

**IBN HALDUN UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF ECONOMICS**

PH.D. THESIS

**MONETARY UNIONS AND CRYPTO-CURRENCY
COMPETITION: IMPLICATIONS FOR
FINANCIAL STABILITY**

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**THESIS SUPERVISOR
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ISTANBUL, 2024

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COMPETITION: IMPLICATIONS FOR
FINANCIAL STABILITY**

by

AYUBA NAPARI

**A thesis submitted to the School of Graduate Studies in partial
fulfilment of the requirements for the degree of Doctor of
Philosophy in Economics**

**THESIS SUPERVISOR
ASSIST. PROF. ASAD UL ISLAM KHAN**

ISTANBUL, 2024

APPROVAL PAGE

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the award of a Doctor of Philosophy in Economics.

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This is to confirm that this thesis complies with all the standards set by the School of Graduate Studies of Ibn Haldun University.

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name Surname:

Signature:

ÖZ

PARA BİRLİKLERİ VE KRİPTO PARA BİRİMLERİ REKABETİ: FİNANSAL İSTİKRAR ÜZERİNDEKİ ETKİLERİ

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Mart 2024, 131 Sayfa

Bu tez, üç makaleyi içeren bölümlerden oluşmaktadır. Birinci bölüm, araştırma alanının boşluğunu, makalelerin amaç ve hedeflerini ve bunların önemini açıkça belirten tezin genel girişidir. İkinci bölüm, kredi açığı ve çıktı açığına bağlı bir takipteki krediler modelini geliştirmektedir. Finansal sağlamlığın bir ölçüsü olarak takipteki kredi oranlarını kullanan model, parasal birliğin üye ülkeler üzerindeki finansal istikrar etkilerini incelemek için kullanılmaktadır. Bu durum, henüz uygulamaya konulmamış olan Batı Afrika Para Bölgesi'nin bir üyesi Gana'da kullanılarak olgusal bir çerçevede test edilmiştir. Üçüncü bölüm, Hayek'in kripto para birimlerinin yaygınlaşmasından önce ve sonra Paranın Denasyonalizasyonu önerisine ilişkin literatürü gözden geçirmektedir. Ayrıca kripto para birimlerinin Hayek'in paranın ulusallıktan çıkarılması önerisiyle ne ölçüde uyumlu olduğu değerlendirilmektedir. Hayek'in önerisine ilişkin görüşlerin eleştirelden temkinli beğeniye doğru değiştiği sonucuna varılmıştır. Ayrıca, stabil kripto Hayek'in önerisini en iyi şekilde yansıttığı ve hükümetin okunabilirlik düzenlemelerinden kurtulma olasılığı en yüksek kripto varlık olduğu sonucuna varılmıştır. Dördüncü bölümde, kripto para birimi getirileriyle temsil edilen kripto para ikamesinin döviz kuru oynaklığı üzerindeki etkisi Nijerya örneği için ampirik olarak incelenmiştir. Kripto para birimi getirilerinin Naira'nın oynaklığı üzerinde olumlu bir etkisi olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Hayek, Kripto Paralar, Kriptolaşma, Özel Para, Para İkamesi, Parasal Birlikler.

ABSTRACT

MONETARY UNIONS AND CRYPTO-CURRENCY COMPETITION: IMPLICATIONS FOR FINANCIAL STABILITY

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March 2024, 131 Pages

This thesis contains three article chapters. Chapter One is a general introduction to this thesis, explicitly stating the research gap, the purpose and objectives of the essays and their significance. Chapter Two models nonperforming loan ratios as dependent on the lending gap and the output gap. Using nonperforming loan ratios as a proxy for financial soundness, the model is used to examine the financial stability implication of a monetary union. This is tested in a counterfactual framework using Ghana, a member of the yet-to-be-implemented West African Monetary Zone. Chapter Three reviews the literature on Hayek's "Denationalisation of Money" proposal prior to and after the proliferation of cryptocurrencies. It also evaluates the extent to which cryptocurrencies align with Hayek's proposal in the Denationalisation of Money. It is concluded that opinions on Hayek's proposal subtly changed from critical to cautious acclaim. Also, it is concluded that custodial stablecoins best reflect Hayek's proposal and are the crypto assets most likely to survive government legibility regulations. In chapter four, the impact of crypto-currency substitution, proxied by cryptocurrency returns, on exchange rate volatility is examined empirically for Nigeria. Cryptocurrency returns have been found to have a positive impact on Nigerian Naira's volatility.

Keywords: Cryptocurrencies, Cryptoization, Currency Substitution, Hayek, Monetary Unions, Private Money.

DEDICATION

I dedicate this work to my daughter, Katari Aadilah Napari, whose first two and half years I could not be part of due to this thesis. I also dedicate it to my wife, Sherifa Ahmed Tijani Nassam, who had to deal with my absence.



ACKNOWLEDGEMENT

I want to extend my warmest thanks to my supervisors, Dr. Asad Ul Islam Khan and Prof. Dr Rasim Özcan, for their immense support, guidance, and encouragement throughout my doctorate. I would also like to thank Prof. Dr Muhittin Kaplan, Prof. Dr Hasan Vergil, Dr Şerife Genç İleri, Dr Sadullah Yıldırım, Dr Yusuf Varli, Prof. Dr Mehmet Kutluğhan Savaş Ökte and Dr Önder Yerlikaya for their insightful comments as members of my PhD Committee at various stages. A special thanks to Dr Asad ul Islam Khan, Prof. Dr Rasim Özcan and Prof. Dr Muhittin Kaplan for their guidance and accommodations, especially in the latter parts of the thesis when despair was beginning to set in. I will forever be in their debt.

All omissions and commissions that remain in the thesis are mine.

Ayuba Napari
ISTANBUL, 2024

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LIST OF SYMBOLS AND ABBREVIATIONS

CBDCs	Central Bank Digital Currencies
CBN	Central Bank of Nigeria
CEMAC	Economic and Monetary Community of Central Africa
DeFi	Decentralised Finance
ECB	European Central Bank
EWMA	Exponential Weighted Moving Average
ECOWAS	Economic Community of West African States
GARCH	Generalised Autoregressive Conditional Heteroskedasticity
IFS	International Financial Statistics
IMF	International Monetary Fund
IT	Inflation Targeting
LASSO	Least Absolute Shrinkage and Selection Operator
MPR	Monetary Policy Rate
MPTC	Monetary Policy Technical Committee
WAMZ	West African Monetary Zone
WAEMU	West Africa Economic and Monetary Union

CHAPTER I

INTRODUCTION

1.1. Introduction

The European Monetary Union (EMU) has enchanted the world, especially former European colonies in Africa, who see it as a pan-European project which could be replicated in the pan-African project. Besides these, perhaps sentimental and/or political reasons, Trichet (2019) has assessed the Euro project positively. Trichet (2019) argues that the euro as a currency has performed quite well in delivering real economic growth for participating countries and facilitating nominal and real convergence inside the monetary union. These, Trichet (2019) claims, have been done while maintaining the stability, credibility, and resilience of the currency. The successes of the euro project have catapulted the euro to the second most important international currency, accounting for over one-third of global payments (Trichet, 2019).

The European Central Bank (ECB) policy toolkit that has yielded the supposed credibility, stability and resilience of the euro has been informed largely by neoclassical, neoliberalist, and monetarist principles. During the 2008-2009 financial crises, the ECB, however, abandoned the strict adherence to monetarism to act “pragmatically” by increasing the money supply and using quantitative easing programs to stabilise member countries’ economies (Karakas, 2015). Again, during the COVID-19 pandemic, the ECB, after initial reluctance, eventually reached for the Keynesian handbook and began to purchase the bonds of the most economically vulnerable member states and provided extraordinary levels of grants and cheap loans to member states (Hogan, 2021). The actions of the ECB during the financial crisis and the global pandemic are indicative of the kind of policies described as emergency Keynesianism by Béland et al. (2021).

Keynesianism was birthed in the lively monetary and economic debates of the interwar years. Specifically, two seminal works of Lord John Maynard Keynes, “A Tract on Monetary Reform”, published in 1923 and “The General Theory of Employment, Interest and Money”, published in 1936, are credited with the birth of Keynesian. The central theme of Keynes (1923) “Tract on Monetary Reform” was to make a case for why central banks should prioritise internal price stability over exchange rate stability. He argued that local (Sterling) prices should not be plunged if the foreign central bank (Federal Reserve Board) fails to keep the foreign currency (Dollar prices) steady (Keynes, 1923, p.147). In line with this, Keynes (1923, p.158) argued that central banks should aim for the commodity value of their currencies rather than for the stability of the gold value of the currency. This calls for central banks to vary the commodity value of their currency by varying the gold value of the currency if necessary. In essence, Keynes was proposing fixed but adjustable exchange rates with exchange controls (Irwin, 2017). However, many economists considered this heresy (Irwin, 2017), especially Friedrich Hayek and Lionel Robbins.

Hayek and Robbins disparaged Keynes’ managed fiat currencies as monetary nationalism, which they contend would lead to monetary instability and economic chaos (Irwin, 2017). They challenged and criticised the coincidence between national and monetary boundaries because they believed that monetary nationalism along national frontiers could lead to the political abuse of economics and a major vehicle of crises. Hayek (1937, p.3) declares that the effects of monetary nationalism will be pernicious. According to Hayek (1937, p.84), the aim of the international monetary system must be to increase the certainty that one form of money will always be readily exchangeable against other forms of money at a known rate. This, however, should not lead to changes in the total quantity of money. Instead, reforms in the opposite direction to those proposed by Keynes and fellow monetary nationalists would be needed. Instead of flexible parities or a widening of the ‘gold points’, absolute fixity of the exchange rates should be secured by a system of international par clearance.

In line with this, Hayek (1939, p.259) argued that a federation of a sort with a common monetary unit (currency area) would diminish the latitude given to the national central banks. These national central bank policy options will be “restricted at least as much as it was under a rigid gold standard” or even more rigid. This, he asserts, could be so

since interstate fluctuations in exchanges were much greater than intra-state fluctuations in exchanges during the traditional gold standard. In this regard, Huerta de Soto (2013) notes that the operations of the EMU and the euro are very similar to the classical gold standard and, as such, should be considered as an imperfect equivalent of the gold standard. Thus, Hayek (1939) saw economic (monetary) federalism as a remedy to the increasing subjection of economic policymaking to the politics of inflationary demand management. He also argued that this would loosen restrictions on cross-border capital, labour, and commodity movements (Bonefeld, 1998).

On his part, Robbins (1937, p. 287) contend that both theory and experience suggest that “in a world in which exchange disequilibrium has become general, the fluctuations of the exchanges have an actively disequilibrating tendency”. Robbins (1937, p.291) also declares that of all forms of economic nationalism, monetary nationalism is the worst and the one that can swiftly disrupt the world economy. Aside from his criticism of floating exchanges, Robbins was also critical of the position of fixed but adjustable exchanges (Irwin, 2017) as adopted by the Bretton Woods system. Instead of floating or fixed but adjustable exchanges, Hayek and Robbins advocated for monetary internationalism/supranationalism (Irwin, 2017).

The supranational European Central Bank (ECB) and other unionised central banks and their associated monetary unions could be said to be the, or a variance of the supranational monetary federalism that was advanced by Hayek (1937, 1939) and flirted with by several authors including Robbins (1937, p.272), Meade (1951, p.104-107, p.114-124), Friedman (1953), and (culminating in) the theory of Optimum Currency Area (OCA) by Mundell (1961).

The literature on optimum currency areas stresses flexibility in real wages, labour mobility within and across borders and fiscal integration as prerequisites for an optimal currency union (De Grauwe, 1996). Aside from these, the Maastricht Treaty, the foundational document of the European Monetary Union, set out some nominal convergence criteria to be met by prospective entrants into the European Monetary Union. These include a cap on budget deficit, inflation, debt levels and interest rates

(Botto Tornielli, 2018). These convergence criteria are meant to ensure monetary stability and a fixed exchange rate regime among member countries (Afxentiou, 2000).

The concept of financial stability is only meaningful in a monetary economy (Schinasi, 2004). Financial stability and monetary stability are instrumental in the effective functioning of capitalist economies as they provide the foundations for the rational intertemporal allocations of real resources (Crockett, 1996). As such, debates on the causes and the most effective means of achieving financial and monetary stability goals have been ongoing ever since economics became a distinct field of study.

Due to the difficulty in defining financial stability, most authors prefer to examine the absence of stability and, as such, focus on financial instability (Schinasi, 2004). Crockett (1996) notes that the first signs of financial instability are often seen in deteriorating asset quality. This deterioration in asset quality erodes confidence and precipitates and intensifies bank runs. Thus, the first sign of financial instability is the deterioration in the quality of bank assets. This deterioration is often measured using the nonperforming loan ratios.¹

Financial instability has been explained for decades using two strands of theories, cyclical and monetarist (Crockett, 1996). Cyclical theories of financial instability contend that irrational exuberance and excesses instigate bubbles that eventually burst and result in a deterioration of the assets of financial intermediaries. Minsky (1977), for example, notes that success breeds disregard for the possibility of failure and leads to euphoria. This euphoria results in short-term financing of long-term positions. This speculative finance results in a more fragile financial system that will eventually burst, and the cycle continues. It is in this regard that Keynesian economists suggest a counter-cyclical monetary and fiscal policy (Haralambie, 2011). This counter-cyclical view of monetary policy has come to be referred to as *Lean Against the Wind Vindicated (LAWV)* in the literature.

More classical-leaning economists, particularly Austrian and monetarist economists, see financial instability as intricately linked and, oftentimes, caused or exacerbated by

¹ <https://www.minneapolisfed.org/article/2011/measuring-asset-quality>

actions or inactions of monetary authorities. As such, monetarists like Friedman contend that financial imbalances are unlikely to be serious in the absence of disruptions in the money supply (Crockett, 1996). The idea that monetary authorities should exclusively focus on price stability and that financial stability is better served by macroprudential policy has come to be known as the Modified Jackson Hole Consensus (MJHC).

A third position is also being advanced to the effect that financial stability is price stability (FSPS). This views financial stability and price stability as intertwined objectives, with financial stability determining price stability due to the financial sector's role in inside money creation (Purification & Sapienza, 2023). As such, there cannot be price stability without financial stability. Neither is there a trade-off between the two (Issing, 2003).

Considering the debates on the role of monetary policy in causing a financial crisis or promoting financial stability, it is most likely that a unionised monetary policy conducted in a monetary union could be consequential for financial stability. This can be reasonably expected if members of such a monetary union have asymmetric (real and) monetary cycles. For this reason, the literature on optimum currency areas emphasises flexibility in real wages, labour mobility and fiscal shock absorbers as prerequisites for an optimal currency union (De Grauwe, 1996).

The six countries' West African Monetary Zone (WAMZ) has been pushing for the implementation of a monetary union since the year 2000. The pursuance of the zonal monetary union is despite member countries' failure to meet the convergence criteria. For example, Asongu (2014) examines the level of real, monetary, and fiscal convergence among the yet-to-be-operationalised West African Monetary Zone (WAMZ) and the East African Monetary Zone (EAMZ). It was found that members within each monetary zone were structurally different, with no indication of fiscal convergence. Also, labour mobility is still restrictive in the zone and the wider Economic Community of West African (ECOWAS) region (Adepoju, 2015). This implies that the cons of the forfeiture of exchange rate adjustment by these countries will be extreme in case of an asymmetric shock (Dabrowski, 2019).

➤ **Gap 1:**

- The literature on optimum currency areas focuses almost exclusively on nominal and real factors with almost no consideration for the financial impact of monetary unification of countries with asymmetric monetary cycles.

➤ **Purpose and Objectives**

- The first essay in this thesis seeks to fill this gap by examining the impact of monetary unification on financial institutions' asset quality (as represented by nonperforming loan ratios) and, thus, financial stability.
- This is done by modelling financial institutions' asset quality as dependent on the monetary (lending) cycle and the real cycle. It is then hypothesised that asymmetry in the monetary cycles of monetary union member countries will likely result in financial volatility and, thus, instability.
- The model is empirically tested counterfactually using Ghana, a member of the West African Monetary Zone (WAMZ).

➤ **Significance**

- The essay settles the debate on the financial stability cost of a monetary union due to the nonalignment of the monetary cycles. It can also be employed by monetary authorities in deciding whether or not to give up monetary autonomy.

Despite Hayek's (1937, 1939) initial position and proposition for the internationalisation of monetary policy as a means to transition back to the gold standard and to check political influence on economic policymaking, Hayek changed course in the "Denationalisation of Money" first published in 1976 (Bonefeld, 1998).

This supposed change or refocus was due to his belief that the post-war framework lacked the structure to support a return to the gold standard. As such, the Denationalisation of Money was the outcome of a search for an incentive-compatible

framework that would automatically provide monetary stability (Caton, 2020). Also, Bonefeld (1998) contends that Hayek's change of position in the Denationalisation of Money could have been because of his distrust of "subsidiarity", which could result in the supranational institutions taking responsibility for fiscal policy leading to a supranational system of redistribution.

In the Denationalisation of Money, Hayek (1990) argues for the institution of currency competition among public and privately issued currency units to ensure market freedom. This proposal received little attention prior to the internet-induced electronic money and blockchain revolution. Such studies had often been critical to the extent that Hayek himself referred to his proposal as utopian. The advent of blockchain-based cryptocurrencies has, however, revived interest in the proposal. Recent studies have approached the proposal with praise for its foresight and seek to re-examine, re-interpretate and perhaps modify the proposal to fit the times. Some studies have also claimed the realisation of his proposal in the proliferation of cryptocurrencies, which claim to be digital money. Sanz Bas (2020) notes that the proposal for the denationalisation of money has now become the work reference in the cryptocurrency literature, with many re-reading the proposal with less scepticism.

➤ **Gap 2:**

- Despite the revived interest in the proposal, there has not been an exhaustive review of the literature on Hayek's proposal and the impact of the cryptocurrency revolution on its reception.

➤ **Purpose and Objective**

- The second essay seeks to delineate the pattern of opinion regarding the proposal for the denationalisation of money prior to and after the proliferation of cryptocurrencies.
- Also, the study seeks to compare and contrast Hayek's proposal and the cryptocurrency ecosystem to determine if, indeed, cryptocurrencies are the realisation of Hayek's proposal.

➤ **Significance**

- This will consolidate the literature on the proposal and its relationship with cryptocurrencies.
- This will guide future research in the field.

Endres (2009) notes the parallels between the current international vehicle currency competition and the transnationalisation of currencies embedded in Hayek's (1990) proposal. Specifically, Endres asserts that Hayek's proposal for the transnationalisation of currencies has been realised with the exchange and capital market liberalisations that have taken place since the 1980s. This is reflected in the now stylised fact of currency substitution and dollarisation. With currency substitution and dollarisation, economic agents resort to saving and even transacting in foreign currencies during periods of currency devaluation and inflation. This ability for agents to substitute local (and perhaps more inflationary) currencies for foreign (more stable) currencies reflects Hayek's proposal for currency competition and choice in money.

