials price. This figure displays that all positive and negative changes in GDP are linked to the proportional change in food price, metal price and terms of trade. Regarding the amplitude of business cycles, the metal price presents high volatility compared to other external parameters. However, in 2000, 2003 and 4th quarter of 2019, we note a negative co-movement between the GDP growth and the metal price, while the terms of trade and food price are closed to South African GDP cycle for all study period (1995: q1- 2019: q4). This situation let us understand that the fluctuations in GDP cycle is more related to food price and terms of trade. The cross-correlation coefficients of 0,5443 (at lag 1), 0,6903 (at lag 3) and 0,3360 (at lag 4) show respectively the procyclicality of food price, metal price and terms of trade. They are leading the change in GDP business cycle. Particularly, in the graph one can notice that the metal price shock has at a certain level contributed to the 2009 recession in South Africa.

Moreover, the change in Nigerian GDP business cycle is approximatively similar to variations of cycles of food price, crude oil price and terms of trade. Regarding the cross-correlation of 0,16203 (at lag 2), -0,3513 (at lag 4) and 0,1125 (at lag 4), we can note the crude oil price is countercyclical for this study period, while other external variables are procyclical (Appendix 4). The expectation was to see a procyclical linkage, this shows that all shocks in GDP are not related to crude oil price shocks. The two recent recession in Nigeria (2009 and 2016) were mainly associated to the decline in crude oil price.

Further, IMF (2010) found that the global recession was also transmitted through the drop of exports in volume. The graph below displays the way the exports in volume are co-moved the GDP growth:

Figure 25 Co-movement between the GDP and the export volume index
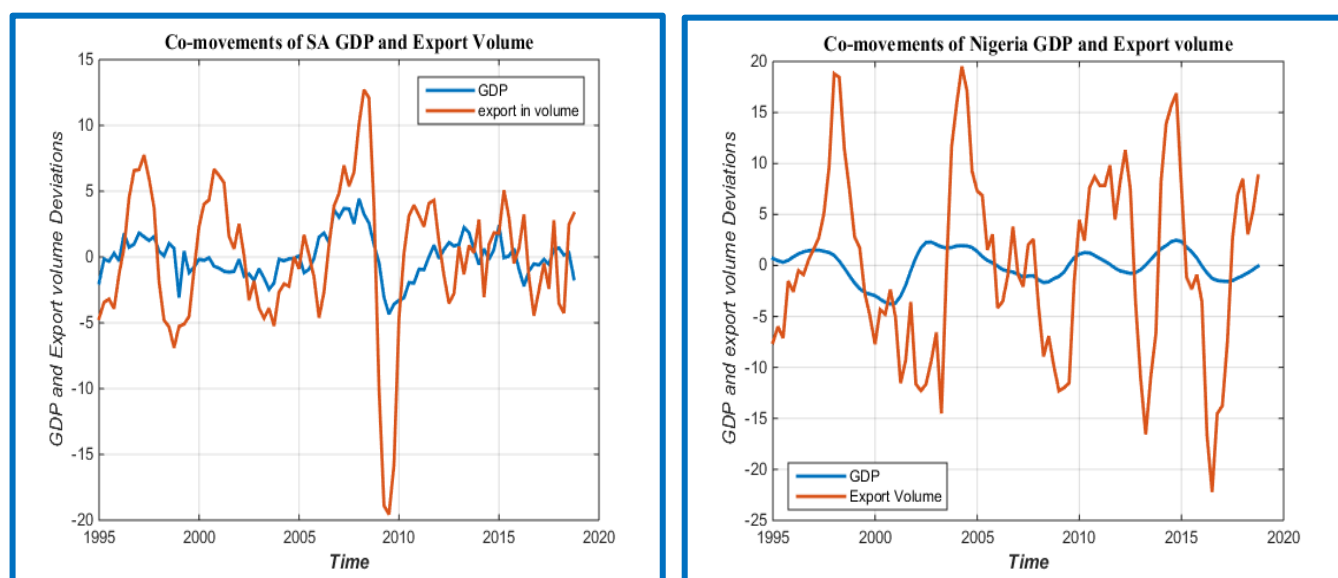
Source: Estimation with Matlab

During the pre-recession period, the high decline in export volume of South Africa was equal to 6 percentage points (left of the graph). However, the onset of the global recession made the volume of exports drop by 19 percentage points. As a small opened exporting country, the decline in export volume drastically contributed to pave the road of recession in South Africa. In the post-recession period, the export volume index became less volatile. The cross-correlation coefficient of 0,563 (at lag 1) shows a positive co-movement between the GDP and the export volume index of SA (the export volume is leading the change GDP cycle). For Nigerian case (right side), we can see that all important declines of export volume index were associated to decline of GDP growth (especially in 2009 & 2016, etc.). Overall, the correlation analysis shows (0,4511 at lag 3) a positive co-movement between the GDP and the export volume index in Nigeria, this means that the change in Nigeria GDP can be also explained by the variations of the volume of exports (Appendix 5). In 2009, the export volume index declined by 12 percentage points while in SA it was equal to 19 percentage points. The situation starts give light on the reasons why South Africa faced a high decline of GDP compared to Nigeria, as this country faced more decline in exports.

As we can see the 2 last graphs, the decline of GDP in 2009 was linked to the drop of commodity prices, terms of trade and export volume index. Thus, the regression analysis will further clarify which variable explains significantly the change in Sub-Saharan African GDPs.

4.2.2. Transmission of crisis through financial channel

Different empirical studies sustain that recession from external origin (especially developed countries) has negative impact on capital inflows to developing countries (decline in FDI, investment portfolio, foreign aids, remittances, etc.). Referring to the statistics of IMF (2009 & 2010), the recession did not affect the inflow of remittances and foreign aids to Sub-Saharan Africa, reason why for the analysis of financial channel, we build on the net inflow of FDI and portfolio investment. The following figure highlights the way the GDP and capital net inflows co-moved in 1995 – 2019:

Figure 26 Co-movement between the GDP and the financial channel
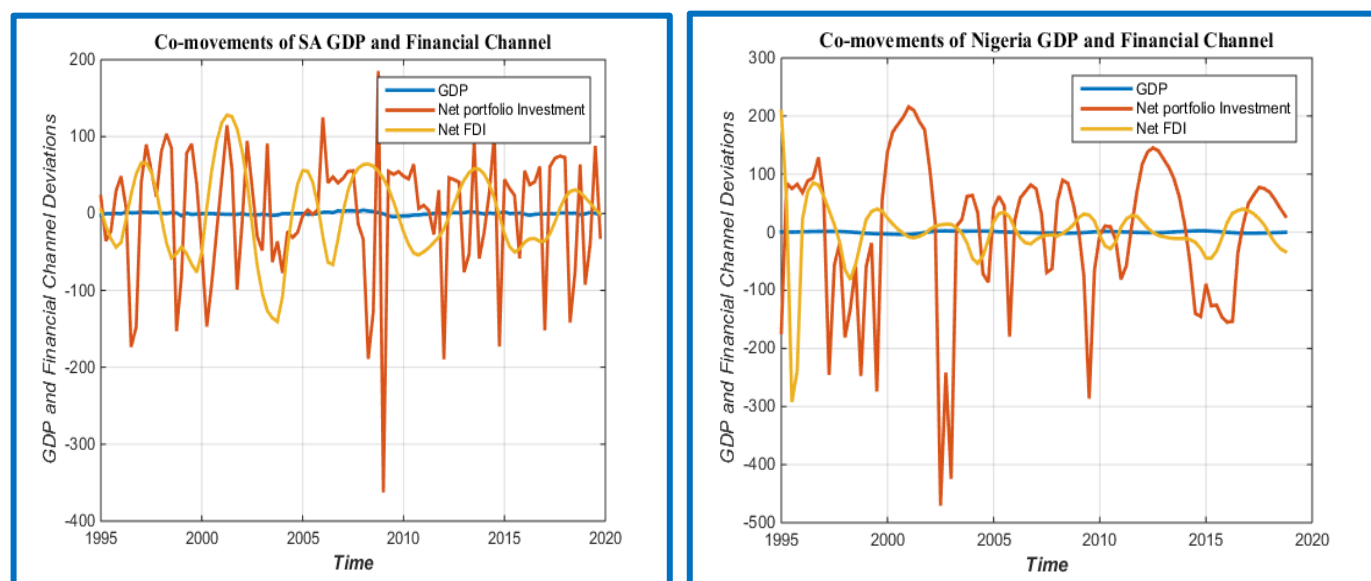
Source: Estimation with Matlab

For the both countries, business cycles of net inflows present numerous fluctuations compared the GDPs, this means that all declines in capital net inflow are in all cases linked to the drop of GDP. As we can see in the 2 parts of the graph, in 2009, the FDI net inflow increased, while the expectation was to see it decline due the financial crisis. However, the net portfolio investment net inflow has declined in 2009. Hence, it remains skeptical to conclude whether capital net inflows have affected the GDP growth during meltdown period.