The advent and proliferation of blockchain-based cryptocurrencies have also ignited hopes and assertions that the second strand of Hayek's proposal that calls for the participation of the private sector in the issue of currency notes is nigh or has been realised. Kaplanov (2012), for example, contends that a unique confluence of technology and demand has made Bitcoin a viable, global currency that functions in the same manner as cash.

In high-inflation countries like Argentina, the substitution of fiat currency for cryptocurrencies, particularly stablecoins, has been observed. This trend of cryptocurrency substitution for local currencies has been termed cryptoization, akin to dollarisation. In the literature, currency substitution and currency dollarisation are known to contribute to exchange rate volatility and weakening of monetary policy pass-through. With local currencies now being substituted for global cryptocurrencies, particularly stablecoins, several authors have forewarned monetary and regulatory authorities about the implications of cryptoization on monetary, exchange rate and macroprudential policy. Copestake et al. (2023), for example, note that cryptocurrencies as global currencies can amplify global contagion and facilitate

dollarisation (digital dollarisation) and currency substitution, especially for emerging and developing economies with weak currencies.

➤ **Gap 3:**

- Despite these calls, the impact of such stablecoins on fragile, inflation-prone emerging market currencies, like the Nigerian Naira, has not been empirically studied.
- Specifically, no study has been conducted on the volatility impact of cryptocurrencies on the Nigerian Naira.

➤ **Purpose and Objective**

- The third essay of this thesis aims to fill this empirical gap by empirically examining the impact of cryptocurrencies on Nigeria's exchange rate volatility.

➤ **Significance**

- This is crucial considering the impact of exchange rate volatility on financial stability through its impact on banking performance (Keshtgar et al., 2020), firm-level productivity (Eklou, 2023), foreign direct investment (Ullah et al., 2012), and inflation (Musa, 2021).
- Knowing whether cryptocurrencies impact the exchange rate volatility or not will aid monetary policymakers, firms and households in predicting and hedging their exchange rate exposure.

1.2. Structure of the Thesis

The remainder of the study is structured as follows.

Chapter Two seeks to fill gap one by first modelling the impact of a symmetric monetary policy on the asset quality of members of a monetary union. Particularly, the nonperforming loan ratios (NPLs) of a country in a monetary union are modelled to be dependent on the lending and, as such, the monetary gap and the output gap. The implications of asymmetric monetary (lending) cycles are examined. The model is

tested counterfactually for Ghana, a member of the West African Monetary Zone (WAMZ), using quarterly data from 2008Q1 to 2021Q4.

Chapter Three takes up the second gap by examining the pattern of literature on the denationalisation of money from its publication to 2024. This is aimed at establishing the pattern of opinion, criticism, or otherwise and determining whether the cryptocurrency revolution has indeed resulted in the realisation of Hayek's proposal. Particularly, the literature is divided into prior to and after cryptocurrency proliferation, spanning 1977 to 2012 and 2013 to 2024. Hayek's proposal is also compared with the core crypto assets often seen as private money to determine if, indeed, they match up. Some preliminary comments on the future trajectory of the blockchain revolution as it relates to currency competition and the international monetary system are offered.

In Chapter Four, the implications of cryptoization for emerging market currencies are empirically tested. Particularly, cryptocurrency returns are used to proxy substitution to cryptocurrency (cryptoization) and its impact on exchange rate volatility in Nigeria is examined using an Exponentially Weighted Moving Average (EWMA) formulation of an Exponential Generalised Autoregressive Conditional Heteroskedasticity (E-GARCH) model.

Chapter Five draws some conclusions from Chapter 2 to Chapter 4 and their implications for financial stability.

CHAPTER II

MONETARY UNION AND FINANCIAL STABILITY OF MEMBER COUNTRIES ²

2.1. Introduction

From the Economic Community of West African States (ECOWAS) to the Eurasian Economic Union (EAEU) and the ultra-ambitious African Economic Community, interest in economic integration is growing around the world, with monetary union always a complementary goal. This heightened interest has been despite the Eurozone crises of the 2010s, which shook an otherwise successful currency project. (Dabrowski, 2019). Frieden(1998) notes that it is universally agreed among economists that the benefits of monetary unions do not substantially outweigh the cost, and in the case of the Eurozone, politics rather than economics has been the main driver. In 1999, when the Euro was introduced, one could consider France and Germany to be similar in terms of their economic structures, but not France and Spain. This prompted prophecies of doom with Frieden(1998) predicting some countries might drop before the full implementation of the Euro in 2002, mainly due to the variance in their economic structures. Miraculously, however, no country dropped, and the number of Eurozone members increased from 11 in 1999 to 20 in January 2023, with six more countries on the enlargement agenda.

Schoeller (2019) notes that leadership of powerful states and organisations is essential for a successful economic integration project. Thus, the success of the European Union and the Eurozone is owed to the rich and powerful countries of Western Europe and the political commitment in the various capitals to make the project a success. Germany, for instance, proved to be a powerful leader during the Euro Zone Crises of

² A version of this chapter has been published with the Journal of Economic Studies as Napari, A., Ozcan, R., & Khan, A. U. I. (2023). Monetary policy and nonperforming loan ratios in a monetary union; a counterfactual study. Journal of Economic Studies. DOI: 10.1108/JES-12-2022-0651.

the 2010s (Meiers, 2015). The West African Economic and Monetary Union (WAEMU) and the Economic and Monetary Community of Central Africa (CEMAC) are largely sustained by French leadership. The question is what happens when institutionally poor countries with similar economic structures and restrictive labour mobility attempt to form a monetary union with no powerful benefactor like the one planned by the West African Monetary Zone (WAMZ) and/or the African Economic Community.

WAMZ is a 6-member monetary zone made up of The Gambia, Ghana, Guinea, Nigeria, Sierra Leone and Liberia. This was created in 2000 with the goal of setting up a second monetary zone in the ECOWAS region that will eventually be merged with WAEMU to create a single ECOWAS currency union. Since these countries are all developing with underdeveloped institutions, it is doubtful if there are/will emerge powerful states and organisations to ensure the successful implementation of this ambitious project, which is even moderate compared to Stage (V) of the African Economic Community, which will result in a single monetary union for all of the African continent (Treaty establishing the African economic community, 1991). However, supposing it does, the impact of a joint monetary policy on the real and financial sectors of member country economies that will be losing monetary sovereignty for the first time is still a 'Pandora's box'.

The intellectual foundation of modern monetary unification is the Optimum Currency Area (OCA) proposed by Mundell (1961) (Dabrowski, 2019). This theory attempts to balance the pros and cons of a stable exchange rate and the forfeiture of the exchange rate adjustment tool in the case of an asymmetric shock (Dabrowski, 2019). This is done by evaluating the characteristics that make a stable exchange rate and monetary unification desirable. These characteristics are symmetry (asymmetry) in output disturbance, intra-regional labour mobility, trade linkages and the extent of automatic economic stabilisers (Bayoumi & Eichengreen, 1997). The presence (absence) of business cycle asymmetry among member countries is particularly important to the extent that it is often referred to as the cost of monetary union to member countries, given that joining a monetary union denies a member country from using monetary policy to lean against economic cycles (Houssa, 2018).

Looking at the WAMZ and ECOWAS countries in general, labour mobility is still quite restrictive, with Adepoju (2015) noting that some member countries have enacted/retained laws that restrict foreigners, including from ECOWAS member states, from certain economic activities even against ECOWAS protocols. The implication is that, generally, it is not substantially easier for a Ghanaian to settle and work in Liberia than settling and working in, say, South Africa or Kenya, even though Ghana and Liberia are both members of WAMZ and ECOWAS. Contrary to this, labour mobility in the European Union and the Eurozone has been smooth, with auf dem Brinke and Dittrich (2016) concluding that labour mobility has been a cure to imbalances in the Euro Area. ECOWAS Intra-regional trade is also comparatively low, standing at 12% in 2010 (Osabuohien et al., 2017). This has not improved in the past decade, with intra-regional exports and imports as of 2021 standing at 11.2% and 10%, respectively. For automatic economic stabilisers, they are almost non-existent. Real business cycles among member countries ECOWAS (Mati et al., 2019) and among the WAMZ countries (Houssa, 2008) have also been found to be asymmetric.

This implies that the WAMZ or an ECOWAS monetary union might not be able to solve the conflict scenarios Frieden (1998) hypothesised as the litmus tests of a monetary union, especially in times of asymmetric economic downturn. One of the litmus tests of a monetary union occurs when some countries are hit by a recession, and these recession-hit countries seek help, say through monetary loosening from the unified central bank. Those in normal economic times or even in a boom will be wary of the inflationary impact of such a loosening and will likely argue that the resulting inflation will even have more long-term consequences. The central bank will then be faced with two unpalatable scenarios: loosen monetary policy (equivalent to weakening the currency) and, in the long run, cause a currency crisis or hold on and risk a political backlash from the region in recession. Even if it does loosen monetary policy, this could trigger an excessive credit boom in non-recession economies, which could eventually lead to a credit crunch and financial crises in the non-recession economies.

The purpose of this study is to determine if the implementation of the planned monetary union in the WAMZ will have a substantial impact on the financial stability of member countries. Unlike Byrne and Kelly (2019), who examined the impact of

loan impairment and nonperforming loans on monetary policy pass-through, we sought to look in the opposite direction to determine the impact monetary policy has on nonperforming loans. This is then used to examine the impact a monetary union will have on financial stability in Ghana, given the restrictive labour mobility, poor institutions and lack of political leadership and commitment.

To accomplish this, we build on the extreme-backward-looking loan loss provisioning model of Zilberman and Tayler (2014) to expand and formalise the relationship that exists between the output gap, credit gap and the financial institutions' asset quality as measured by their nonperforming loan ratios. Also, this study significantly contributes to the literature by explicitly modelling the volatility impact a unionised monetary policy can have on nonperforming loans in a monetary union member country. This could be essential for monetary and financial regulators by helping them reign in reigning in on elevated and volatile nonperforming loans. The model is empirically tested using quarterly nonperforming loans and monetary policy rates for Ghana, a member of the six (6) country WAMZ, in a counterfactual study using ARDL and LASSO regression as the baseline and robustness, respectively. This is done by computing several counterfactual monetary policy rates for the WAMZ and superimposing them on Ghana's nonperforming loan ratio response function to estimate counterfactual nonperforming loan ratios and the nonperforming loan volatility. The results indicated that a monetary union in the WAMZ region would be less costly, at least in terms of financial stability as depicted by the nonperforming loan ratios, than broadly assumed.

The remaining part of the essay is structured as follows. The next section, section 2, briefly discusses the literature on the price stability and financial stability nexus, focusing on whether monetary policy does, indeed, affect and should include financial stability considerations in the policy response function. Section 3 details the theoretical model. Section 4 presents the data used to test the model. Section 5 outlines the methodology and results of the parameter estimations. Section 6 presents and compares the actual and counterfactual nonperforming loans and their volatilities, and Section 7 Concludes the study.

2.2. Literature Review

Just as the great depression birthed macroeconomics as a distinct subject of study in the 1930s, the 2008-2009 birthed or perhaps re-oriented macroprudential policy (Kenç, 2016). This revival and or re-orientation of macroprudential policy is due to its role as the main policy instrument in countering financial imbalances. The 2008-2009 financial crises triggered an unprecedented quantitative easing and an overly loose monetary policy in developed countries. This exposed emerging market economies to excessive short-term capital inflows. To reduce the build-up of financial stability risk, emerging market economies, as expected, resorted to utilising (Fendoğlu, 2017) and reforming macroprudential policy. Thus, the crisis has renewed interest in macroprudential policy. This renewed interest is on the backdrop of the pre-crisis assumption of price and financial stability dichotomy (Hahm et al., 2012), with price stability viewed to be the only goal and mandate of monetary policy and monetary authorities while financial stability was assumed to be the mandate of financial regulators. This price-financial stability disconnect came to be known as the Modified Jackson Hole Consensus (MJHC). Though MJHC still holds sway with its proponents arguing that financial stability is best achieved with macroprudential policy since monetary policy is a blunt instrument and can at best, have a limited impact on counteracting financial risks (Jansson, 2014), the ability of macroprudential policy to shoulder the responsibility of achieving financial stability by itself has since been questioned.

For example, Fendoğlu (2017) concluded that, whereas borrower-based macroprudential tools are effective in containing credit cycles in major emerging market economies, financial institutions-based macroprudential tools have a weaker result in containing credit cycles. In Claessens et al. (2013), it was concluded that macroprudential policies like countercyclical buffers, reserve requirements, limits on profit distribution and dynamic provisioning were found to mitigate increases in bank leverage. However, these were found to be less effective in adverse times. In a similar vein, Milne (2009) contends that macroprudential policy is unable to remove political and institutional obstacles to controlling credit booms.

The insufficiency of macroprudential policy to tackle financial imbalances has revived the debate on whether monetary policy should be used to promote financial stability (Aikman et al., 2019; Quarles, 2019) with a strengthened position that the monetary policy response function should include a financial stability parameter (Purificato & Sapienza, 2023). This augmentation will require more deliberations and will result in a more complicated monetary policy than a price stability-only focused monetary policy. Nonetheless, such an augmentation, it is believed, could have a significant and complementary role to macroprudential policy in preventing financial imbalances (Jansson, 2014). Besides, monetary policy rules like the Taylor Rule (Taylor, 1993) that emphasise the output gap in monetary policy setting imply that monetary authorities do not and cannot ignore real sector shocks, which are significantly impacted by financial sector shocks (Jermann & Quadrini, 2012). If so, then monetary policy is likely to be aligned if not outrightly used to prop a sluggish growth or dampen an overheated economy. This makes it safe to assume that monetary policy is counter-cyclical, with monetary policy tightening in times of growth above trend and loosening in times of growth below trend. This line of argument is known as the Lean Against the Wind Vindicated (LAWV) in the literature.

In this regard, Nair and Anand (2020) augmented the conventional Taylor rule to include asset prices in an Indian context. They concluded that such an augmentation is beneficial in taming financial imbalances and economic slumps. Also, Gambacorta and Signoretti (2014) used a DSGE model with both firm balance sheet and bank lending channels to investigate the usefulness of augmenting the monetary policy response function with financial stability parameters. It was concluded that, for supply-side shocks, it is much more desirable to lean against the wind during output volatility, especially for economies characterised by high private-sector indebtedness. Filardo and Rungcharoenkitkul (2016) examined the effectiveness of leaning against the build-up of financial imbalances in an environment with recurring cycles of imbalances. They concluded that leaning systematically over the whole financial cycle is found to outperform benign policies of neglect. Thus, providing evidence in support of the benefits of a monetary policy that considers financial stability in the monetary policy response function.

Yet, a third position is being advanced to the effect that financial stability is price stability (FSPS). This views financial stability and price stability as intertwined objectives, with financial stability determining price stability due to the financial sectors' role in inside money creation (Purificato & Sapienza, 2023). As such, there cannot be price stability without financial stability, and neither is there a trade-off between the two (Issing, 2003).

One of the proponents of this view is Charles Goodhart, who has long argued and trumpeted Alchian and Klein (1973) position that standard measures of inflation are flawed since they ignore future service flow prices, which ought to include broader measures such as housing and stock market prices (Goodhart, 1995). Alchian and Klein (1973) contend that this exclusion of asset prices was partially responsible for an overly volatile monetary policy swinging from too easy to too tight from 1967 to early 1971. The crude modification of the inflation measure to include, say, stock prices would have provided a much better indicator for price level and price stability target. On the interdependence of financial and price stability, Roger (2009) explains that negative shock causes a decline in bank equity, which in turn results in shoot sales of bank assets, leading to a deterioration of bank balance sheets and, consequently, a reduction in inside money creation. Suppose fiscal policy measures are not executed in a timely manner, then the decrease in the money supply causes deflationary pressure and a liquidity spiral that hurts banks and redistributes wealth away from productive balance sheet-challenged industries. Finding out which sectors are affected, transferring wealth, and resuming the flow of money to the economy's productive sectors are all steps that monetary policy can take to dampen the amplification effects, which will require more than strict inflation targeting. In essence, the FSPS argues that inflation creates financial instability (Issing, 2003), while financial instability can imply adverse effects on price stability (Purificato & Sapienza, 2023).

The theoretical implications of LAWV and, to some extent, the FSPS raise several problems for a monetary union. A monetary union of dissimilar economies will likely result in multiple economic and financial cycles in the monetary union, with some economies enjoying growth above trend while other economies are growing below trend. Under such a circumstance, a 'one size fits all' monetary policy will always be

right for some countries but overheat some economies and or make it difficult for some economies to come out of economic slump (Edberg Thorén & Lima, 2018).

For instance, a monetary policy loosening to spur economic activity in one economy will likely trigger credit booms for other economies, especially those economies whose real economic activity is on/above trend. This rapid expansion of credit will result in a decline in lending standards (Dell’Ariccia et al., 2012) and a growth in nonperforming loan ratios as a result caused in part by increased competition among banks for market share (European Systemic Risk Board, 2019). This led Purificato and Sapienza (2023) to conclude that there are synergies and trade-offs between price stability and financial stability, which may become more pronounced in a monetary union with an area-wide monetary policy.

Thus, the appeal of the argument that monetary policy should be used to lean against financial imbalances stems from the role of monetary policy in triggering credit booms and encouraging excessive financial risk-taking (Aikman et al. 2019). Dudley (2019) argues that financial stability should be part of the monetary authority’s reaction function since, in the case of financial instability, the monetary authorities lose their ability to influence economic activity as they do in normal times. This assertion is formalised by Byrne and Kelly (2019), who showed that an increase in impairment ratio decreases interest pass-through, with the nonperforming loan gap playing a significant role in pass-through fragmentation in the eurozone.

2.3. Theoretical Model

In the literature, there is the idea of an equilibrium credit with Basel III regulatory framework entreating macroprudential supervisors to estimate equilibrium credit using the Hodrick-Prescott (HP) filter applied to the ratio of nominal credit to nominal GDP (credit-to-GDP ratio) (Buncic & Melecky, 2014). The HP-filtered trend of the Credit-to-GDP ratio is then taken as the equilibrium credit(L_e). So that, excessive/sluggish credit growth is judged against the benchmark equilibrium credit(L_e). Buncic and Melecky (2014) have criticised this purely statistical measure of equilibrium credit and argue for using economic fundamentals like financial depth and access to financial services, among others, in determining country-specific equilibrium credit levels.