4.2.3. The role of domestic channel in GDP change: commodity supply in tons & Barrels/day

To quantify the commodity supply, we used the for each countries the production of the important primary commodity exported. For South Africa, we took crude iron production (in tons) as a proxy of mining products and for Nigeria we used crude oil and other liquids production (in barrels/day). The South African and Nigerian economies were hit by an aggregate supply shock during the crisis (2009). Thus, the mechanism is that the crisis made the world commodity price declines, which in turn pushed the suppliers to drop production, as the production collapsed, the price level increased on the local market. In the regression model, the commodity supply was not integrated due the problem of endogeneity between the GDP and the commodity supply (what is causing what). The figure resumes the evolution of GDP versus the commodity supply:

Figure 27 Co-movement between the GDP and the commodity supply
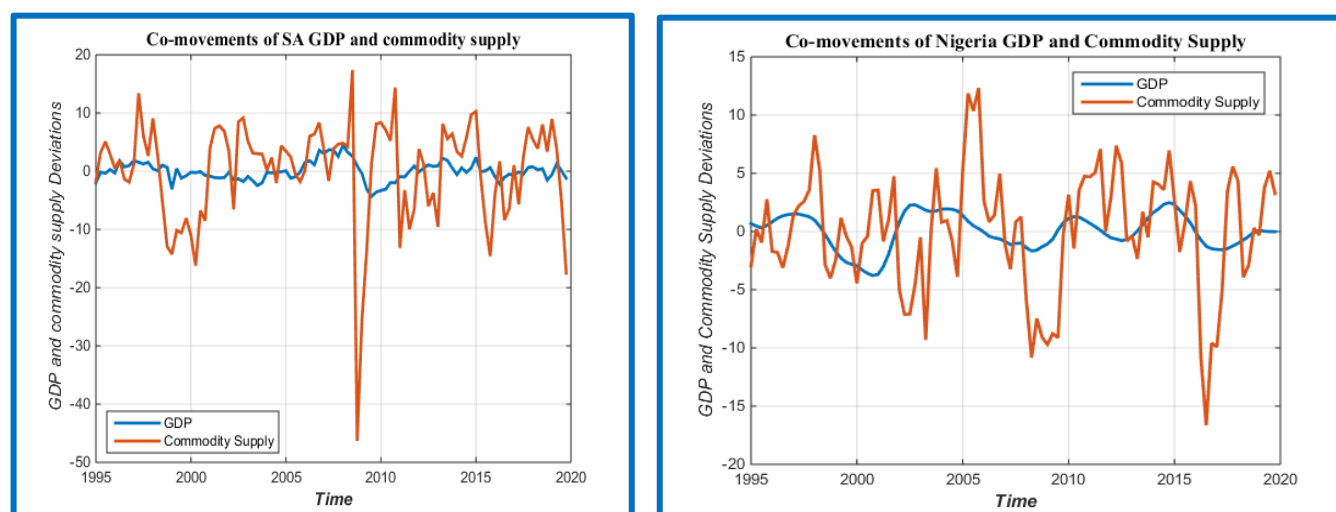
Source: Estimation with Matlab

All periods of negative shocks on the production of primary commodities are associated the important drops in GDP. From 2008 to 2009, the mining production declined from 18 percentage points to -45 percentage points, while the Nigerian Crude oil and other liquid production moved from 1 to -9 percentage points. The way the important primary commodity exported declined in South Africa compared to Nigeria, continue displaying why the recession has more effect on South Africa than Nigeria. Employments and sectors depending mining production were exposed to be drastically shaken. The cross-correlation of 0,2881 (at lag 2) shows a positive co-movement between the SA GDP growth and mining production, i.e the positive or negative change in mining production is linked to the similar change in GDP (Appendix 6). The Nigerian GDP growth and production of crude oil and other liquids are positively linked (0,2536 at lag 3). Finally, one can say the decline of GDPs in SA and Nigeria during the recession can also be related to the drop of commodity production.

4.3. Understanding the impact of monetary policy during the 2009 recession

To analyze the impact of CBN and SARB policy on the GDPs, we also consider other variables which can explain the macroeconomic fluctuations in Sub-Saharan countries for control. Indeed, the control variables are built on external monetary policy, financial and trade channels.