Hardy and Tieman (2008) note that the rapid increase in credit can largely be explained by improved economic prospects. Lown and Morgan (2006) found output to have a positive effect on loan demand.

This implies that in periods of trough, credit or lending (L) will most likely be below the equilibrium level, (L_e), due to tightening of credit standards (Dvorkin & Shell, 2016), among others, so that the ratio, $L/L_e = L_r$, is less than 1. (i.e., $0 < L_r < 1$). Since credit is below what the economic fundamentals predict should be the level of credit, an increase in lending will not necessarily pose a risk to the financial sector. This is because, per the economic fundamentals, there are households and businesses that are credit-worthy, and an increase in lending to these credit-worthy households and businesses might actually be healthy for the economy. Sluggish growth in credit, when $L_r < 1$, could mean excessively restrictive credit, which can result in underinvestment and slow economic growth (Buncic & Melecky, 2014). On the contrary, $L_r > 1$ could mean overexpansion in credit, which could mean lowering of credit standards (Hardy & Tieman, 2008), with a sudden halt of this excessive credit growth associated with the onset of crises (Enoch, 2007). This implies that $L_r > 1$, increases the risk of loans not performing. Intuitively, this could mean that non-credit-worthy businesses and households are being granted loans, and the probability of these loans not performing is higher than credit-worthy borrowers.

Beyond the economic fundamentals, loans are dependent on loan pricing. In an exhaustive model of loan pricing, Byrne and Kelly (2019) modelled loan price (essentially the lending interest rate (R_l)) as a function of the probability of loan default, monetary policy interest rate (R_m), the share of funding shortfall that is catered for using interbank lending and bond issue, the sovereign bond yield, sensitivity of bank capital to new lending, the elasticity of loan demand, market concentration, and the bank loss given default (see Byrne and Kelly (2019) for details). In our case, without loss of generality, it will suffice to assume that banks borrow exclusively from the Central Bank at the monetary policy rate (R_m) and lend to households and businesses at a premium at the rate (R_l). Thus, the lending rate is given by $R_l = f(R_m, \alpha)$ Where α is a vector of parameters that affect the lending rate outside the monetary policy rate (R_m) with a positive rate pass-through, that is $\frac{\partial R_l}{\partial R_m} > 0$. By

implication, loan demand (lending) is given as a function of the lending rate (R_l), and a vector of other factors (β) that includes all other economic fundamentals that influence loan demand. That is, by $L = g(R_l, \beta)$ with $\frac{\partial L}{\partial R_l} < 0$.

Also, following the lead of Zilberman and Tayler (2014), we assume a natural, exogenously positive and constant risk of loans not performing, and we represent this exogenous risk by φ with $\varphi \in (0,1 \text{ or } 0 \text{ to } 100\%)$. This implies that φ along with the L_r determines the ratio of nonperforming loans so that when $L_r > 1$, the interaction of L_r and the exogenous risk of loans not performing, φ , will result in higher non-performing loan ratios.

In normal economic times, realised output (Y) is approximately equal to the potential output (Y_p) so that the ratio Y/Y_p is approximately 1. However, in times of economic downturn, output is below potential ($0 < Y/Y_p < 1$) giving rise to profitable economic opportunities. This will imply that an increase in lending to pursue those profitable opportunities will not necessarily increase φ since the risk of a loan not performing is dependent on unemployment (Gerardi, et. al., 2018) and the business cycle (Farzad, 2020). As these profitable opportunities in the economy are exhausted, Y/Y_p turns to 1. In a period of above-potential economic activity, $Y > Y_p$, the ratio, $Y/Y_p = Y_r > 1$, implying an overheated economy. This overheated economy will eventually have to cool down so that output, Y , converges to the potential output, Y_p . Thus, interacting with the exogenous risk of nonperforming loans, φ , the total risk of nonperforming loans will be high when output is above potential and will be low when output is below potential. Combining these yields the nonperforming loan ratio equation as

$$NPL = \varphi Y_r L_r = \varphi \frac{Y}{Y_p} \frac{L}{L_e} \quad (2.1)$$

From equation (2.1), a change in the monetary policy rate will result in a chain reaction through the pass through to the lending rate and onto NPL ratios as given in equation (2.2)

$$\frac{\partial NPL}{\partial R_m} = \varphi \frac{Y}{(Y_p L_e)} \frac{\partial g(R_l, \beta)}{\partial R_l} \frac{\partial R_l}{\partial R_m} \quad (2.2)$$

Noting that $\frac{\partial R_l}{\partial R_m} > 0$ and $\frac{\partial g(R_l, \beta)}{\partial R_l} < 0$, then $\frac{\partial NPL}{\partial R_m} < 0$. Thus, a rise in the monetary policy rate will trigger a reduction in the nonperforming loan ratios and a fall in the monetary policy rate will trigger a rise in nonperforming loan ratios, all other things being equal. This implies that if a country is in normal economic times, with $Y=Y_p$ and $L = L_e$, but for some reason, the central bank decreases the monetary policy rate, L_r is going to rise above 1, and interacting with the exogenous risk of loans not performing will increase the total nonperforming loan ratios above the natural level.

On the other hand, if $Y_t=Y_p$ and $L_t = L_e$ so that the nonperforming loan ratios are at the natural level, φ_i , an increase in the monetary policy rate will result in a decrease in L so that $L < L_e$ ($L_r < 1$) pushing the nonperforming loan ratios to below its natural levels. Equivalently, if for some reason, $Y_t < Y_p$ so that $Y_r < 1$, unless an expansionary monetary policy is pursued to increase lending and investment so that L_r increases above (or converges to 1 if $L_r < 1$), then the total risk of default is going to be less than the natural level φ . This could mean over screening or excessively restrictive credit (Buncic & Melecky, 2014) in the banking system so that households and businesses who are credit-worthy are denied credit. This could result in a monetary-induced economic recession. Walsh (1993) attributes the economic recessions of the 1980s in large part to restrictive monetary policy. The foregoing suggests that any deviation from the natural rate risk of nonperforming loans, either as a result of high or low lending, is unhealthy and unsustainable.

In a monetary union, the nonperforming loan ratios of country i for $i = 1, 2 \dots n$ at time t is given by

$$NPL_{it} = \varphi_i \frac{Y_{it}}{Y_{ip}} \frac{L_{it}}{L_{ie}} \quad (2.3)$$

From equation (2.3), any change in monetary policy will trigger a chain reaction through the lending rate to lending and nonperforming loans. To this, we propose that non-performing loan ratios of economies with asymmetric business cycles in a monetary union will be more volatile than if each economy were to maintain monetary sovereignty. This proposition is a direct implication of equation (2.3). This can be seen by considering two economies, say economy i and economy j . Supposing economy i is in a recession, whereas economy j is at potential. A monetary expansion will result

in increased lending and economic activity in economy i pushing both L_{ir} and Y_{ir} towards 1 and thus pushing the NPL ratios towards φ_i . On the other hand, this will trigger a credit boom in economy j , causing both L_{jr} and Y_{jr} above 1 and thus increasing the NPL ratios above φ_j . This will eventually cause a credit crunch and possible financial crises and, by implication, economic crises, by which time economy i would have returned to potential growth and equilibrium credit levels. Then the positions of economy j and economy i will change, and the cycle will start all over. This trend or asymmetry will be weak if the economic structures are similar with symmetry in their business cycles. In the case of dissimilarities in economic structures and asymmetric business cycles, the trend can be broken if there is enough labour mobility and/or enough fiscal buffer so that governments have Keynesian tools for economic resuscitation.

However, in the case of business cycle symmetry, there will be no significant difference in magnitude and volatility in nonperforming loan ratios of member countries since a recessionary cycle in country A inevitably means a recessionary cycle in the other countries, resulting in a correlated need for monetary expansion or monetary contraction. Thus, unionised monetary policy will be innocuous to financial stability and nonperforming loan ratios of member countries.

To test this hypothesis, we assume that the last period's economic growth rate is the potential growth level, and the last period's MPR rate is the MPR that results in the equilibrium lending rate that results in the equilibrium level of credit. From these assumptions, the lending rate and the level of credit can be proxied by the MPR and linearised as in equation (2.4).

$$\ln NPL_{i,t} = \ln \varphi_i + \ln \left(\frac{Y_{i,t}}{Y_{i,p}} \right) + \ln \left(\frac{MPR_{i,t}}{MPR_{i,t-1}} \right) \quad (2.4)$$

With \ln being the natural log. Noting that $\ln \left(\frac{Y_{i,t}}{Y_{i,p}} \right)$ is the output or GDP growth rate (gdp), equation (2.4) can be reformulated as in equation (2.5).

$$\ln NPL_{i,t} = \ln \varphi_i + GDP\ growth_{i,t} + \ln \left(\frac{MPR_{i,t}}{MPR_{i,t-1}} \right) \quad (2.5)$$

Taking the exponential of equation (2.5) results in equation (2.6)

$$NPL_{i,t} = \varphi_i + e^{GDP\ growth_{i,t} + \ln \left(\frac{MPR_{i,t}}{MPR_{i,t-1}} \right)} \quad (2.6)$$

Equation (2.6) implies that the nonperforming loan ratios of country i , is related to the long-term average NPL represented by φ_i , the exponential of the GDP growth rate, and the ratio of the current to last period's monetary policy rate (henceforth mpr_t).

2.4. Data

The study utilises quarterly nonperforming loan ratios of Ghana from the Bank of Ghana (BoG) Financial Soundness indicators, monetary policy rate and/key interest rates of Ghana, Nigeria, Guinea, Sierra Leone and the Gambia from the IMF International Financial Statistics, Ghana's quarterly GDP growth rates from the Bank of Ghana Real Sector Indicators, quarterly GDP growth of Nigeria from various publications of the Nigeria Bureau of Statistics (NBS) and the annual GDP growth data of Guinea, Sierra Leone and the Gambia from the World Bank's National Accounts Database. Except for the annual GDP growth and the quarterly GDP growth of Nigeria, which spans 2010 to 2021, data for all other variables are from 2008Q1 to 2021Q4. The data and data sources are presented in Table 2.1.

Table 2.1. Data and Data Sources

VARIABLE	SYMBOL	DATA SOURCES	URL
Nonperforming Loan Ratios as a % Gross Loans	<i>npl</i>	Bank of Ghana	https://www.bog.gov.gh/economic-data/financial-soundness/
Monetary policy rate	<i>MPR</i>	IMF-IFS	https://data.imf.org/regular.aspx?key=61545855
Ghana Quarterly GDP Growth Rate	<i>gdp</i>	Bank of Ghana	https://www.bog.gov.gh/economic-data/real-sector/
Quarterly GDP Growth Of Nigeria		Nigeria Bureau of Statistics	https://nigerianstat.gov.ng/elibrary?queries=GDP
Annual GDP growth rates		World Bank	https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

Table 2.1. (cont.)

Monetary Policy Ratio	mpr_t	Author Calculations	$\frac{MPR_t}{MPR_{t-1}}$
Exponential of GDP growth rate	exp_gdp	Author Calculations	$expontial(gdp)$

Source(s): Author's own creation/work

Ghana's nonperforming loan ratios as a percentage of gross loans over the study period evolved in oscillation from 8.7% in 2008Q1, peaking at 18.6% in 2010Q1 to 2010Q4, perhaps in the shadows of the 2008 Global Financial Crises. From 2011 to around 2015, NPL ratios saw a steady decline, hitting a trough of 11.2 in 2015Q2. This peaked at an all-time high of 22.6% amidst the Ghana financial sector clean-up exercise that took place from 2017 to 2020.

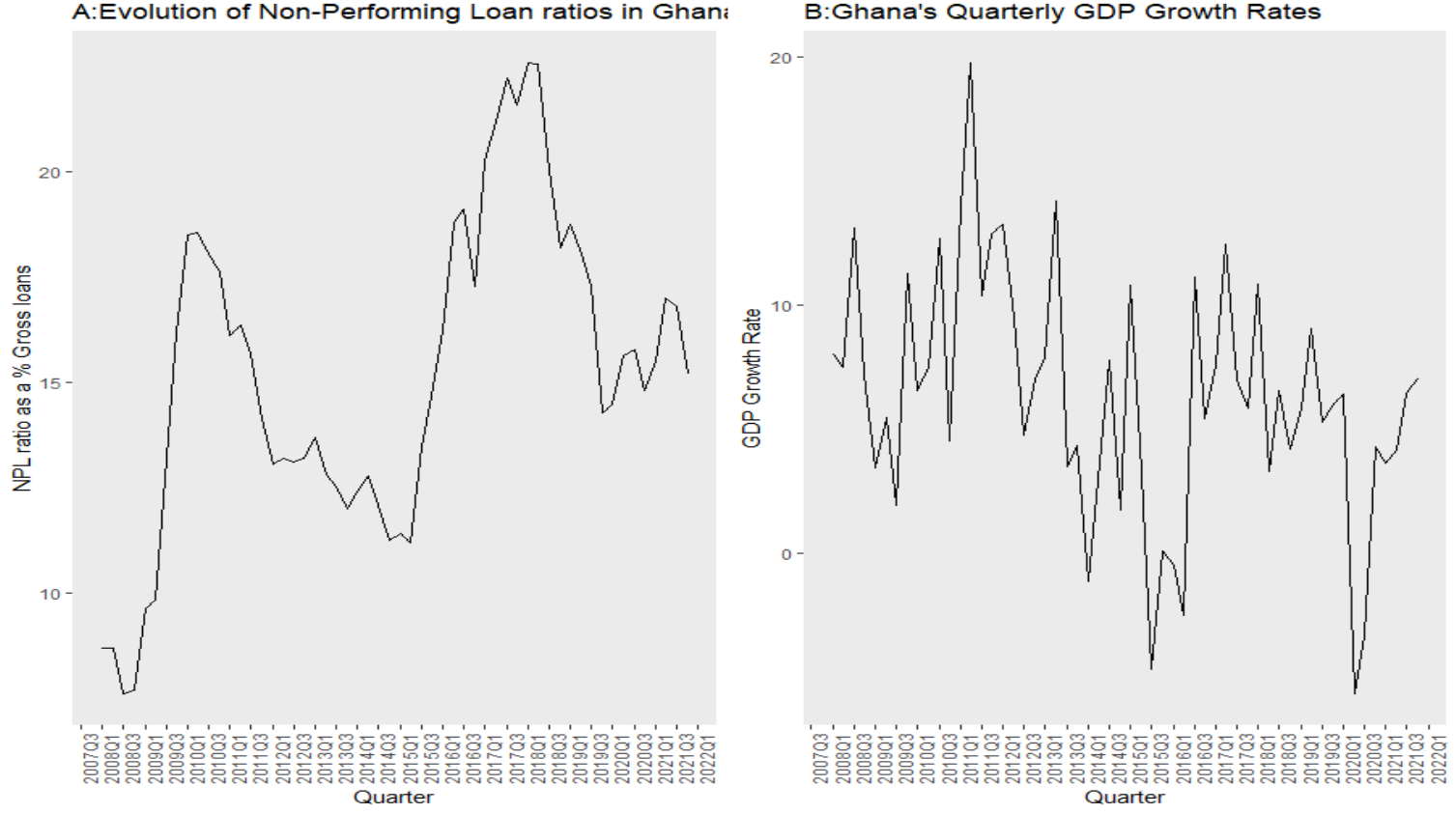


Figure 2.1. Evolution of Ghana's NPL Ratios and GDP Growth Rates

Source(s): Author's own creation/work

The NPL ratios has since fallen to 15.1% as of 2021Q4, as depicted in Panel A of Figure 2.1

The quarterly GDP growth rates of Ghana, sourced from the Bank of Ghana's Real Sector Indicators, have been extremely oscillatory, swinging from a start of positive 8.03 and peaking at 19.78 quarterly growth in the second quarter of 2011. The lowest drop in GDP over the period occurred in 2020Q2, as can be seen in Panel B of Figure 2.1.

With regards to monetary policy, Ghana was the first to transition to an indirect monetary policy regime, adopting a partial Inflation Targeting (IT) framework in 2002 (Quartey & Afful-Mensah, 2014) and becoming the first developing country in the world to fully adopt the inflation targeting regime in May 2007 (Akosah et al., 2019). As such, the main indicator of monetary policy stance of Ghana is the Monetary Policy Rate (MPR). In Nigeria, IT is widely accepted as the principal guide of monetary policy, although the IT framework has not been formally adopted (Ewurum et al., 2017), with an MPR used as the main indicator of the monetary policy stance of the Central Bank of Nigeria(CBN).

The Bank of Sierra Leone has undergone a myriad of transformations, introducing a Monetary Policy Technical Committee (MPTC) and an MPR in Q2 of 2011 to indicate a monetary policy stance and a tool for the fulfilment of its core mandate of price stability (Jackson et al., 2020). Before Quarter Two (2) of 2011, the lending rate was used as the prime interest rate for the Sierra Leonean economy. As such, this study uses the lending rate from 2008Q1 to 2011Q2 and the MPR from 2011Q2 as the monetary policy stance of Sierra Leone. The Bank of the Gambia and the Central Bank of the Republic of Guinea (Banque Centrale de la République de Guinée -BCRG) are monetary aggregate targeters. Nonetheless, they both maintain an MPR to indicate the stance of monetary policy. The Bank of Liberia still uses exchange rate stability and fixing as its core mandate and modus operandi despite the ongoing processes of transitioning to a market-based system.

In this study, only the five countries with a central bank policy rate or key interest rate are used. The historical MPR (Key interest rate) are sourced from the International Monetary Fund's (IMF) International Financial Statistics (IFS) and presented in Figure 2.2.

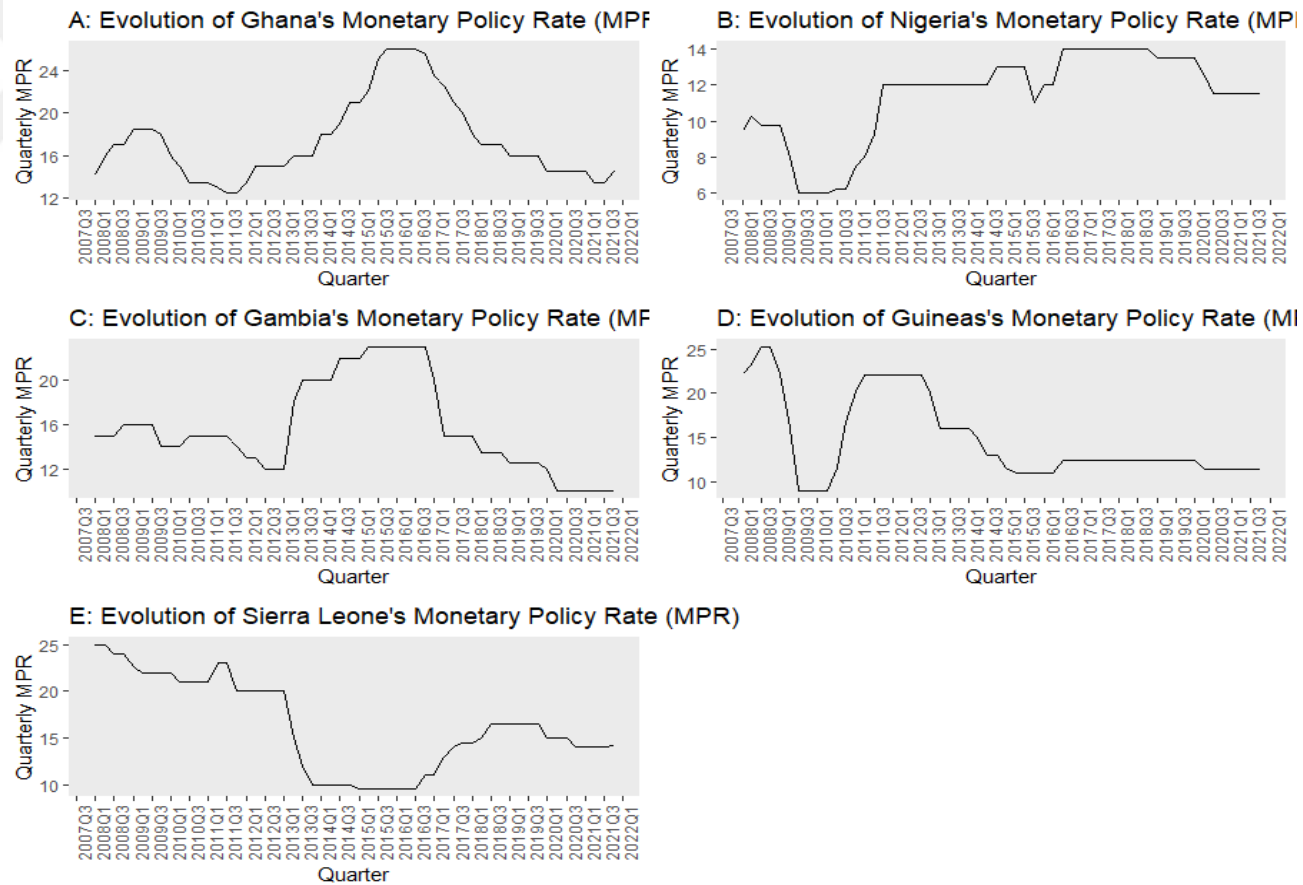


Figure 2.2. Monetary Policy Rate of 5 WAMZ Member Countries

Source(s): Author's own creation/work

Panels A, B, C, D and E depict the evolution of the MPR of Ghana, Nigeria, the Gambia, Guinea, and Sierra Leone since 2008Q1. The MPR of Ghana over the period of this study started off at 14.5% in 2008Q1, rising to 26% in 2015Q4 to 2016Q3 before falling to 14.5% in the fourth quarter of 2021, as depicted in Panel A of Figure 2.2.

Quarterly GDP growth rates for members of the WAMZ are largely unavailable, with only Ghana and Nigeria reporting quarterly GDP and GDP growth rates with data available for Ghana since 2008 Quarter 1 and for Nigeria since the GDP rebasing in 2010 Quarter 1. The Gambia, Guinea and Sierra Leone do not report quarterly GDP growth rates. As such, the annual GDP growth rates of these countries are sourced from the World Bank Group World Development Indicators (WDI) database, which are then interpolated using the Fritsch and Carlson (1980) formulation of the monotone Hermite Spline.

Figure 2.3. presents the correlation graphs of the MPRs and the annual GDP growth rates of the WAMZ countries considered in this study.

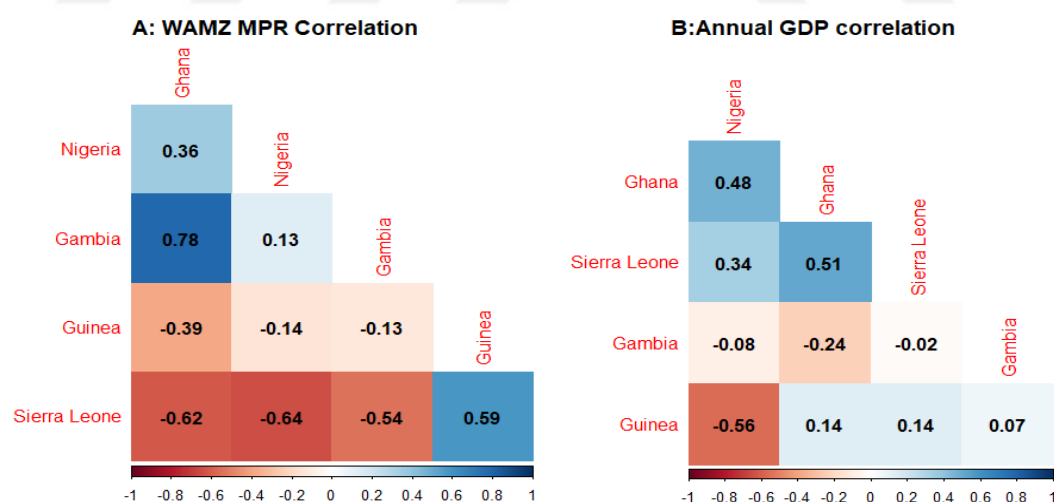


Figure 2.3. Correlation of Monetary Policy and Annual GDP Growth in WAMZ

Source(s): Author's own creation/work

From Figure 1.3, correlation between the monetary policy rates of Ghana and the Gambia and, a to lesser extent, Nigeria is observed. Indeed, the computed correlation coefficient is 0.78, showing a high positive correlation between Ghana and the

Gambia, a 0.36 correlation between Ghana and Nigeria and a correlation of -0.62 and -0.39 between Ghana and Sierra Leone and Guinea, respectively, as shown in Figure 2.2 Panel A. This, thus, indicates a positive correlation in the monetary cycle of Ghana, the Gambia, and Nigeria, and a negative correlation in monetary cycle between these countries and Sierra Leone and Guinea.

In terms of business cycle alignment, Ghana, Nigeria and also Sierra Leone are the most aligned, as can be deduced from the annual GDP growth rate correlation in Figure 2.2 Panel B, even though structurally Sierra Leone is the smaller and poorer with a GDP per capita of \$516 compared to the \$2,445 and \$2,085 for Ghana and Nigeria, respectively as at 2021³.

In the event of a monetary union, the monetary policy reaction function will have to factor in the business cycles of the member countries; as such, we compute 2 counterfactual monetary policy rates to capture the hypothetical monetary policy rate of WAMZ if the monetary policy union was to be implemented. One such monetary policy rate is computed as the simple average of the monetary policy rates without regard to the size, business cycle and importance of the economy. As the second counterfactual monetary policy rate, we use a GDP growth-weighted average MPR. The descriptive statistics of the nonperforming loan ratios, gross domestic growth rates, the monetary policy rate of Ghana, and the counterfactual MPRs are presented in Table 2.2.

Table 2.2. Descriptive Statistics

	<i>npl</i>	<i>MPR</i>	<i>gdp</i>	<i>SMPR</i>	<i>WMPR</i>
No. Obs.	56	56	56	56	48
Mean	15.23	17.43	6.30	15.13	14.89
Median	15.35	16.00	6.45	15.25	15.15
Max	22.55	26.00	19.78	18.40	17.18
Min	7.62	12.50	-5.64	12.10	12.09
Std.	3.76	3.87	4.95	1.59	1.42

³ https://www.ilo.org/empent/Projects/score/WCMS_868172/lang--en/index.htm

Table 2.2. (cont.)

Skewness	0.01	0.99	-0.08	-0.17	-0.58
kurtosis	2.47	2.96	3.38	2.51	2.28

Source(s): Author's own creation/work

Nonperforming loan ratios averaged 15.23% over the study period, while the monetary policy rate of Ghana, the GDP growth rate of Ghana, the simple mean counterfactual MPR of WAMZ, and the GDP growth weighted counterfactual MPR averaged 17.43, 6.30, 15.13, and 14.89, respectively. Interestingly, NPL is found to be perfectly symmetrical, one of the signature features of normal distribution, with a standard deviation of 3.79 and a kurtosis of 2.42. Comparing the MPR and its counterfactuals, it is observed from Table 1 that a unionised monetary policy would have resulted in a lower standard deviation of 1.59 and 1.42 for the SMPR and WMPR, respectively.

2.5. Parameter Estimation

Counterfactuals have been of interest to philosophers for ages (Ginsberg, 1986). However, the econometric analysis of counterfactuals is quite recent and sparse. Recently, there has been an increase in interest in developing statistical methods to perform counterfactual analysis with aggregate data for when a single "treated" unit experiences an intervention, such as a policy change, and there is no obvious control group. The offered solutions often rely on creating an artificial counterfactual from a group of "untreated" peers that are arranged in a panel data structure (Masini & Medeiros, 2022). One of the few, and theoretically sound methodologies for estimating the effect of a policy in a counterfactual framework with mixed stationary time series is that of Pesaran and Smith (2016), henceforth PS, which is based on an ARDL model. Pesaran and Shin (1999) show that ARDL estimates are robust to endogeneity and robust to a mixture of stationarity or near stationary time series.

In this study, the reduced form policy counterfactual methodology used in PS is employed as the baseline model to estimate the parameters of our theoretical model, which is then used to study the impact of a unionised monetary policy on financial stability as measured by the nonperforming loan ratios of Ghana.

As postulated by PS, given a policy response series, y , and a policy variable, x , along with w , a control variable, then the response of y to changes in x can be modelled with a reduced form equation as in equation (2.7).

$$y_t = \alpha + \beta x_t + \gamma w_t + \epsilon_t \quad (2.7)$$

Suppose that a policy change to x_t is ad-hoc and does not affect the parameters of equation (2.7), then a full structural parameter is not necessary, and the impact of the policy change can be analysed using the reduced form policy parameters as estimated from equation (2.7) (PS). As such, an exogenous change to the policy variable from x_t to \hat{x}_t where $\hat{x}_t = x_t + \vartheta$, with ϑ being a non-zero policy shock, at time T will result in a change in y from $T + 1$. This change in the policy response variable can be estimated as in equation (2.8).

$$\widehat{y}_{T+h} = \widehat{\alpha} + \widehat{\beta} \widehat{x}_{T+h} + \widehat{\gamma} w_{T+h} \quad (2.8)$$

Where $\widehat{\alpha}$, $\widehat{\beta}$ and $\widehat{\gamma}$ are the estimates of the true parameters from equation (2.7). The impact of the policy variable change on the policy response variable from time $T + 1$ is estimated as in PS to be

$$d_{T+h} = \widehat{y}_{T+h} - y_{T+h} = \widehat{\beta} (\widehat{x}_{T+h} - x_{T+h}) \quad (2.9)$$

Where d_{T+h} is the effect of the effect of the policy shock. All though the reduced form equation in 2.7 is misspecified, PS contend that if the objective is to study the counterfactual impact for which only the total effect is the goal, then the reduced form equation yields consistent estimates, more likely to be robust to the disparity in invariance between the total effect and marginal effect of policy variables, likely to be more efficient to estimate and less sensitive to estimation errors than a full structural model. The mean policy effect can be estimated as the average of the post-intervention sample size, H , resulting in

$$\overline{d_{T+h}} = H^{-1} \sum_{h=T+1}^H \widehat{d}_{T+h} \quad (2.10)$$

Dynamics can be introduced in both the endogenous and exogenous variables to ensure the residuals in the reduced form model are serially uncorrelated (PS). This, with some manipulations, will result in a finite order ARDL model specified as in equation (2.11)

$$y_t = \alpha + \gamma_i \sum_{i=1}^{p_1} y_{t-i} + \beta_i \sum_{i=0}^{p_2} x_{t-i} + \gamma_i \sum_{i=0}^{p_3} w_{t-i} + \epsilon_t \quad (2.11)$$

The policy response variable y , after time T , then becomes.

$$\widehat{y}_{T+h} = \widehat{\alpha} + \widehat{\gamma}_i \sum_{i=1}^{p_1} \widehat{y}_{T+h-i} + \widehat{\beta}_i \sum_{i=0}^{p_2} \widehat{x}_{T+h-i} + \widehat{\gamma}_i \sum_{i=0}^{p_3} w_{T+h-i} \quad (2.12)$$

Again, the effect of the policy after time T can be estimated as in equation (2.10).

Given that the objective of this study is to determine the impact of a unionised monetary policy on the nonperforming loan ratios of Ghana, the npl_t of Ghana is taken as the policy response variable, and the monetary policy rate as in equation 2.6 is taken as the policy variable with the exponential of GDP growth as the control variable. The reduced form policy equation becomes as in equation 2.6, and the ARDL reduced form policy equation is as in equation (2.13).

$$npl_t = \varphi + \gamma_i \sum_{i=1}^{p_1} npl_{t-i} + \pi_i \sum_{i=0}^{p_2} mpr_t + \rho_i \sum_{i=0}^{p_3} e^{gdp_t} + \epsilon_t \quad (2.13)$$

After 100 simulations using the Schwarz Information Criterion (SIC), the optimum lag order of $p_1, p_2, p_3 = (2, 0, 0)$ was chosen. The estimated ARDL model is as in Equation (2.14).

$$npl_t = \varphi + \gamma_1 npl_{t-1} + \gamma_2 npl_{t-2} + \pi mpr_t + \rho e^{gdp_t} + \epsilon_t \quad (2.14)$$

Checking for stationarity is a prerequisite for time series analysis. As such, the stationarity properties of the variables were checked using the ADF test by Dickey and Fuller (1979), the NG-Perron test by Ng and Perron (2001) and the DF-GLS test by Elliot et al.(1996). The stationarity results are presented in Table 2.3.

Table 2.3. Unit Root Tests of Stationarity

Variable	ADF- test		NG-Perron MZa		DF GLS test		Conclusion
	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept	
I (0)							
<i>npl</i>	-2.41	-3.23*	-4.36	-114.10***	-1.52	-2.95*	Unit-root
<i>MPR</i>	-2.31	-2.43	-29.00	-17.17***	-2.31**	-2.58	Unit- root
<i>gdp</i>	-3.21**	-3.59**	-3.21**	-3.59**	-3.09***	-3.64**	Stationary
<i>mpr_t</i>	-2.40	-2.29	-3.09	-5.71	-1.23***	-1.93	Unit-root
<i>exp_gdp</i>	-7.40***	-7.46***	-27.50***	-27.47***	-7.43***	-7.53***	Stationary

*, **, and *** denotes significance at 10%, 5% and 1% level respectively.

The stationarity testing found nonperforming loan ratios, the Monetary policy rate of Ghana and the Monetary policy ratio to be nonstationary, while the GDP growth and the exponential of GDP growth (*ex_gdp*) were found to be stationary. Owing to the mixed order of integration of our variables, the estimated ARDL model was tested for

cointegration using the Pesaran et al. (2001) ARDL bounds testing cointegration methodology, the most theoretically sound cointegration test (Khan et. al., 2019) and reported in Table 2.4.

From Table 2.4, it can be concluded that the Bounds F statistic and the Bounds T statistic are both significant at the 5% level, which confirms the existence of at least one cointegrating equation in the model. Masini and Medeiros (2022) contend that the existence of at least one cointegration equation in nonstationary counterfactuals ensures estimated parameter consistency. The parameters, as estimated from the pre-intervention, data is presented in Table 2.5.

Table 2.4. Bounds Test of Cointegration

Test Statistic	Value	k	Significance Level	Lower Bound	Upper Bound
F-Statistic	4.98**	2	10%	3.17	4.14
Critical Values			5%	3.79	4.85
			2.5%	4.41	5.52
			1%	5.15	6.36
Test Statistic	Value		Significance Level	Lower Bound	Upper Bound
T-Statistic	-3.69		10%	-2.57	-3.21
Critical Values			5%	-2.86	-3.53
			2.5%	-3.13	-3.8
			1%	-3.43	-4.1

From Table 2.5, ϕ , the long-term average nonperforming loan ratios is found to be 12.69%, and the first and second lag of the nonperforming loan ratios has a coefficient of 1.148 and -0.3388, all significant at 1%. The policy variable, the monetary policy ratio, negatively impacts nonperforming loans with a coefficient of -9.7. This implies that an increase in the monetary policy ratio results in a decrease in nonperforming loan ratios in the long run, which is in line with our hypothesis. The exponential GDP ratio is, however, positively related, though insignificantly.

Table 2.5. Parameter Estimates

Variable	coefficient	t-stats
φ	12.69	3.216***
γ_1	1.148	8.673***
γ_2	-0.3388	-2.746***
π	-9.700	-2.807***
ρ	1.238e-09	0.398
F-stats	112.6***	
Adj. R-squared	0.8939	
Breuch-Godfrey test	5.426	
Breusch-Pagan test	2.4201	

*, **, and *** denotes significance at 10%, 5% and 1% level respectively.

As a robustness check, we employed a popular predictive machine learning algorithm, the Least Absolute Shrinkage and Selection Operator (LASSO), first proposed by Tibshirani (1996), to double-check our baseline model. The LASSO estimation is done using Friedman et al. (2010). The LASSO algorithm focuses on minimising the residual sum of squares subject to a ℓ_1 – norm of the coefficient (Osborne et al., 2000). This is the algorithm used in the first stage of the counterfactual package, ArCo, in R developed by Carvalho et al. (2018) and used in several other studies (like McNeish, 2015; Hesterberg et al., 2008; Roy et al., 2015; Ziel, 2016).

The Lasso estimation confirms the findings of the ARDL baseline estimates with a negative coefficient of -39.72 for the policy variable, the monetary policy ratio and shrinks the exponential of GDP growth, which is found to be insignificant in the ARDL baseline estimate, to zero.

2.6. Actual and Counterfactual Nonperforming Loans: A Comparison

With the estimated parameters from equation (2.13), we estimate the counterfactuals assuming the simple mean unionised monetary policy rule and the GDP growth weighted unionised monetary policy rule as in equations (2.14) and (2.15). That is, we

estimate a simple mean counterfactual NPL (snpl) as in equation (2.14) and a GDP growth-weighted mean counterfactual NPL (wnpl) as in equation (2.15).