Tableau 2 Impact of African Central Bank monetary policy

	SOUTH AFRICA				NIGERIA			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP
Ln Policy rate	-0.562***	0.0547*	-0.0514***	-0.0507**	-0.637***	-0.276***	0.00483	-0.123
	(-17.73)	(2.32)	(-3.55)	(-3.09)	(-4.63)	(-6.42)	(0.21)	(-1.96)
Ln real domestic credit		0.647***	0.184*	0.266**		0.0802*	0.0431*	0.0384
		(20.41)	(2.66)	(3.41)		(2.30)	(2.63)	(1.44)
Ln G7 shadow rate		-0.0585***	-0.0157*	-0.0228*		-0.0336*	-0.0364***	-0.0276*
		(-5.21)	(-2.04)	(-2.67)		(-2.18)	(-5.65)	(-2.53)
Ln G7 real credit		0.00403	0.129***	0.0979**		0.507***	0.299***	0.368***
		(0.19)	(5.83)	(3.54)		(11.84)	(7.25)	(4.83)
Ln Food price			0.337***	0.345***			0.153*	0.00390
			(5.09)	(4.57)			(2.07)	(0.03)
Ln Metal price			0.0299	-0.00948				
			(0.66)	(-0.20)				
Ln Crude oil price							-0.0899***	0.0394
							(-3.87)	(0.42)
Ln Terms of trade			0.146	0.0536			1.478***	0.792
			(1.96)	(0.72)			(7.90)	(1.59)
Ln export volume index			0.0455	0.0895			-0.0721*	-0.123
			(0.79)	(1.35)			(-2.35)	(-1.89)
Ln net portfolio investment				0.00544				0.00356
				(1.74)				(1.16)
Ln net FDI				-0.000116				-0.0179
				(-0.02)				(-0.81)
Constant	29.71***	9.619***	16.57***	15.46***	31.60***	10.28***	11.47***	13.22***
	(423.07)	(12.87)	(11.02)	(9.51)	(89.95)	(11.67)	(12.81)	(6.72)
N	100	57	57	37	100	57	57	27
t statistics in parentheses								
* p<0.05, **p<0.01, *** p<0.001								

Source: Author's estimation through Stata

The model without control shows the significant positive impact of expansionary monetary policy on GDP growth over time for SA and Nigeria. For any policy rate cut of 1%, the GDP increase by 0.562% and 0.637% in respectively South Africa and Nigeria. After control, one can see that when the policy rate decreases by 1%, GDPs increase by 0.0507% and 0.123% for SA & Nigeria (the impact is not significant for Nigeria). Monetary and credit shocks have exerted significant effect on GDPs. Thus, improvement in domestic credit to private sector push the GDP to increase by 0.266% in SA and 0.0384% in Nigeria (the

impact is not significant). The shadow rate affects negatively the GDP meaning that the decline of shadow rates in G7 countries has made GDPs increase by 0.0228% & 0.0276% in SA and Nigeria. The credit shock in G7 has made the GDP increase by 0.0979% and 0.368% in respectively SA and Nigeria. Further, among trade and financial variables, Food price exerts significant and positive impact on South African GDP (0.345%). But for Nigeria the impact of the trade variables seems not to be significant. However, excluding financial channel in the model, the food price, the terms of trade, crude oil price and the export volume have a significant impact on Nigerian GDP. Over time the regression can show possible insignificant impact of trade and financial channels, but as one can see the co-movement analysis these two channels have played important role in GDP cycle during the period of recession.

One can cross the policy rate with crisis binary variable to visit the way changes of policy rate affected the GDP during the recession, knowing that the policy rate holds 0 value in the other periods. In addition, the shadow rate can also be crossed with the unconventional monetary policy (binary variable), to see whether the change in shadow rate affected GDPs of sub-Saharan countries. The table below shows the way the GDP reacted to monetary policies during the crisis:

Tableau 3 Unconventional monetary policy and 2009 recession

	SOUTH AFRICA				NIGERIA			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP	Ln real GDP
Ln Policy rate*Crisis	0.0551 (0.88)	0.187 (1.61)	-0.0184 (-0.30)	0.0313 (1.86)	0.0968 (0.90)	-0.0941 (-0.48)	0.172** (2.98)	0.176* (2.48)
Ln real domestic credit		0.569*** (18.37)	0.270** (2.94)	0.461*** (4.25)		0.252*** (7.00)	0.00812 (0.44)	0.00138 (0.05)
Ln G7 shadow rate*UMP		0.266 (1.45)	-0.0253 (-0.26)	0.00 (.)		-0.125 (-0.43)	0.216* (2.53)	0.218* (2.15)
Ln G7 real credit		0.0535* (2.48)	0.151*** (5.79)	0.0617 (1.51)		0.369*** (7.41)	0.421*** (11.15)	0.406*** (5.20)
Ln Food price			0.353*** (4.59)	0.495*** (4.93)			0.254** (3.45)	0.235 (1.59)
Ln Metal price			0.00912 (0.16)	-0.120 (-1.81)				
Ln Crude oil price							-0.128*** (-5.07)	-0.0793 (-0.82)
Ln Terms of trade			0.129 (1.32)	-0.132 (-1.24)			1.395*** (6.62)	1.270* (2.44)
Ln export volume index			-0.0254 (-0.35)	0.230 (2.04)			-0.126*** (-4.04)	-0.132 (-1.88)
Ln net portfolio investment				0.00777 (1.59)				0.00221 (0.61)
Ln net FDI				-0.0136 (-1.57)				-0.00535 (-0.21)
Constant	28.48*** (1079.25)	10.31*** (17.07)	13.66*** (7.02)	11.17*** (5.04)	29.97*** (694.78)	9.754*** (9.59)	8.443*** (11.35)	9.675*** (5.04)
N	100	57	57	37	100	57	57	27
t statistics in parentheses								
* p<0.05, **p<0.01, *** p<0.001								