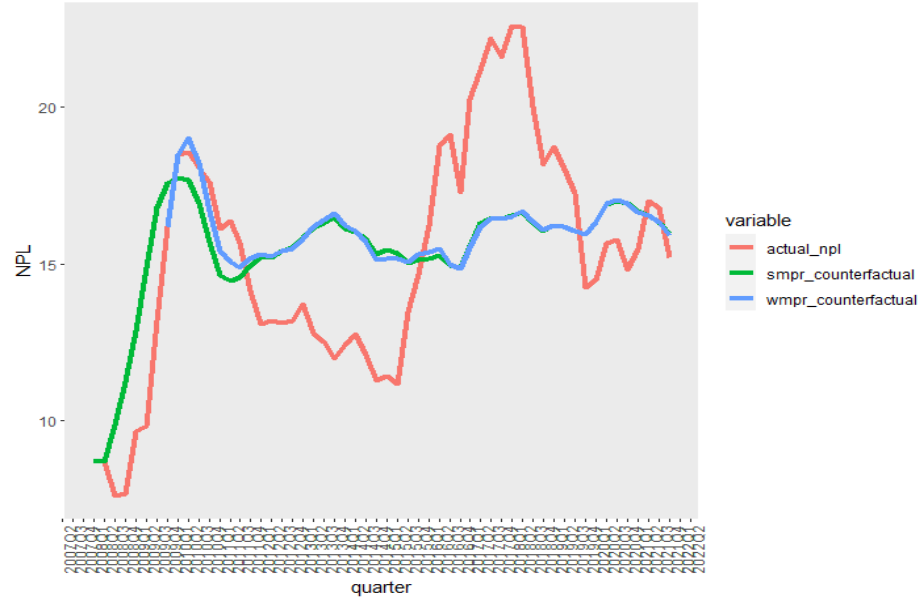
$$sNPL_t = 12.69 + 1.148sNPL_{t-1} \pm 0.3388sNPL_{t-2} \pm 9.700smpr_{ratio_t} + 0.0000000012e^{gdp_t} \quad (2.14)$$

$$wNPL_t = 12.69 + 1.148wNPL_{t-1} \pm 0.3388wNPL_{t-2} \pm 9.700wmpr_{ratio_t} + 0.0000000012e^{gdp_t} \quad (2.15)$$

The actual and counterfactual nonperforming loan ratios are plotted in Figure 2.4 with panel A of Figure 2.4. depicting the actual and counterfactual nonperforming loan ratios as estimated by the baseline ARDL model and panel B depicting the actual and counterfactual nonperforming loan ratios as estimated by the LASSO algorithm.

From Figure 2.4 Panel A, the actual nonperforming loan ratios started off at a lower percentage than the counterfactuals. Its oscillation, too, is more pronounced, while the simplified and weighted counterfactuals are more moderate, hovering around 15% throughout the time considered. The mean effect of the unionised policy rates on the NPLs is computed as in equation 2.10 and found to be 0.2215249, while the mean effect of a GDP growth-weighted unionised monetary policy is found to be infinitesimal at -0.0006312266 percentage points.

Panel A: Actual and Counterfactual NPL ratios of Ghana-Baseline



Panel B: Actual and Counterfactual NPL ratios of Ghana-Robustness

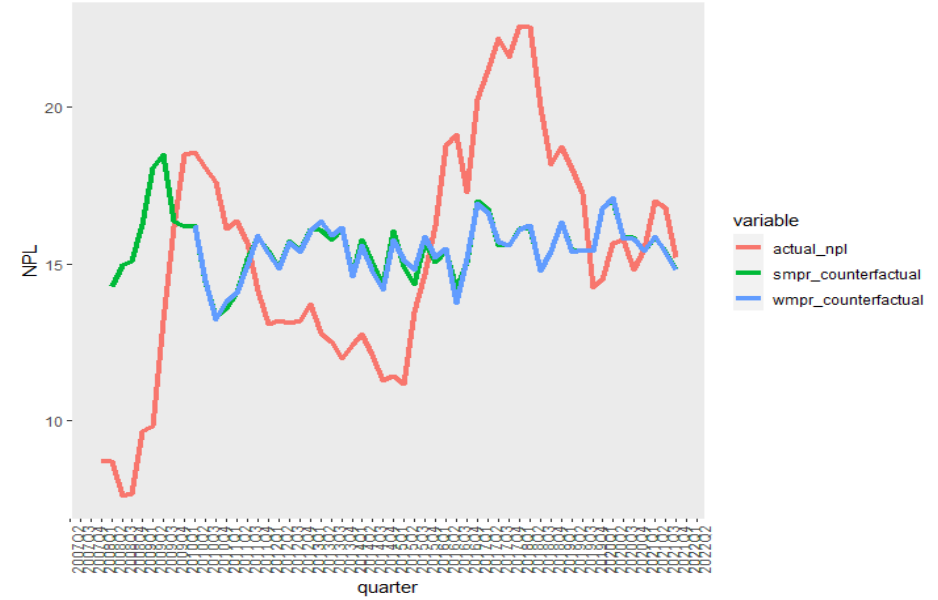


Figure 2.4. Actual and Counterfactual NPLs Ratios

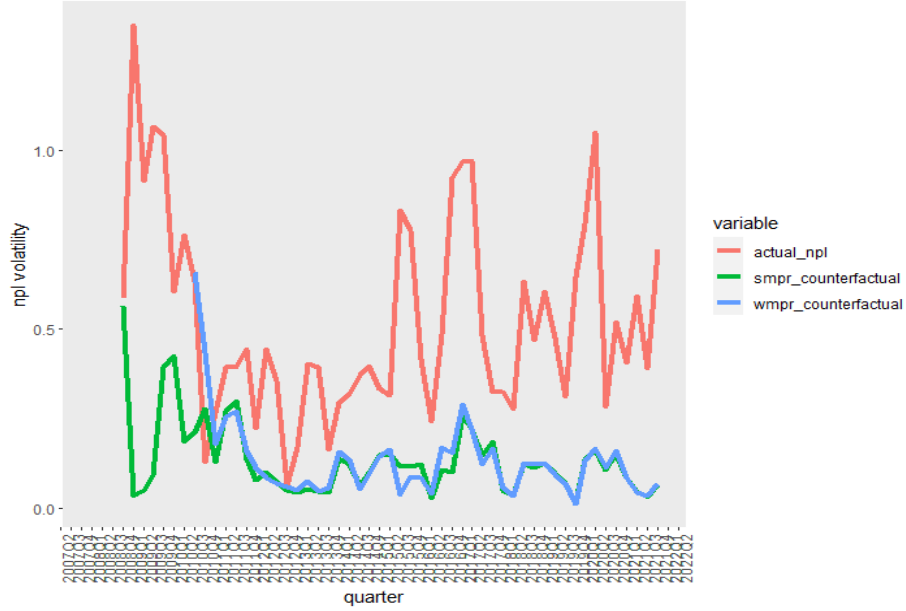
Source(s): Author's own creation/work

Panel B of Figure 2.4 also shows a more elevated nonperforming loan ratio compared to the weighted mean MPR counterfactuals, especially after 2016 Q2. Specifically, the mean effect of the LASSO-based counterfactuals is to increase nonperforming loan ratios by 0.20, similar to the baseline prediction when the simple mean monetary policy rate of member countries is used as the unionised policy rate. Using the GDP-weighted monetary policy rate of member countries as the unionised monetary policy rate, however, results in a 0.57 reduction in the nonperforming loan ratio of Ghana on average. This is similar in conclusion but much larger in magnitude to the results of the baseline estimates.

What this implies is that a unionised monetary policy will add less than a percentage point to nonperforming loan ratios, while a unionised monetary policy with GDP growth as a weighting factor will result in a decrease in nonperforming loan ratios for Ghana.

Beyond the magnitude of NPLs, NPL volatility is also found to precede banking crises. As such, we estimate the close-to-close historical volatility (CCHV) rates of the actual and counterfactual NPLs to determine if a unionised monetary policy has a heightening or dumping effect on Ghana's nonperforming loan volatility. The actual and counterfactual NPL volatilities are plotted in Figure 2.5.

Panel A: Comparison of Actual and Counterfactual NPL volatilities-Baseline



Panel B: Comparison of Actual and Counterfactual NPL volatilities-Robustness

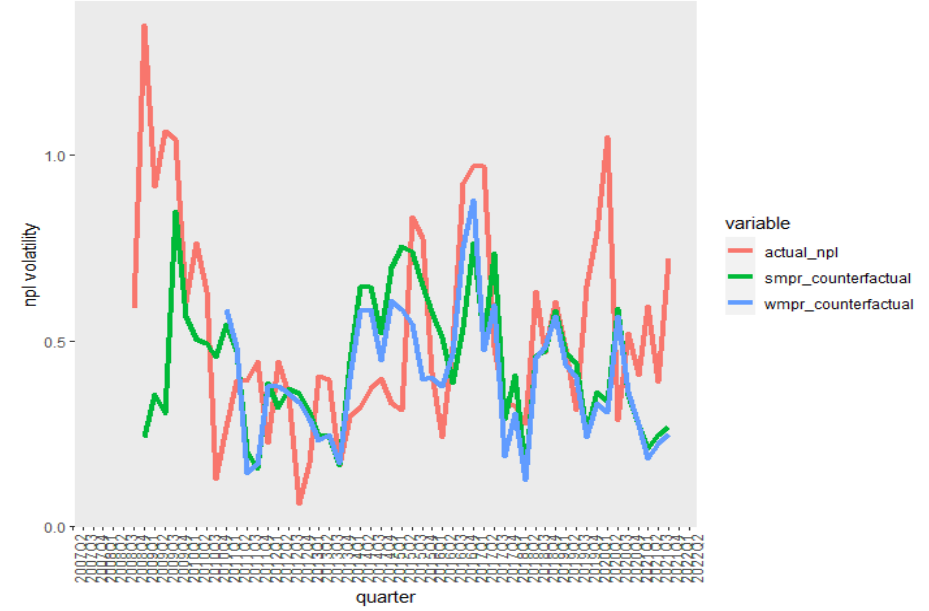


Figure 2.5. Actual and Counterfactual NPL Volatility

Source(s): Author's own creation/work

Panel A confirms the insinuations we made from Figure 2.4, with the actual NPLs having a more elevated volatility while the simple mean counterfactual NPL (snpl) and GDP growth-weighted mean counterfactual NPL (wnpl) share almost equal volatility. Comparatively, the simple mean monetary policy will decrease NPL volatility by 0.38, while the weighted mean monetary policy will decrease NPL volatility by 0.33.

The robustness check volatility estimates are shown in Figure 2.5 Panel B. Though the difference in volatility is less perceptible in Panel B compared to Panel A, the conclusion is the same, only differing in magnitude. The implementation of a monetary union in the WAMZ region will result in a 0.08 and 0.07 reduction in nonperforming loan ratio volatility in Ghana if the simple and weighted mean of monetary policy rates of member countries are used as the unionised monetary policy rate.

This is conceivable because a unionised monetary policy will be an average, as such a moderated version of the individual country's monetary policy stances. This will result in more circumspection, as such a less volatile monetary policy and, by an extension, a less volatile nonperforming loan ratio, which is a core antecedent to economic crises.

2.7. Conclusion

This essay sought to estimate the impact of a unionised monetary policy in the West African Monetary Zone (WAMZ) on financial stability as represented by the nonperforming loan ratios of Ghana. This is done by modelling nonperforming loan ratios as a function of the monetary policy rate and the GDP growth rates in a reduced policy framework. The reduced policy parameters are estimated using Quarterly data from 2008 Quarter 1 to 2021 Quarter 4. The estimated parameters are then used to estimate the impact of a unionised monetary policy crudely measured as a simple mean of member countries' individual monetary policy rates and the GDP growth weighted mean of member countries' monetary policy rates. From the results, it is found that monetary union will not pose a substantial risk to financial stability in Ghana in the event of a role out of a single currency in the WAMZ. As a robustness check, similar analyses and conclusions are arrived at using a LASSO regression to predict the counterfactual impact of a unionised monetary policy in the WAMZ. This implies that the cost of monetary union as regards the magnitude and volatility of nonperforming loan ratios is not substantial, as such, member countries should increase the momentum towards monetary union.

CHAPTER III

CRYPTOCURRENCIES AND HAYEKIAN CURRENCY COMPETITION: A CRITICAL REVIEW

3.1. Introduction

Hayek's bold and futuristic proposal in "The Denationalisation of Money", first published in 1976 (henceforth, the proposal), is coming out of the shelves after several decades in obscurity (Fernández-Villaverde & Sanches, 2018). In the Denationalisation of Money, Hayek (1990) argued for the liberalisation of the money market to allow for competition among government-sanctioned central banks and private note-issuing banks. He contends that the substitution of currency competition for the state-controlled and monopolised monetary system will establish and maintain a stable and efficient monetary system (Dowd, 1988). Though Hayek's proposal seemed bizarre at first mention, it differed from free banking in that he proposed private money issuers issue their own distinct currencies, which amount to the privatisation of the unit of account role of money (Fantacci, 2019). Also, unlike the private money issuers in the free banking era, whose currency was mostly backed by gold reserves (Mayer & Bofinger, 2024), Hayek proposed a raw material commodity price standard (Hayek, 1990, p.75).

Hayek's (1990) proposal from the onset garnered criticism from the likes of Milton Friedman, a fellow neo-liberal and a member of the Mont Pelerin Society (MPS), which Hayek founded. Friedman (1984) raised issues with the mechanics of a stable private money issue, noting that it will require fixed purchasing power securities that perhaps only a government can issue. However, private money backed by such a security will, in effect, mean government money rather than private money. Aside from this, Hayek's proposal has also been criticised for failing to consider habits of economic agents (Friedman & Schwartz, 1986), that people may not necessarily

demand a stable currency (Howard, 1977), and failure to consider network effects that could lead to private monopoly in monetary issue (Sanz Bas, 2020) among others.

Beyond these criticisms, however, a limited number of studies have argued that the international monetary system post-Bretton Woods with several vehicle currencies is reminiscent of transnational monetary competition (Endres, 2009), as proposed by Hayek (1990).

Starting with ECB (2012), several authors have sought to draw parallels between blockchain-based cryptocurrencies and Hayek's private money proposal. The parallels drawn by ECB (2012) have been reiterated by Sanz Bas (2020), who alludes to the proposal for the denationalisation of money being a clear harbinger of the coming of cryptocurrencies. Blockchain and cryptocurrencies, Sanz Bas (2020) contends, are now recognised by many as the future of the international monetary system. This has resulted in many re-reading the proposal for the denationalisation of money (Sanz Bas, 2020) with less scepticism. The proposal for the denationalisation of money has now become the work of reference in the cryptocurrency literature (Sanz Bas, 2020).

But how relevant are the historical criticisms of the proposal in the era of cryptocurrencies? And how much less sceptical are readers and commentators of the proposal for the denationalisation of money post-cryptocurrency proliferation? This essay seeks to answer these questions by critically reviewing the literature on the denationalisation of money prior to and after the proliferation of blockchain-based cryptocurrencies.

As a prelude, Section Two briefly discusses free banking, touching on its main features and why it was outlawed. This is then followed in Section Three by a brief examination of the Denationalisation of Money with a focus on the key features of the proposal. This is aimed at laying a foundation with which criticisms and exonerations of the denationalisation of money prior to and after cryptocurrency proliferation can be evaluated. This is followed by Section Four, which reviews the literature on private money, specifically on the criticisms, theoretical and empirical exonerations or otherwise of Hayek's proposal for the denationalisation of money prior to the proliferation of cryptocurrencies. Specifically, the keywords "Hayek" and "private money" or "currency competition" were searched for on Google Scholar, and the most

relevant publications (and working papers) accessible to the author reviewed. To gauge the balance of opinion on Hayek's Denationalisation of Money prior to and after the proliferation of cryptocurrencies, the reviewed papers are divided into two. The prior to the proliferation of cryptocurrencies is taken to mean from 1976 to 2012. This is between when the denationalisation of money was first published and when ECB (2012) drew the parallels which coincided with the explosion in interest in and value of cryptocurrencies.

After examining the research themes of private money prior to cryptocurrencies, the framework and assets of the Decentralised Finance (DeFi) ecosystem are discussed in Section Five. This is aimed at establishing the key features of the DeFi ecosystem most relevant to the private money proposal and for examining the similarities or otherwise of cryptocurrencies and the proposal. Section Six seeks to draw parallels between Hayek's proposal and the cryptocurrency ecosystem. Section Seven reviews the literature on the denationalisation of money after the proliferation of cryptocurrencies, which is taken to mean research and publications from 2013 to date.

Section Eight takes a detour to offer some remarks on the illegibility and legibility struggle between Decentralised Finance (DeFi) and Centralised Finance (CeFi) and its implications for the future of currency competition presented. Section Nine Concludes the study.

3.2. Free Banking

One of the perennial debates in monetary theory is on the role of central banks and whether money creation should be separated from financial intermediation (Goodhart & Jensen, 2015). These debates are reflected in two schools of monetary thought: the banking school and the currency school. The differences between these schools are particularly stark on the level and growth of the money stock. While almost all members of the currency school propose rules, banking school advocates make room for discretion and flexibility (Goodhart & Jensen, 2015). In this regard, Rothbard (1987), based on the analysis of Smith and Yeager (1990), declared that the currency school advocates were hard-money men who deemed bank credit inflation as evil and sought to eliminate it so as to bring the money supply as close as possible to a

commodity standard. Members of the banking school, however, are deemed to be inflationists who favoured bank credit expansion in accordance with the needs of trade.

In Smith and Yeager (1990), which is touted as the locus classicus of work on the free banking and central banking debate by Rothbard (1987), members of the banking and currency schools are further divided into free banking advocates and central banking advocates. Per their analysis, elements of both banking school and currency school have appealed to free banking as a means to achieve their ends. For example, while Parnell and Mises were both advocates for free banking, Smith and Yeager (1990) considered Parnell a banking schooler while Mises a currency schooler. Also, even though Professor Lawrence Henry White is considered one of the famous advocates and authority on free banking, Rothbard (1987) considers him one of the banking schoolers who only disagrees with the central banking aspects of the school but is sympathetic with their desire to inflate bank credit.

The divergences in opinion on the ultimate goal of free banking necessarily translate into disagreements about what constitutes free banking. Nonetheless, the key features of free banking are said to be competition in note issue, low legal barriers to entry, and no central control of reserves (Schuler, 1992). Rockoff (1972) examines the American case of free banking and notes that banks were allowed to issue notes redeemable in gold and silver and secured by bond. That is, note-issuing banks were mandated to hold designated government bonds deposited with a state authority as security for all circulating notes issued by the bank. Should a bank fail to meet convertibility, proceeds of the bonds were used to reimburse note holders (Rockoff, 1972). Thus, under free banking, note-issuing banks could issue banknotes in the country's currency unit. These currencies were, in most cases, required to be redeemable in specie. It is almost impossible, notes Schuler (1992, p.20), to find a free banking system under which fiat money was issued with no promise of fixed rate convertibility.

At the dawn of economics as a distinct subject of study in the late 1700s, the banking and monetary regime in Scotland and in most parts of the world could have been considered as free banking regimes to varying degrees (Selgin, 2008). This lasted until the early 20th century (Selgin, 2008), with Namibia being the last place to formally outlaw free banking in 1962 (Dowd, 2002). Schuler (1992) gives a sample of free

banking episodes in various countries, as depicted in Table 2.1. These privately issued bank notes under free banking are claimed to have efficiently served as money by Williamson (1999) until they were outlawed.

Table 3.1. Sample of Free Banking Episodes

Country	Free Banking Era	Start of Central Banking
United States of America	1782-1914	1914
Canada	1817-1933	1934
France	1796-1848	1848
Germany	1821-1875	1875
United Kingdom:		
Channel Islands	1797-1914	1914
England, Wales	1668-1844	1844
Scotland	1716-1845	1845
Isle of Man	1802-1961	1961
Ireland	1693-1845	1943
China	1004-1935	1942
Brazil	1836-1892	1920
New Zealand	1840-1933	1934

Source: Schuler, (1992)

3.2.1. Proscription of Free Banking; The Reasons for and Their Validity

Many jurisdictions, however, started to outlaw Free banking in the 17th, 18th and 19th centuries, granting exclusive note-issuing rights to “central banks” (Selgin, 1988). The monopolisation of currency issue largely faced no objections from theorists. Eventually, the monopolised currency issue came to be seen, even by economists of the laissez-faire tradition, as the status quo and an indispensable part of the national monetary policy framework (Selgin, 1988). It has been claimed that the eventual monopolisation of the currency market was due to the belief in notes/coins as symbols of sovereignty (Hayek, 1990), seigniorage (Meisel, 1992), the belief in the market for currency being a natural monopoly (Dowd, 1992), the flaws of competitive note issue (Dowd, 1992) and/or that fighting the monopoly of central banks in coinage was not a winning battle as such a futile endeavour (Selgin, 2008).

Hayek attributes the eventual hegemony of public central banks and their bank notes to the long-held belief that coinage should be the preserve of the prince and, as such, an important component of sovereignty, as proposed by Jean Bodin (Hayek, 1990). Money, according to this sovereignty theory, serves as a symbol of might through which the ruler asserts sovereignty, usually by embossing his image on the “coins” to be carried to the remotest part of the realm. In an exhaustive study tracing the journey to the monopolisation of monetary notes in the United States, Noll (2012) ascribed the eventual monopolisation to the unanimous belief of both Democrats and Republicans that allowing for the private issue of bank notes gave private financial interest, too much power, a power that “rightfully” belonged to the people and congress. Thus, the Bureau of Engraving and Printing was awarded the exclusive monopoly to print banknotes due to a belief that minting should be the preserve of the “prince”, as suggested by Hayek (1990).

The second reason that is often advanced for the proscription of free banking is seigniorage. The argument goes that the monopolisation of the notes market by the government was due to the sheer profitability of seigniorage. Meisel (1992, p.97), for example, contends that the Colombian government outlawed free banking and the right of other banks to issue notes due to pressing fiscal demands of the government rather than any flaws or dissatisfaction with the operations of free banking.

Also, proponents of central banking and even members of the neoliberal school exempted the note-issuing market from the rigour of market competition because of the presumption that the market for note issue is a natural monopoly (Dowd, 1992, p.1). By definition, a natural monopoly is said to exist if only a single entity is able to run profitably due to the existence of economies of scale over the entirety of market demand (Mosca, 2008). As such, a natural monopoly can only be said to exist in the market for notes if a single note-issuing bank evolves to become a central bank by capturing the market share of other note-issuing banks and driving them out in a free competitive market with no discriminatory subsidies in its favour (Vaubel, 1984). The natural monopoly argument for the monopolisation of note issue has, however, been questioned. In a historical review of when competitive note issue was the norm in several parts of the world, Schuler (1992) notes that, whereas economies of scale did result in the consolidation/collapse of some private note-issuing banks, especially

when branching was permitted, in no jurisdiction was a single bank able to capture the market shares of all competitors to become a monopoly. For example, whereas Scotland had 29 issuing banks in 1826, only 19 issuing banks were operational at the end of the free banking era in 1845. In Canada, the peak was 51 banks in 1875, which was reduced to 10 in 1932, and most countries showed the same pattern (Schuler,1992). As such, the claim of central banks being natural monopolies is unsustainable.

The statutory monopolisation of the market for notes has also been defended with the argument that competition will lead to rapid inflation. Hayek (1990, p.14) notes that this belief is further strengthened by the advocates for free banking who agitated for the free issue of bank notes because they wanted more money (Hayek,1990, p.14). The claim that competitive note issue will result in inflation has, however, been disputed theoretically and empirically with a historical examination of free banking episodes. Dowd (1992) examines the historical records of free banking and concludes that the historical experience discounts the claim that competitive note issues will result in inflation. He claimed that inflation and deflation during the era of free banking were due to the inflation and/or deflation of the anchor commodity. Dowd also asserts that free banks, until government regulation outlawed them, continued to issue convertible and, thus, sound money. Inflation only picked up following government-induced abandonment of convertibility.

The last but not the least reason advanced for the need to put money under the control of a governmental body is that competition in the issue of notes will and did result in banking industry instability and its related consequences. Dowd (1992) concedes that the banking crisis did occur during the free banking era, but these crises were always precipitated by spillovers from crises in a regulated banking system nearby or by a governmental intervention of some sort. As such, these crises could not be blamed squarely on the nature of free banking and, as such, cannot be advanced as the reasons to monopolise the note-issuing market. Schuler(1992) surveyed the world's experience with free banking and concluded that out of the over 50 episodes of free banking, only 10 were crisis, a significant reason for outlawing free banking and placing note issuing under governmental monopoly.

3.3. Hayek's Proposal for the Denationalisation of Money

Prior to the Denationalisation of Money, Hayek had argued for a constant stream of money stock. This was due to his belief that a frozen stock of money was the least discoordinating (White,1999). In this regard, he criticised the gold standard for allowing for the variation of monetary gold and free banking for allowing for the variation in bank-issued money (White,1999).

In the Denationalisation of Money, however, Hayek radically departed from his earlier views and abandoned the constancy of the money stream to embrace a consumer price level stabilisation as the most important monetary policy goal (White,1999). In addition to this, he proposed that currency and capital markets be liberalised to allow for the concurrent use of first, public, and then public and privately issued fiat currencies within national frontiers (Hayek, 1990, p.23). This, he believes, is the surest bet to forcing central banks and, for that matter, any other note-issuing bank to provide sound money.

...this scheme is to impose upon existing monetary and financial agencies a very much needed discipline by making it impossible for any of them, or for any length of time, to issue a kind of money substantially less reliable and useful than the money of any other (Hayek, 1990, p.23)

Hayek then sets out to outline the sequential steps to institutionalise competition among state-sanctioned central banks and private note-issuing banks within national frontiers. In his "practical proposal", Hayek contends that currency competition can be instituted first among central banks issued fiat currencies. Hayek proposes that this be done through a treaty. The treaty will seek to bind member countries so that they do not impose any restrictions on the use of other treaty member countries' currencies (Hayek, 1990, p.23).

Hayek also proposes that the treaty be broadened to include the relaxation of banking regulations. The purpose of such a relaxation will be to allow for banks incorporated in one of the treaty countries to establish branches (on the same terms) in other treaty countries. Hayek (1990, p.24) stresses that the extension of free trade in money to free trade in banking is essential due to the (already) significant portion of bank-created private money in the form of chequing deposits in the aggregate media of exchange in

most countries. This is also essential given that proponents of central banking and of the national management of base money almost always invoke the need for banking credit regulation in support of their case.

First, bank deposits subject to cheque, and thus a sort of privately issued money, are today of course a part, and in most countries much the largest part, of the aggregate amount of generally accepted media of exchange. Secondly, the expansion and contraction of the separate national superstructures of bank credit are at present the chief excuse for national management of the basic money Hayek (1990, p.24).

Hayek then contends that there is no reason to limit the issue of bank notes to central banks of the treaty signatories. Instead, the financial and monetary sector can be relaxed further to allow for private banks to issue and put into circulation their own (token) currency notes.

A private note-issuing bank willing to issue its own currency note can initiate the process by issuing non-interest-bearing certificates or notes (henceforth certificates) with a distinct trademarked name. The bank can then open chequing accounts in the trademarked certificates. This, in all practical terms, will make the trademarked certificate a unit of account like the US dollar or the Ghanaian cedi. "...joint stock banks.....I would announce the issue of non-interest-bearing certificates or notes, and the readiness to open current cheque accounts, in terms of a unit with a distinct registered trade name such as '**ducat**'" Hayek (1990, p.46).

The reference to a joint stock bank implies a bank legally incorporated with substantial capital to meet legal capital requirements. This essentially makes the certificates derivatives (Murphy, 2020) whose value depends on the value (of the issuer's assets) and credibility of the bank. Also, the essence of the distinct trademarked name is to privatise the unit of account function of money rather than just the means of exchange function, privatisation that was trumpeted by proponents of free banking (Fantacci, 2019; Issing,1999). The issued certificates, having been denominated in the distinct trademarked name and acquiring the unit of account role, imply that the issued certificates are not bank liabilities in the conventional sense since they are not to be paid in legal tender (Fantacci, 2019).

Hayek notes that the issuance of the certificates could be accompanied by the bank accepting the legal obligation to redeem them at the option of the holder for a specified amount of other (conventional government-issued fiat) currency(ies). Though redemption is not decisive, it may be necessary, at least in the beginning (Mayer & Bofinger, 2024). The rates of redemption will serve as the floor below, which the new currency unit will not fall. To accomplish this, the announcement of the conversion rates could be accompanied by a pledge to regulate the quantity (and thus the value) of the new currency units as represented by the certificates to keep their purchasing power, as nearly as possible, constant.

This redemption value would however be intended only as a floor below which the value of the unit could not fall because I would announce at the same time my intention to regulate the quantity of the ducats so as to keep their (precisely defined) purchasing power as nearly as possible constant Hayek (1990, p.46).

The bank could also commit to make known the commodity equivalence in terms of which the value of the currency unit will remain constant with the option to discretionarily vary the composition of the commodity standard based on experience and the preference of the public. This essentially means a commodity price standard (especially of raw material prices), determined and malleable to users' experience, time, and place, taking into consideration the relative importance, trade volume and relative price stability.

Hayek contends that if the banking firm has substantial assets to back the certificates and the public is confident of the firm's credibility, the issued certificates will be auctioned at a premium. As government currencies continued to depreciate in real terms, the premium on this privately issued currency would continue to increase, inviting competing private currency issuers with different named currencies to enter the market. After a regular market had been established, the new private currency would then be issued through ordinary banking businesses, such as through short-term loans.

Since borrowers will be apprehensive of the bank arbitrarily causing its currency to appreciate in terms of the commodity standard, the bank will have to explicitly commit to accepting in loan repayment either the nominal figure in its own currency or by

corresponding amounts in other currencies sufficient to buy in the market the commodity equivalent which at the time of making the loan it had used as its standard. This will serve to reassure borrowers (Hayek, 1990, p.47). This essentially means that loans will be indexed to the price of a commodity basket just as the currency unit.

To maintain the purchasing power of the privately issued currency constant, the amount issued would have to be adaptable to changing demand, which would be the benchmark for evaluating success or otherwise. By this, Hayek implies changing the quantity of the money stock to prevent excessive depreciation or appreciation of the currency. If the currency issuer shows enough commitment to maintaining the currency's value from the beginning, speculation and arbitrage would counteract any destabilising move, making the need for the issuer to intervene in this regard redundant (Fantacci, 2019).

If the bank was known for taking prompt and effective measures to correct any deviation, would lead to its efforts being assisted by more of its currency being demanded when it was expected to appreciate ... and less being demanded when it was expected slightly to depreciate Hayek (1990, p.61).

Hayek concludes that as long as the currency can preserve its purchasing power and leave it approximately constant, it will continue to be in demand as long as the public has a choice. This continuous demand will ensure that the bank can be trusted to make every effort to maintain the approximately constant purchasing power, which is more than what any monopolist will do.

From the foregoing, the essentials of the Hayek proposal for the institutionalisation of currency competition envisaged

- First, a competition among central bank issued fiat currencies and liberalised banking systems to permit inter-country branching.
- Private note issued by legally incorporated banks, public or private, with trademark laws protected currency units that issue certificates or notes to serve all functions of money, including unit of account.
- Competition among note-issuing banks will be based on the credibility of their promise to keep the value of their currency units stable.

- A commodity price standard will be applicable. It is, however, not necessary nor legally desirable for an issuer to tie itself to a specific standard. Rather, a periodic discretionary variation of the standard will be more desirable.
- The proposal for the institution of competing currencies is a proposal for competing currencies with a constant value to a commodity or a commodity basket rather than a fixed value.
- Since every currency will aim to keep the value of the currency in relation to a specific commodity basket constant, a floating exchange between and among the different currency units is implied, with the value of the currency unit varying as the price of the commodity basket in terms of other currency units vary.
- Also, as different currency units choose to peg the value of their units to different commodity baskets, customers will eventually learn to hold a collection of currencies representative of their consumption distribution.

In the “Market Standards for Money”, which is rarely cited, Hayek (1986) notes that he is still convinced of the merit of his proposal for the denationalisation of money. However, he concedes his proposal seems wholly utopian, with the possibility of governments relinquishing their monopoly over money in the foreseeable future unlikely. In this regard, Hayek (1986) downplayed the centrality of the issued certificates of notes in the trademarked unit to his proposal for the denationalisation of money. This, he ascribes to the proliferation of credit cards and current accounts, which makes it possible for a bank to offer a stable payment account without the necessity of issuing it on a circulating metal coinage or piece of paper. Hayek (1986) thus asserts that a “current account in stable units redeemable on demand in such amounts of the currencies generally used as required to buy a “basket” of raw materials and foodstuffs at spot prices determined at the international commodity exchanges and measured by a weighted index- will achieve the same results”. By this, Hayek (1986) is essentially suggesting a private store of value or a stable currency (coin) dependent on the price of a commodity or basket of commodities. This, Hayek contends, is more likely to survive the political obstruction to the proposal as expounded in the Denationalisation of Money.

3.4. Hayekian Currency Competition Before Cryptocurrencies

Hayek's proposal for the denationalisation of money expectedly invited criticisms and plaudits over the years. Some of the most significant commentary on Hayek's proposal from its publication until the dawn of blockchain and cryptocurrencies in 2012 are reviewed in this section.

One of the first reviews of Hayek's denationalisation of money was by Howard (1977). He criticised Hayek's proposal for failing to consider the possibility that people may not demand stable valued money, noting that debtors and creditors will have differing preferences regarding the stability of the monetary unit. This, he contends, might result in a preference for an unpredictable and, thus, unstable monetary unit. Howard (1977) also criticises Hayek for failing to consider interest rates. If interest is paid on the money produced by a competitive free market, then the interest rate differentials on these monetary units will result in monetary instability. One other front Howard (1977) criticised Hayek was his failure to consider the possibility of a dominant monetary supplier emerging, which could be facilitated by the information cost of monetary competition. The swiftness with which Hayek suggests his proposal be implemented was also criticised as failing to consider the fact that the governmental supply of money is a social institution which evolved to fulfil a need. In this regard, care must be taken in unwinding it even if it is no longer deemed useful (Howard, 1977). Howard (1977) caps his review with assertions that the international monetary system was competitive enough with several monies with different levels of stability held and used. This implies that the mere abolition of exchange and capital controls will seem to achieve the currency competition among government fiat currencies suggested in the first strand of Hayek's proposal without the unregulated private production of money.

Rantala (1980) compares Hayek's proposal and the free banking proposals of Murray Rothbard. Rantala notes that, whereas Rothbard asserts that only a commodity with independent desirability, particularly precious metals, can be money and considers all fiduciary money as a joke, Hayek's proposal is based on fiduciary paper money. Rantala (1980) then highlights some of the objections to Hayek's proposal and rebuts them as inconsequential, with the violation of Mises regression theory and Hayek's

refusal to entertain a role for gold (and any other precious metals) as the more serious criticisms. Rantala then attempts to outline their agreements, noting that they both see no role for governments in the production and management of money.

White (1983) notes Hayek's own remarks that the market is a discovery process and criticises him for pretending to know (predicting) the form of outside money that will result from a future free-market monetary system. He then terms Hayek's prediction on the type of money that might come to dominate under open competition as social science fiction and entrepreneurial speculation, not a prediction derivable from economic theory. Nonetheless, White (1983) asserts that this criticism is inconsequential to Hayek's most valuable message in the denationalisation of money. That is, there is no more effective check against the governmental abuse of money than if people are allowed the freedom to choose the money to transact in (White, 1983).

Friedman (1984), while agreeing with Hayek's fundamental proposition regarding changes in legislation to allow for the issue of private notes, is sceptical about the intended outcomes. Friedman opines that private firms will stand a chance of issuing money with fixed purchasing power only if governments, in turn, issue purchasing power securities that will constitute the underlying assets of the private firm. But governments have been lackadaisical. Even if governments were to issue such purchasing power securities in large quantities that private firms could rely on to issue their own distinct currencies, such currencies would constitute, in essence, government, not private money (Friedman, 1984). Friedman (1984), however, agrees fully with Hayek's first proposition. He suggests that the removal of currency control laws allowing for the use of different national currencies within national frontiers will drive out bad fiat money, especially in small economies. Friedman then goes on to rehash Hayek's (1990, p.41) argument that contrary to Gresham's Law that bad money drives out good money, in the absence of fixed convertibility and with floating exchange between currencies, the good money will drive out bad money.

In Friedman and Schwartz (1986), it is argued that the seigniorage and related inflation of fiat money is the cost economic agents are willing to pay to preserve the unit of account and the medium of exchange as they have become habituated. Thus, even when private money, as suggested by Hayek, does come to exist, economic agents may

still not abandon the publicly issued non-stable money due to habits. This assertion has been empirically documented by Luther (2013), who found that despite the lack of laws and even a government to prevent the use of foreign fiat currencies within Somalia, the Somali Shilling is still widely used. Luther ascribes this reluctance to switch to better-managed foreign fiat currencies like the dollar to the network effects and switching costs associated with such a switch.