In the model without control, change from non-recession period to 2009 recession, made the policy rate increase the SA GDP by 0.0551% (insignificant impact) and the Nigerian GDP by 0.176%. During the conduction of unconventional monetary policy, the shadow rate did not affect the SA GDP, while it has significant impact on Nigerian GDP (0.218%). Foreign and domestic credit impact on GDPs remain robust in this model with UMP. Among financial and trade channel variables, only food price and terms of trade have impacted positively SA and Nigerian GDPs (0.495% and 1.270% respectively). Particularly, one can note that the crude oil price and metal price (except gold) has exerted insignificant negative impact on GDPs.

CONCLUSION AND DISCUSSION OF RESULTS

Here we are at the end of our work entitled *"understanding the impact and policy of African Central Banks during the recent recession"*.

The purpose of this work was to capture the impact of the 2009 recession crisis, assess the factors explaining it and find the role played by domestic and external monetary policy within the economy. Co-movement analysis and ordinary least squares achieved this goal.

Indeed, starting from the model without control, domestic monetary policy exerts a positive influence on South Africa and Nigeria. The results reveal that any 1% reduction in the policy rate, South African and Nigerian GDP increases by 0.562% and 0.637% respectively. Including credit shock, external monetary policy, trade and financial channel variables as control; internal and external credit shocks exert a positive influence on the level of GDP in both countries. This ties in with the ideas put forward by **Houssa et al (2013, 2015)** highlighting the positive impact of the credit shock from G7 on South Africa and Ghana. These authors have mentioned that the shock on credit and trade are the transmitters of the external shocks on developing countries. This can be seen in our results, given the fact that in addition to monetary policy shock, the credit shock and certain trade factors have impacted the South African and Nigerian economy (Food price, oil price, terms of trade, etc.).

Our results show that the financial channel variables did not exert a significant influence on GDP in both countries. This prompts us to point out that macroeconomic fluctuations in Nigeria and South Africa are generally influenced by monetary policy shocks, credit shocks and the trade channel. **Oladunni (2019)** underlined the importance of oil shock in Nigeria; as our result reveals, the crude oil price exerted negative impact on GDP, meaning that it is important for Nigeria to keep its economy more and more independent from crude oil (this was among suggestions of IMF consultancy team to Nigerian government for stabilization policy).

In addition, **Loayza and Raddatz (2006)** mentioned the importance of FDI in GDP fluctuation, in our analysis on SA and Nigeria the impact of net capital inflows on GDP was found to be insignificant. **Megersa (2017)** found a negative impact of unconventional monetary policy on assets yields in SA, our results show that the UMP has no impact on SA GDP. However, the impact was noted positive on Nigerian GDP.

Finally, the domestic monetary policy during the recession of 2009, the monetary policy of the SARB did not exert a significant influence on South African GDP (0.0313%) while the Nigerian monetary policy led to a significant increase of 0.176% of GDP. Further, the GDPs have responded positively to the change in external monetary policy. Overall, the co-movement analysis and regression results expose the impact of monetary policy shock, credit shock and trade channel shocks. For financial channel, co-movement analysis has shown that the shape of business cycles of capital net inflows does not correspond to GDP cycle, meaning that all changes in financial channels don't turn into the change in GDP. The regression result also points out the insignificant impact of the financial channel on the GDP/.

This methodology applied in the paper is for time reason, but the most appropriate methodology would be the historical decomposition in SVAR model to see the contribution of each shock to GDP. Moreover, the counterfactual analysis in SVAR model could allow us to clearly identify the effectiveness of monetary policy in the GDP. The plan is to perform in the future the same subject by applying the appropriate methodology underlined.

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APPENDIX

Appendix 1 Cross-correlation between GDP and CPI

Lag	GDP cycle	CPI cycle	P-Value GDP cycle	P-Value CPI cycle
SOUTH AFRICA				
Lag	**GDP cycle**	**CPI cycle**	**P-Value GDP cycle**	**P-Value CPI cycle**
Lag 0	1	-0,374543703	0	0,000123501
	-0,374543703	1	0,000123501	0
Lag 1	0,75853607	-0,497490497	9,60E-20	1,62E-07
	-0,232803104	0,950191004	0,020400369	6,57E-51
Lag 2	0,632551667	-0,599438106	2,81E-12	6,97E-11
	-0,082238655	0,8218134	0,420796355	3,46E-25
Lag 3	0,528001755	-0,659043259	2,73E-08	2,16E-13
	0,051503591	0,642392914	0,616365192	1,32E-12
Lag 4	0,336901644	-0,661073799	0,000789658	2,30E-13
	0,148582545	0,432049761	0,148523017	1,11E-05
NIGERIA				
Lag	**GDP cycle**	**CPI cycle**	**P-Value GDP cycle**	**P-Value CPI cycle**
Lag 0	1	0,261543803	0	0,008576846
	0,261543803	1	0,008576846	0
Lag 1	0,962397855	0,279605493	1,05E-56	5,07E-03
	0,300985563	0,90059799	0,002467806	7,11E-37
Lag 2	0,858001037	0,279348377	1,58E-29	5,34E-03
	0,314568236	0,660197128	0,001607182	1,42E-13
Lag 3	0,704057183	0,250241385	8,66E-16	1,34E-02
	0,315712391	0,408125938	0,001632282	3,33E-05
Lag 4	0,518553579	0,192825779	6,24E-08	5,98E-02
	0,314631215	0,218706274	0,001795939	3,23E-02

Source: Estimation with Matlab

Appendix 2 Cross-correlation between policy rate and lending rate

Lag	Policy rate cycle	Lending rate cycle	P-Value Policy rate cycle	p-value Lending rate cycle
	SOUTH AFRICA			
Lag	**Policy rate cycle**	**Lending rate cycle**	**P-Value Policy rate cycle**	**p-value Lending rate cycle**
Lag 0	1	0,983560473	0	1,16E-74
	0,983560473	1	1,16E-74	0
Lag 1	0,887454377	0,88165514	2,13E-34	2,11E-33
	0,858235172	0,871805598	7,49E-30	7,98E-32
Lag 2	0,653699457	0,658735363	2,94E-13	1,67E-13
	0,618707883	0,633692433	1,13E-11	2,50E-12
Lag 3	0,411024975	0,417749126	2,89E-05	2,07E-05
	0,374554936	0,386787457	0,000157033	9,10E-05
Lag 4	0,198431787	0,200321244	5,26E-02	5,04E-02
	0,16457705	0,166634187	0,109079886	1,05E-01
	NIGERIA			
Lag	**Policy rate cycle**	**Lending rate cycle**	**P-Value Policy rate cycle**	**p-value Lending rate cycle**
Lag 0	1	-0,0035563	0	9,72E-01
	-0,0035563	1	9,72E-01	0
Lag 1	0,765099056	-0,217901702	3,00E-20	3,03E-02
	0,158881263	0,820691086	1,16E-01	2,58E-25
Lag 2	0,491571185	-0,291505267	2,75E-07	3,59E-03
	0,230470677	0,588330632	2,24E-02	1,89E-10
Lag 3	0,17366026	-0,266571495	8,89E-02	8,31E-03
	0,27252938	0,324240408	0,006920846	1,20E-03
Lag 4	-0,094034223	-0,222654693	3,62E-01	2,92E-02
	0,238789584	0,0523842	0,019129126	6,12E-01

Source: Estimation with Matlab

Appendix 3 Cross-correlation between policy rate and Domestic credit to private sector