Rothbard (1985), in making the case for a genuine gold dollar, notes that Hayek's proposal conflates money to all other goods and services. However, since conventional goods and services are demanded for their own sake, money is demanded precisely for its value in exchange. For any monetary unit to be acceptable as a medium of exchange, it must have originated from a commodity which was accepted on account of its non-monetary utility as outlined by Mises's (2009) regression theory. As such, the Hayekian ducat is a utopian invention that will not be accepted in lieu of the dollars, pounds and the Turkish Lira, which originated as units of weight of precious metals (Rothbard, 1985). Friedman and Schwartz (1986) and Rothbard (1985) stress that even if the Hayekian ducat was to be backed by gold or silver and thus based on a non-monetary commodity, wide acceptance of the ducat is still doubtful since economic agents have become habituated with the dollar and their respective currency units and will continue to use them even under revaluations. Thus, the only way to denationalise money is to denationalise the currency unit (dollar) by linking the dollar (and, for that matter, all national currencies) to a useful market commodity such that the fiat paper tickets are made to represent the weight of some precious commodity (Rothbard, 1985).

Vaubel, in Klausinger and Vaubel (1997), contends that Hayek's proposal for competition among government central bank currencies was far more influential and much more central in his proposal than usually given credit for. Specifically, Vaubel also notes that Hayek's proposal for competition among governmental fiat money contributed to several theoretical and practical developments, including the demise of international macroeconomic policy coordination in the 1980s and increased scepticism regarding policy harmonisation, among others.

Issing (1999), in a speech at the Institute of Economic Affairs in memory of Hayek, highlights the main features of the denationalisation of money and interprets it in relation to Hayek's previous writings. According to Issing (1999), Hayek views coordination as the most basic problem of economics. Solutions to this coordination problem are sought from competition through the market with prices as signals. However, prices are quoted in currency units, which essentially act as the measuring metric. In the presence of inflation or deflation, this measuring metric keeps changing and results in a changing unit-of-account-language for which the unit of account of money provides the foundations. This invariably impairs the efficiency of the common money language and, thus, the coordination of the economy. Thought of from this point, the unit of account function of money is a public good. The medium of exchange and store of value functions have, however, been supplied not exclusively by private enterprises (Issing,1999). Thought of from this point, the crust of Hayek's (1990) proposal aimed to privatise and, as such, stabilise the unit of account role of money to provide a stable unit of account language in the market coordination process.

Issing (1999) then raised questions about some aspects of the proposal. Particularly the workings of the proposal during the discovery process, which Issing argues will be inherently unstable. Also, noting that the real rate of interest will tend to vary across the business cycle in response to demand for loans, so too will the rate of deflation. This is especially so if one is permitted to doubt that the private sector discovery process is itself unstable. Issing also contends that aside from Hayek's failure to consider the role of network externalities, the currency competition as proposed by Hayek is likely to result in as many numéraires as there are currencies, which will deceive the goal of having a measuring metric for economic coordination. With this, Issing concludes that it appears Hayek's goal for the proposal would not be achieved even if it were to be implemented.

Azariadis et al. (2001) construct a pure exchange three period lived overlapping generations economy to test the comparative validity of Friedman, Hayek, and the real bills doctrine. Particularly, their model tested the assertions of Friedman, who, in contrast to Hayek, argues that allowing for the private provision of near-money instruments can generate indeterminacy of equilibrium and "excessive" volatility (Azariadis et al., 2001). Their results showed that circulating privately issued near

money is associated with endogenous volatility. However, completely excluding these privately issued near-money substitutes was found to result in significant inefficiency (Azariadis et al., 2001). Far from vindicating Hayek, a privatised monetary system was also found to be sub-optimal. They concluded that both public and private outside and inside money were required for optimality.

Cohen (2001), in commenting on electronic money, notes that there is no reason to believe that currency competition by private note-issuing firms, as suggested by Hayek would produce better outcomes than traditional central banks. However, there is evidence to suggest that such competition might be worse, with the most likely outcome being even more inflation emanating from inter-firm rivalry for seigniorage. Nonetheless, Cohen (2001) believes that the end of the dominance of governmental control of money is near, with Hayek's vision of a world of unrestricted currency competition becoming a reality for better or for worse. Dagum (2002), on the other hand, concludes that Hayek's proposal could lead to a private monopoly of money creation without appropriate regulation.

Martin and Schreft (2006) employed a general equilibrium monetary model to test for the existence of equilibrium under monopolist and competitive note issue. Their results showed that privately issued outside money does have an equilibrium if agents believe there is a threshold such that all notes issued up to that threshold have value and any issued note after that threshold to be worthless. This essentially implies the existence of a threshold where the marginal utility of money reaches zero (Martin & Schreft, 2006)

On the stability of Hayekian Ducats, Stephen Ferris and Galbraith (2006) re-examine the criticisms of Hayek's proposal, especially as levelled by Rothbardian free bankers declaring that the criticisms of Hayek's ducat for being non-redeemable is, based on an incomplete examination of what makes a money promise effective. They note that inspirations from the workings of inflation targeting by central banks could be used to handle policing problems posed by non-redeemable money. This can be done by developing an enforceable performance contract, which will eventually become industry standards for dealing with the complications of multiple monetary units.

Endres (2009), on his part, notes that the growth in financial innovation, which led to a decrease in cross-border information and transaction costs, has decreased the threshold of efficient cross-border transaction values. This decrease has resulted in an increase in the magnitude and frequency of cross-border movement of capital and funds, making national currencies within borders less independent and, as such, more competitive (Endres, 2009). This has created an international financial and monetary system characterised by currency competition and substitution and the use of parallel currencies in some border regions (Endres, 2009). This competition with national currencies competing for international use is, in many respects, what Hayek proposed in his denationalisation of money, which called for the removal of legal impediments to allow for the use of foreign-issued fiat currencies within national frontiers (Endres, 2009). Endres (2009) stresses that beyond the idealised version of currency competition proposed by Hayek (1990) to allow for the private issue of money, he did hold a preference for the transnationalisation of currencies, which Friedman (1984) re-stated as the alternative (Endres, 2009).

Gomez and Budd (2012) examine the implications of electronic money and free banking for central banking. Free banking, as used by Gomez and Budd, seems to imply both the Hayekian and Rothbardian variants. They also talk of contestable central banking, which may act as a route to transitioning to free banking. They concluded that e-money shares some key similarities with the propositions of free banking and could nudge central banks towards free banking practices going forward.

From the foregoing, it can be concluded that Hayek's proposal in the Denationalisation of Money has been criticised for being unrealistic in the sense that its implementation will not achieve its intended purpose (Issing, 1999) due to its ignorance of the impact of interest rate differentials (Howard, 1977), network effects might result in a dominant (private) monetary supplier with all the negatives of monopoly (Howard, 1977), and that it assumed without justification that stable currencies will be demanded (Howard, 1977). Also, the proposal has been criticised for failing to satisfy the regression theorem (Rantala, 1980; Rothbard, 1985) as proposed by Mises (2009) and for making no room for the role of gold (Rantala, 1980), being presumptuous and prejudicious on the outcome of the market discovery process (Issing 1999; White, 1983) and for having highly doubtful mechanics (Friedman, 1984). Aside from these, the proposal has also

been criticised for failing to consider the impact of habits (Friedman & Schwartz, 1986) and that interfirm competition may lead to inflation (Stephen Ferris & Galbraith, 2006).

On the plus side, it has been praised for its foresight (Endres, 2009; Gormez & Budd, 2012; Klausinger & Vaubel, 1997), and influence on several positive developments in the international monetary system (Klausinger & Vaubel, 1997), contestable central banking (Gormez & Budd, 2012) and that the vision of the proposal may actually be realised (Cohen, 2001; Gormez & Budd, 2012). The criticism of the lack of stability and equilibrium has also been discounted by Martin and Schreft (2006), while the criticisms of its non-redeemability have been rebutted by Stephen Ferris and Galbraith (2006).

It does appear that the reception of the Denationalisation of Money was that of criticisms and scepticisms from the start. This, however, gave way to cautious reconsideration and perhaps grudging acceptance as the internet revolution transformed the financial industry and electronic payment systems became widespread. This shift in thought happened even before the proliferation of the blockchain and its supposed private monies.

Even so, the revision of the proposal by Hayek (1986) has grandiosely been overlooked by many authors. In Hayek (1986), the centrality of the means of payment and even the unit of account role of privately issued currencies are downplayed in favour of the store of value role as depicted in his proposal for the Standard Account Limited (SAL).

3.5. The DeFi Revolution: Terminologies, Framework and Stablecoins

The term disruptive technology is used for innovations that alter or promise to alter the way and manner industries, firms, consumers and regulators behave and interact. Per this, blockchain is envisaged to be disruptive and comparable in scale to the internet (Arooj et al., 2022). One of the key elements of the blockchain revolution is the proliferation of new terminologies to describe the new markets, products, and governance of the blockchain ecosystem. Prominent among these new vocabularies is Decentralised Finance (DeFi). In the blockchain ecosystem, DeFi is hard to define

(Katona, 2021) and a generic term/concept used to describe all blockchain-based financial services operating in a peer-to-peer fashion without centralised authority (Corbet et al., 2023). OECD (2022) attempts to define DeFi based on the features that differentiate DeFi from traditional financial services. These features are non-custodial, self-governed, community-driven, and composable. Schär(2021) views DeFi as an open, permissionless and highly interoperable smart contract platform built on a public blockchain such as the Ethereum blockchain (Schär, 2021), while Katona (2021), upon an extensive review of the literature, concludes that DeFi can be said to be the (eco)system of public, permissionless, Distributed Ledger Technology(DLT)-based, interoperable protocols and decentralised applications(dApps) built upon them for the provision of financial services. From these definitions, it can be stated that DeFi is a new kind of finance that does not rely on intermediaries. Instead, it creates avenues for parties to enter contracts, settle and transact business directly over blockchain-based applications using blockchain-based verifications.

Schär (2021) develops a framework for analysing the building blocks that make up the architecture of DeFi, as depicted in Figure 2.2. According to this framework, the foundation of DeFi is the settlement layer. The settlement layer consists of the blockchain and its native protocol asset and allows the network to store ownership information securely and to audit state changes to ensure that the system's rule sets are adhered to (Schär, 2021). Thus, the settlement layer is the foundation of DeFi and houses the operating rules of the ecosystem (Katona, 2021).

On top of the settlement layer is the asset layer. The native protocol assets (cryptocurrencies) and additional assets(tokens) are issued on the asset layer (Schär, 2021). For example, on the assets layer of Ethereum, Ether, the native cryptocurrency of the blockchain and other fungible (ERC-20) and nonfungible (ERC-721) tokens are issued. The native(primary) crypto asset of a blockchain is often referred to as the cryptocurrency of the blockchain, and other (secondary) fungible and nonfungible assets issued on the blockchain are referred to as tokens. Tokens are referred to as such because they are tokenised versions of real or virtual assets and promises and can be transferred more easily and more efficiently. This makes tokens fundamental to the functioning of the DeFi ecosystem (Schär, 2021). Corbet et al. (2023) and Ozcan et al. (2022) contend that DeFi tokens constitute a different class of assets. This is because

of their usage beyond the speculative (capital gain motive) and the medium of exchange role most cryptocurrencies like Bitcoin have assumed to include a wide array of financial transactions like lending and borrowing, spot, margin and derivative trading, provision of interest-earning assets and market making (Corbet et al., 2023).

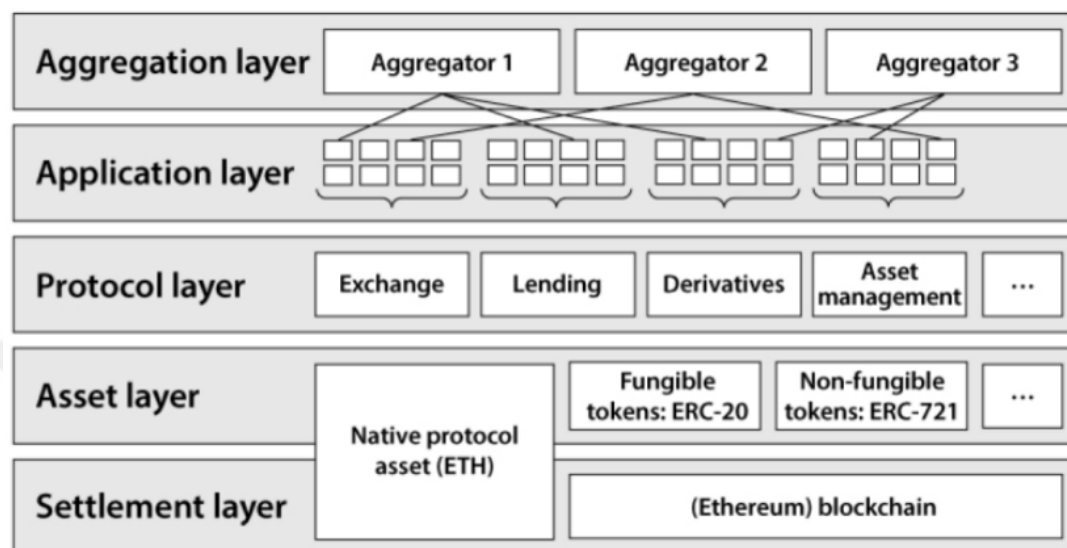


Figure 3.1. The Architecture of DeFi

Source: (Schär, 2021).

The third layer, the protocol layer, provides standards for specific use cases through smart contracts. A smart contract is a contract written in a computer program with automatic execution subject to certain conditions (Zheng et al., 2020). This contrasts with conventional contracts, which normally require a third party, often an intermediary, to act as a repository and enforcer for the contracting parties. Smart contracts are built and implemented on the protocol layer and allow for automatic execution of these contracts once certain specific conditions are met (OECD, 2022; Schär, 2021). The multitudes of functions of the DeFi ecosystem are thanks to the protocol layer's customizability, which allows smart contracts to be written and deployed. In the blockchain, smart contracts are designed in the form of small applications stored on a blockchain and executed in parallel by a large set of validators. Smart contracts can store crypto-assets, function as custodians, and can be customised to include how, when and to whom such assets can be released using extensive and exhaustive instructions (Schär, 2021).

The last two layers are the application layer and the aggregation layer. The application layer is where front-end-based mobile and web applications are developed to connect individual protocols and allow for easy usage, while the aggregation layer connects several applications and protocols for comparison (Schär, 2021). Thus, the aggregation layer gathers information from several protocols and applications to allow for comparison and a broader view.

As already stated, the acclaimed functions and versatility of the DeFi ecosystem are thanks to the protocol layer. This allows for the customisability and deployment of blockchain-based financial services and instruments (DeFi) as diverse as traditional centralised finance and even more with money-like instruments with fluctuating values like Bitcoin, cryptocurrencies that are tokenised versions of tangible assets and/or fiat currencies like Digix Gold Token (DGX) and Tether (USDT) respectively.

The differences in blockchain-based financial instruments and services have resulted in the categorisation of these services/instruments based on characteristics and based on functions (Fokri et al., 2021). Sockin and Xiong (2023), for example, distinguish between tokens, coins and altcoins. Tokens are intrinsically beneficial utility and native currencies accepted on decentralised digital platforms (Sockin & Xiong, 2023). Coins customarily mean Bitcoin, and altcoins normally mean any other cryptocurrency with its own blockchain other than Bitcoin.

Functionally, DeFi services and instruments seek to replace traditional Centralised Finance (CeFi) with crypto entrepreneurs designing DeFi services to mirror those in CeFi. For example, blockchain-based exchanges, especially decentralised exchanges like Uniswap, are noncustodial platforms that seek to replace money and capital markets and the services they provide by automating the complicated and often multi-layered process of escrow servicing, brokerage, clearing and settlement (Broadbent, 2016).

The greatest excitement and nightmare of the blockchain revolution is, however, in the money and banking sector, the sector which the original creator of Bitcoin and blockchain technology intended to revolutionise. In the money and banking sector, cryptocurrencies like Bitcoin, intended to serve as money, leave much to be desired

due to their extreme price volatility, strong price correlation to Bitcoin, the first cryptocurrency ever invented, and often slow and tedious transaction confirmation time. These problems impede their use as a means of exchange (Bode et al., 2021). Specifically, stability is essential because most financial contracts require a low-volatility asset (Schär, 2021), and the speculative and highly volatile nature of the native protocol assets like Bitcoin (BTC) and Ether (ETH) are unappealing in this regard. Aside from these, traditional cryptocurrencies are not expected to acquire the qualities of a unit of account due to the inbuilt advantages of existing currencies (Broadbent, 2016).

However, a specialised kind of token asset, the stablecoins, appears to have an urge over native cryptocurrencies to become “private money”. This is because stablecoins are designed to overcome the usual volatility characteristic of cryptocurrencies. Also, confirmation time and processing are much less tedious than cryptocurrencies. Stablecoins are fungible tokens for which issuers strive to keep their values proportional to the values of an anchored fiat currency or other commodities (Aramonte et al., 2021). Thus far, the majority of stablecoins are pegged to the US dollar and other fiat currencies (Liao & Caramichael, 2022). However, an increasing number of stablecoins are pegged to commodities like gold and even a basket of consumer goods (e.g. Frax Price Index, FPI). The relative stability provided by stablecoins enhances their role as a medium of exchange (Kim et al., 2022). Also, stablecoins are particularly attractive to investors who are upbeat about the benefits of blockchain technology and who value the stability of traditional financial markets (d'Avernas et al., 2022).

The entire business model of stablecoins is based on issuers/platform's ability to meet expectations (Hayek, 1990, p.48) by keeping the value of the stablecoin linked to that of the anchor currency or commodity. For an issuer or platform to continue to be in business, it will therefore depend on users'(customers') perception of the ability and willingness of the issuers to deliver on its promise. This creates issuer risk (Schär, 2021) and creates problems similar to that faced by a central bank under a fixed exchange rate regime (d'Avernas et al., 2022; Obstfeld, 1996). To mitigate this risk, issuers of stablecoins must guarantee their promises using some sort of a backing

model. The three (3) prominent backing models are algorithmic (no) collateral, on-chain collateral, and off-chain(custodial) collateral (Schär, 2021).

No collateral stablecoins claim to employ on-chain algorithms to maintain the value of the coin by minting coins in times of high demand to counteract (realised and foreseen) appreciation in the value of the stablecoins and burning stablecoins to counteract (realised and foreseen) depreciation in the value of the stablecoin. This decrease and increase in the supply are achieved by the issuer issuing a second type of asset, typically a bond, and selling it against the stablecoin in order to reduce aggregate supply and thereby maintain the value (Berentsen & Schär, 2019). Thus, algorithmic stablecoins attempt to stabilise a falling price by promising to increase the future supply of the stablecoin. This essentially means that the issuer's promise is taken at face value with nothing to mitigate counterparty risk. The promise is entirely trust-based (Schär, 2021). This simplifies many logistical challenges and makes the operation of the platform cheaper (Kozhan & Viswanath-Natraj, 2021). This is, however, less convincing (Berentsen & Schär, 2019), and once users' expectations change due to some design flaw or idiosyncratic changes in sentiment, the value usually sinks at a swift pace since there is no inherent redemption value (Kozhan & Viswanath-Natraj, 2021).