Lag	Policy rate cycle	Domestic credit cycle	P-Value Policy rate cycle	P-Value Domestic credit cycle
		SOUTH AFRICA		
Lag 0	1	-0,315649556	0	1,38E-03
	-0,315649556	1	1,38E-03	0
Lag 1	0,887454377	-0,245787285	2,13E-34	1,42E-02
	-0,346712772	0,956114448	4,39E-04	1,63E-53
Lag 2	0,653699457	-0,126228617	2,94E-13	2,16E-01
	-0,356398557	0,833162734	3,16E-04	1,95E-26
Lag 3	0,411024975	0,039551575	2,89E-05	7,01E-01
	-0,354483295	0,651703249	0,000367463	4,86E-13
Lag 4	0,198431787	0,237587978	5,26E-02	1,98E-02
	-0,340818023	0,438368256	0,000679031	7,93E-06
		NIGERIA		
Lag 0	1	-0,202783373	0	4,30E-02
	-0,202783373	1	4,30E-02	0
Lag 1	0,765099056	-0,257668091	3,00E-20	1,00E-02
	-0,13112153	0,962589356	1,96E-01	8,24E-57
Lag 2	0,491571185	-0,297773918	2,75E-07	2,90E-03
	-0,041851528	0,856603581	6,82E-01	2,44E-29
Lag 3	0,17366026	-0,328425344	8,89E-02	1,02E-03
	0,054327469	0,696561781	0,597140056	2,33E-15
Lag 4	-0,094034223	-0,356862739	3,62E-01	3,58E-04
	0,14764425	0,502267483	0,151132485	1,85E-07

Source: Estimation with Matlab

Appendix 4 Cross-correlation between GDP and food price

		South Africa			Nigeria			
	GDP cycle	Food price cycle	Pvalue GDP	Pvalue_food price cycle	GDP cycle	Food price cycle	Pvalue GDP	Pvalue_food price cycle
Lag 0	1	0,510234508	0	5,87E-08	1	0,156690082	0	1,20E-01
	0,51023451	1	5,87E-08	0	0,15669008	1	1,20E-01	0
Lag 1	0,75853607	0,544378668	9,60E-20	5,73E-09	0,96239785	0,156318692	1,05E-56	1,22E-01
	0,40755439	0,915717447	2,83E-05	3,44E-40	0,16200622	0,915717447	1,09E-01	3,44E-40
Lag 2	0,63255167	0,521578355	2,81E-12	3,65E-08	0,85800104	0,150900781	1,58E-29	1,38E-01
	0,25890795	0,705204548	0,01004649	5,24E-16	0,16203497	0,705204548	0,11092786	5,24E-16
Lag 3	0,52800176	0,423675079	2,73E-08	1,53E-05	0,70405718	0,146565277	8,66E-16	0,151990453
	0,08232141	0,431311362	0,42277095	1,03E-05	0,15657599	0,431311362	0,12562944	1,03E-05
Lag 4	0,33690164	0,291908874	0,00078966	0,003904484	0,51855358	0,148761862	6,24E-08	0,148028198
	-0,08691469	0,138791777	0,39977329	0,177465654	0,14093146	0,138791777	0,17081221	0,177465654

Source: Estimation with Matlab

Appendix 5 Cross-correlation between GDP, metal price and crude oil price

	South Africa				Nigeria			
	GDP cycle	Metal price cycle	Pvalue GDP	Pvalue metal price	GDP cycle	Crude oil price cycle	Pvalue GDP	Pvalue crude oil price
Lag 0	1	0,353877154	0	0,000303973	1	-0,237227678	0	1,75E-02
	0,35387715	1	0,000303973	0	-0,23722768	1	1,75E-02	0
Lag 1	0,75853607	0,534228936	9,60E-20	1,23E-08	0,962397855	-0,165136026	1,05E-56	1,02E-01
	0,16524414	0,94117931	0,10214658	1,68E-47	-0,29897604	0,931711854	2,65E-03	1,87E-44
Lag 2	0,63255167	0,648188727	2,81E-12	5,39E-13	0,858001037	-0,080189202	1,58E-29	4,33E-01
	-0,02642659	0,783901502	0,796176604	1,39E-21	-0,34305831	0,754613037	0,000544	2,90E-19
Lag 3	0,52800176	0,690340647	2,73E-08	5,17E-15	0,704057183	0,017753464	8,66E-16	0,86296725
	-0,20247574	0,558524999	0,04670613	2,77E-09	-0,3608137	0,5103182	0,00028272	9,31E-08
Lag 4	0,33690164	0,657130513	0,000789658	3,56E-13	0,518553579	0,121513972	6,24E-08	0,23825131
	-0,32717871	0,296735863	0,001139001	0,003327465	-0,35132482	0,233389317	0,00044852	0,02210927

Source: Estimation with Matlab

Appendix 6 Cross-correlation between GDP and terms of trade

	South Africa				Nigeria			
	GDP_cycle	ToT_cycle	pv_gdp	pv_ToT	GDP_cycle	ToT_cycle	pv_gdp	pv_ToT
Lag 0	1	0,143929149	0	0,153105951	1	0,055978129	0	5,80E-01
	0,14392915	1	0,15310595	0	0,055978129	1	5,80E-01	0
Lag 1	0,75853607	0,142422041	9,60E-20	0,159645753	0,962397855	0,067497072	1,05E-56	5,07E-01
	-0,09243305	0,420967663	0,36283994	1,43E-05	0,031791252	0,927894225	7,55E-01	2,38E-43
Lag 2	0,63255167	0,191087924	2,81E-12	0,059455468	0,858001037	0,07681374	1,58E-29	4,52E-01
	-0,13050973	0,33064975	0,20023238	0,000883176	-0,00109413	0,749729832	0,99146888	6,57E-19
Lag 3	0,52800176	0,221845022	2,73E-08	0,028970664	0,704057183	0,092328049	8,66E-16	0,36840725
	-0,32567562	0,177351551	0,00113322	0,082233472	-0,03184362	0,518806894	0,75683771	5,21E-08
Lag 4	0,33690164	0,33600285	0,00078966	0,000817264	0,518553579	0,112567095	6,24E-08	0,27485293
	-0,30558766	0,134601045	0,00246431	0,191043464	-0,05549298	0,269648169	0,59126098	0,00788871

Source: Estimation with Matlab

Appendix 7 Cross-correlation between GDP and export volume index

	GDP cycle	Export volume cycle	Pvalue GDP	Pvalue export volume
South Africa				
Lag 0	1	0,561359051	0	2,69E-09
	0,56135905	1	2,69E-09	0
Lag 1	0,7695756	0,563371117	8,14E-20	2,79E-09
	0,50973032	0,803497733	1,32E-07	1,15E-22
Lag 2	0,65741073	0,454763358	6,15E-13	4,13E-06
	0,36436271	0,468789406	0,00030584	1,88E-06
Lag 3	0,53083443	0,293353974	4,41E-08	0,004319798
	0,14456335	0,117178243	0,16680668	0,263310218
Lag 4	0,33532749	0,130336085	0,00108493	0,215591083
	-0,04908641	-0,186367999	0,64217269	0,075279589
Nigeria				
	GDP cycle	Export_volume cycle	Pvalue GDP	Pvalue export volume
Lag 0	1	0,360155843	0	3,13E-04
	0,36015584	1	3,13E-04	0
Lag 1	0,96244589	0,264482735	1,86E-54	9,60E-03
	0,42164284	0,833204435	2,09E-05	1,16E-25
Lag 2	0,85848822	0,136757398	2,00E-28	1,89E-01
	0,44724169	0,565932824	6,21E-06	2,78E-09
Lag 3	0,7054808	-0,000448189	2,90E-15	0,996598053
	0,45117772	0,299754346	5,66E-06	3,51E-03
Lag 4	0,52101834	-0,136788571	1,01E-07	0,19352831
	0,43083075	0,047338453	1,81E-05	0,654082676

Source: Estimation with Matlab

Appendix 8 Cross-correlation between GDP and commodity supply

	GDP cycle	Commody supply cycle	Pvalue GDP	Pvalue commodity supply
South Africa				
Lag 0	1	0,106563061	0	2,91E-01
	0,106563061	1	2,91E-01	0
Lag 1	0,75853607	0,199161947	9,60E-20	4,81E-02
	-0,03778727	0,420962342	7,10E-01	1,43E-05
Lag 2	0,632551667	0,288151367	2,81E-12	4,01E-03
	-0,10698901	0,172079748	0,29438024	9,02E-02
Lag 3	0,528001755	0,244960469	2,73E-08	0,015594471
	-0,17160871	-0,038856336	0,09281494	7,06E-01
Lag 4	0,336901644	0,197258402	7,90E-04	0,054056315
	-0,09821066	-0,109728779	0,34111591	0,287214524
Nigeria				
	GDP cycle	**Commody supply cycle**	**Pvalue GDP**	**Pvalue commodity supply**
Lag 0	1	0,198412653	0	4,78E-02
	0,198412653	1	4,78E-02	0
Lag 1	0,962397855	0,15486648	1,05E-56	1,26E-01
	0,227376786	0,656863268	2,36E-02	1,55E-13
Lag 2	0,858001037	0,099241379	1,58E-29	3,31E-01
	0,241828437	0,321301182	0,01644057	1,26E-03
Lag 3	0,704057183	0,045538725	8,66E-16	0,657823552
	0,253687672	0,174466745	0,01216557	8,74E-02
Lag 4	0,518553579	-0,012436151	6,24E-08	0,904279268
	0,246463974	0,071937275	0,01549161	0,486110379

Source: Estimation with Matlab