The second collateralisation method is the on-chain collateral method. This requires an underlying crypto asset that is locked in a smart contract for the stablecoin to be issued, and the locked collateral is liquidated and used to burn the stablecoin if the value of the locked asset falls below a certain threshold. This makes the entire system decentralised and allows for easy diversification across backing assets (Kozhan & Viswanath-Natraj, 2021). Berentsen and Schär (2019) note that the economics of an on-chain collateral system seems sound, but there exist some risks, like faulty smart contracts, that could result in unexpected behaviour. Also, an on-chain collateralised stablecoin will necessarily need price feeds from an exchange or number of exchanges to determine the value of the locked assets. An attack or malfunction of these exchanges will necessarily result in a mistaken price calculation and, thus, behaviour. Aside from these, the volatility of the digital collaterals can make it hard to guarantee a value for the stablecoin (Kozhan & Viswanath-Natraj, 2021).

The third collateralisation method, the off-chain/custodial collateralisation method, relies on off-chain storage of an underlying asset with an escrow service like a commercial bank (Schär, 2021). The underlying assets mostly used to back the custodial stablecoins are bank deposits, treasury bills, certificates of deposits, commercial paper and/or other crypto assets. A centralised designated intermediary, often a company incorporated by the issuer, is often designated to manage these reserve assets and the issuance and redemption of the stablecoin (Aramonte et al., 2021; Kellerman & Seddon, 2022). The majority of stablecoins use this backing model, including the first ever stablecoin, Tether, which is minted by Tether, a subsidiary of iFinex Inc. Gemini USD, another custodial stablecoin, claims to be supervised and regulated by the New York State Department of Financial Services (NYSDFS).

The custodial, centralised (and regulatory-seeking) stablecoins like Tether and GUSD have been criticised by crypto idealists as being fundamentally inconsistent and antithetical to the goals of the blockchain financial revolution (Kellerman & Seddon, 2022). For these crypto idealists, the DeFi ecosystem ought to be a democratising force that should wrestle control of the monetary system and financial services from monopolised central banks and centralised financial interests in line with illegibility-seeking ideals. Thus, the custodial stablecoins have been described, and rightly so, as centralised stablecoins since they rely on traditional, regulated financial firms to store and manage the reserve assets. DeFi stablecoins, in their truest sense, imply the algorithmic and on-chain backed stablecoins since they are intermediary-free.

Beyond the often misclassification of custodial stablecoins as DeFi, the off-chain, custodial collateralisation model can be problematic (Berentsen & Schär, 2019). Critics of this backing model contend that the veracity of the issuers' claims is often questionable, and the scepticisms and suspicions can only be addressed by employing the services of external auditors. These services can be expensive to procure. Also, storing the assets used to back the stablecoin in an escrow like a bank creates a central point of attack for governmental agencies and private hackers. Berentsen and Schär (2019) also contend that an issuer of a fully off-chain stablecoin will likely be tempted to engage in fractional reserve banking to sustain profitability, which will not be any different from the traditional centralised banking architecture currently the norm.

3.6. Cryptocurrencies and Hayek's Ducat

The emergence of cryptocurrencies has triggered a wave of interest in privately issued monies and the economics of analysis same (Fernández-Villaverde & Sanches, 2019; Sanches, 2018). Some commentators now contend that cryptocurrencies are the realisation of the final strand of Hayek's proposal in the Denationalisation of Money. However, cryptocurrencies are a broad class of assets with different structures and operations.

Considering these features and structures of cryptocurrencies, it is reasonable to assume that Hayek and most Austrian economists would have rejected the contention that Bitcoin and altcoins are money. This is because Hayek's proposal was for government and private competition in the provision of money, not a wholesale replacement of government-supplied and regulated money with computer-programmed supply of money, as is the case with Bitcoin and other altcoins. Also, Hayek (1990) envisioned a private note issuing bank. That is a private, legally incorporated firm regulated per the company laws of the country and that strives to keep its issued notes stable. Bitcoin and altcoins have no legal entity backing, which strives to keep the value of their issue (cryptocurrencies) stable. Hayek's ducat is also envisioned to be on a commodity price standard such that its value is pegged to a publicly and internationally traded commodity. Bitcoin and altcoins certainly do not meet these criteria. While cryptocurrencies like Bitcoin and other altcoins are on a floating exchange regime with conventional fiat and other cryptocurrencies, that alone is insufficient to consider them similitudes to Hayek's ducat.

Contrary to Bitcoin and altcoins, stablecoins aim to keep their values stable against a commodity (or a fiat currency). In this regard, stablecoins and Hayek's ducat are united in purpose. However, the stablecoin ecosystem is itself diverse (see Kochergin, (2020) for a detailed exposition) with algorithmic, on-chain collateralised and off-chain collateralised stablecoins. While Hayek envisions a legally incorporated firm with assets based on which private notes are issued and managed, algorithmic and on-chain collateral stablecoins have no registered firms legally responsible for their issuance and management. As such, they are not exactly what Hayek envisioned.

The off-chain collateralised, and centralised institutions managed stablecoins with issuing firms legally incorporated can be said to be the closest realisation of Hayek's ducat. Such stablecoins' Initial Coin Offerings (ICO) are often issued by legally incorporated firms or their subsidiaries as a liability (Liao & Caramichael, 2022) against the assets of the firm akin to the issuance of trademarked, non-interest-bearing redeemable assets that Hayek contends could be used as money. Even more, the trademark and the currency units are in the form of cryptographic secured and protected digital units which are robust to counterfeiting, thus solving the most daunting problems faced by private money issuers in previous private money experiments (Fernández-Villaverde & Sanches, 2019).

Endres (2009) notes that Hayek's conceptualisation of currency competition is largely a competition for reputation or goodwill, and thus, Hayekian competition is all about credibility. This is because money offers services to its users who confer a reputation on them based on experience. As such, competition, in general and in the realm of money, is a process of opinion formation based on the availability and dissemination of information. Centralised stablecoins inherit the reputation of the entity that undertakes and conducts the ICO and manages the reserve assets. With sufficient saturation, centralised stablecoins operators who do not prove sufficient reserve backing and credibility will be pushed out of business, just as Hayek envisaged.

Thus far, most stablecoins are pegged to the US dollar. However, an increasing number of stablecoins are being pegged to commodities (e.g. gold by Tether Gold⁴ and HayekGold⁵) and consumer baskets (e.g. Frax Price Index⁶). This real commodity price (rather than fiat currency) pegged stablecoins are, in all respects, the exact similitudes of Hayek's propositions.

⁴ <https://gold.tether.to/>

⁵ https://tracxn.com/d/companies/hayekgold/___YW6PryShiQa6vSnPBnEwvvOJ7JKpASYEoJ8X7fhEkbk

⁶ <https://app.frax.finance/>

3.7. Hayekian Currency Competition: A Re-assessment in the Era of Blockchain

This section reviews the literature on Hayek's(1990) proposal in light of the cryptocurrency revolution that gained momentum with the Bitcoin bubble of 2013 (Gandal et al., 2021; Nakayama, 2018). While the commentary on the Denationalisation of Money from its publication in 1976 to the proliferation of electronic money was mostly sceptical, it has become the reference work on the new and blockchain-based financial and monetary revolution (Sanz Bas, 2020).

Nonetheless, some of the criticisms that have been levelled against the proposal over decades are still valid. Luther (2013), for example, uses Somalia as a case in evidence in support of Friedman and Schwartz (1986) criticisms of the proposal in failing to consider the impact of habits and network effects. Badescu (2014) notes that the biggest downside of Hayek's (1990) proposal is that it has no precedent. This lack of precedence, and as such, lack of empirical data, impedes its assessment. This, however, does not mean it cannot be implemented but casts doubt on its underlying concepts (Badescu, 2014). This criticism, though not entirely belied, is becoming increasingly untenable. This is because of the changes in the money and finance sector with the penetration of electronic and cryptocurrencies, which are generally now viewed as at least money substitutes.

Malekzadeh (2015) notes the increasing criticisms levelled against the government monopoly over money supply since the 2008 Global Financial Crisis and its implications for the future. This, it is noted, is leading to an increasing number of people to think of virtual currencies as a possible challenger to monopolised central bank fiat currencies. This increasing optimism is despite the illegibility of virtual currencies and the empirical failure of the Austrian Business Cycle Theory (ABCT), the underlying theory that informed the proposal. Malekzadeh (2015) also notes that the illegibility and security concerns of virtual currencies are also prevalent in the conventional fiat-based financial system and, as such, is not a strong case against virtual currencies.

Polleit (2015), it will seem a Rothbardian free banking apologist and a Misesian praxeologist, offers a praxeological critique of the Denationalisation of Money. Polleit

(2015) notes that although Hayek's call for the end of governmental monopoly over money issue is commendable, his ultra-subjectivist approach exposed his proposal to avoidable criticisms. For example, Hayek's ultra-subjectivist approach led to an illusionary view of the relationship between the state and money. For Polleit (2015), a free market in money and a state with the territorial monopoly over coercion are incompatible. Also, Hayek's proposal is noted to conflate money proper, monetary stuff with non-monetary uses, and money substitutes, warehouse receipts of monetary stuff. In this regard, money issuers, or more appropriately, money warehouses, will compete in terms of money substitutes rather than money proper, as suggested by Hayek (Polleit, 2015). On Bitcoin and virtual currencies, it is concluded that "coloured" Bitcoin, cryptocurrencies that represent physical assets such as gold, as money substitutes might become the disrupter to the state's money monopoly in the sense of a Hayekian monetary competition (Polleit, 2015).

Dowd (2015) describes Hayek's proposal as groundbreaking and enumerates some of the ways that have been suggested to tackle cryptocurrency (Bitcoin) volatility to achieve the stability required by Hayek's proposal. It is noted that a change to the cryptocurrency algorithm to cater for demand volatility will remove one of its serious deterrents to widespread adoption as a currency.

Borroni and Seghesio (2016) examined the legal implications of cryptocurrencies in line with Hayek's proposal and declared that governments should not impede "progress" nor seek to harness cryptocurrencies and the blockchain for harmonisation. Instead, they should intervene lightly to support the trend. Borroni and Seghesio (2016) further declared that efficient regulation will mean a regulation that does not seek to damage their best feature, which is flexibility and freedom. This, they claim, will in essence be a modification and re-interpretation of Hayek's proposal to soften the potentially dangerous consequences of the proposal.

Issing (2016) re-examines Hayek's proposal and concedes that currency competition among national monopoly currencies has been tested for years, is advantageous, and must be advocated. However, his suggestions on the wholesale privatisation note issue as a remedy to his insightful diagnostics of the causes and implications of governmental monopoly over note issue is less endearing. Instead, erecting barriers

against public spending and the promotion of independence of note-issuing central banks is suggested as the best strategy to block governmental access to the source of money creation. Issing (2016) further highlights the conditions that might result in instability of privately issued competitive money issue.

According to Nakayama (2018), Hayek envisioned a coexistence between private and public fiat monies rather than a replacement. Fantacci (2019), after expatiating on the aims and nature of Hayek's proposal, criticised the proposal for failing to entertain the possibility that private note over issuance could be used to purchase financial assets, leading to an overissued but stable value in terms of the basket of commodities whose price the currency is pegged to. Fantacci (2019) also invokes the invalidity of Gresham's law in the case of floating exchange rates but with a different interpretation from that advanced by Hayek. According to Fantacci, precisely because good money drives out bad money, people might likely confirm the monetary character of the bad money by preferentially using it as a means of payment while keeping the high-quality money as a store of value. Thus, the preference of users would likely be directed at currencies that are likely to appreciate (Fantacci, 2019). Examining Bitcoin in light of the proposal, Fantacci (2019) declares that Satoshi Nakamoto and Hayek were in agreement regarding their distrust for the governmental supply of currency. However, while Hayek envisaged private participation in the provision of monetary services, Satoshi envisaged an intermediary-free arrangement independent of third-party trust, whether governmental or private. Also, while Hayek advocated a stable currency, Bitcoin is intrinsically deflationary due to its predetermined supply (Fantacci, 2019). Contrasting cryptocurrencies to the Hayekian competitive currency proposal, Fantacci (2019) contends that Hayekian private money is issuer liability while cryptocurrencies do not represent issuer legal liability. As such, cryptocurrencies do not reflect the Hayekian currency competition. Fantacci (2019), however, failed to consider the possibility of blockchain-based stablecoin arrangements like USD Tether, which have private legally registered intermediaries and are designed to be stable as Hayek proposed.

Brunnermeier et al. (2019) distinguish between full monetary competition and reduced money substitute competition and note that Hayek envisaged full competition. This competition will entail distinct currencies (units of accounts) competing for use as a

store of value. Brunnermeier et al. (2019) note that the use of currencies exhibits strong network externalities. These externalities are often made worse by switching costs. These costs are, however, much lower in the digital space, with modern technology making frictionless transactions possible and weakening the rigidities that have hitherto impeded traditional currency competition. They note that the network externalities that were hindrances to currency competition in the traditional sense can be an enhancer of digital currency competition. Also, they suggested that there is unbundling in the monies of the internet with currencies specialising in certain roles. This has the potential to result in even fiercer competition along specialised roles than that envisioned by Hayek (1990). This appears to have merits, with stablecoins competing as stores of value and Bitcoin and altcoins competing as speculative investment instruments. The interoperability of CBDCs on public and private blockchains could also initiate a unit of account competition, at least among national CBDCs.

Sanz Bas (2020) reviews Hayek's proposal and highlights its unsatisfactory treatment of the implications of network effects and its apparent presumption that the legalisation of private money will lead to the demise of governmental fiat money. Sanz Bas (2020) then reviews the cryptocurrency ecosystem and outlines several points of convergence between the proposal and cryptocurrencies. Particularly, Sanz Bas (2020) notes that Hayek and cryptocurrency developers and advocates (like Satoshi Nakamoto) are united in their philosophy, with both openly questioning government prerogative over money issue. Both Hayek and crypto entrepreneurs see a competitive monetary environment with none of the monies being exclusive legal tender. They are also united in their distaste for activist monetary policy and the substitution of confidence in monetary issuers by other factors such as trust in a competitive process or in an algorithm (or struggle for market share). Sanz Bas also concluded that contrary to general thought, Hayek's proposal is reflected more in custodial stablecoins rather than cryptocurrencies like Bitcoin and Altcoins. Sanz Bas (2020) further declares that the proposal in the Denationalisation of Money is a clairvoyant guide in our efforts to understand the new world of monetary competition. It is, however, worth mentioning that Hayek's ducat will not lead to the demise of governmental fiat money, as asserted by Sanz Bas (2020). Rather, Hayek envisaged coexistence rather than replacement (Nakayama, 2018).

Peneder (2022) examines the Austrian, particularly, Hayekian currency competition and the evolving digital currency ecosystem and notes the tendency for successful digital platforms to leverage their dominant position in one area to extend their competitive advantage in other areas. Particularly, economies of scale and network effects lead to the emergence of a dominant unit of account (Peneder, 2022). Norkus (2022) takes up the monetary nationalism and denationalisation debates and concludes that an era of a dethroned governmental and imperialistic monetary system by cryptocurrencies is still out of reach.

dos Santos (2023) examines Hayek's proposal and the growing digital landscape and concludes that one cannot help but be amazed by how a conflation of political, institutional, and technological developments have all aligned to bring Hayek's vision to life, especially as it relates to stablecoins. Parker (2023) examines the commonalities and implications between Hayek's proposal and cryptocurrencies and notes that recent work is supportive of Hayek's thesis that competitive currency markets can lead to more stable and efficient monetary systems. Kumah (2023) notes that the proposal in the Denationalisation of Money was initially overlooked because of the presumption that it was a curiosity rather than a workable idea. The advent of blockchain has since brought that utopian curiosity to life. Kumah (2023) also employs an Ensemble Empirical Mode Decomposition (EEMD) to decompose the exchange rate of the dollar with several African fiat currencies and applies a quantile regression (QR) and quantile-in-quantile regression (QQR) to examine the connections between Bitcoin and the currencies under different regimes. It was concluded that Bitcoin is a viable alternative to the reserve currencies of most of these currencies. As such, Bitcoin could be considered for hedging depreciation in the medium term (Kumah, 2023).

Mayer and Bofinger (2024), after reviewing Hayek's proposal, empirically examined the level of competition among cryptocurrencies. It was found that while cryptocurrencies like Bitcoin and Ethereum compete as speculative investment instruments, stablecoins are competitors to serve as a store of value. However, competition on the medium of exchange front is less pronounced, with monopolistic tendencies within specific submarkets, perhaps due to networks.

Based on the literature, therefore, it can be concluded that the reception to Hayek's proposal has been acerbic criticism prior to the proliferation of electronic money and cryptocurrencies. Post cryptocurrency proliferation, however, the focus of the literature has shifted towards critical re-examination, re-interpretation, modification, commendation and sometimes apprehension.

3.8. Legibility, Stablecoins and the Future of Currency Competition

Global monetary and financial architecture, from after the Second World War to at least the collapse of the Smithsonian agreement, has always been about standardisation. Since the collapse of the Smithsonian Agreement, it has often been argued that the global financial system entered a "no system" era (Angeloni et al., 2011). This is, however, inaccurate since, in principle, most developed economies up until now still coordinate their economic and monetary policies. Developing and emerging economies, on their part, have had to and have been following the lead of the coordinated economic policy actions of the developed world since. This pursuit of international standardisation (in the monetary and financial sector and almost all other fields) and centralisation can be thought of as a climax in what Scott (1999) considered the pursuit of legibility by modern states and an attempt to simplify and centralise the classic state functions of taxation, conscription, and the prevention of rebellion.

Scott (1999) argues that the simplification and centralisation in early modern European statecraft enhanced and permitted finely tuned systems of taxation and conscription, thus enhancing state capacity. This certainly has its positives but can often backfire. Scott (1999) recounts a litany of state standardisation and centralisation drives aimed at improving conditions that have turned out to be disasters. In contrast to the state's pursuit of legibility, illegibility can often be a valuable resource for political autonomy and has always been sought by individuals who seek not to be "governed" (Scott, 1999, p.54). Though not explicit, market actors and their actions are often motivated by (an ideological) search for legibility or illegibility (Kellerman & Seddon, 2022). Pinto and Sobreira(2010) contend that innovations in the financial industry are often exploitative of regulatory (legibility) loopholes.

Kellerman and Seddon (2022) note the distinction between Centralised Finance (CeFi) actors and Decentralised Finance (DeFi) actors, with CeFi actors operating through traditional firms with centralised structures and processes while DeFi actors operate through illegible decentralised, ungoverned spheres (Kellerman & Seddon, 2022). Also, CeFi actors often seek innovations that are more legible and align with the state's goals of facilitating control, resource appropriation and rebellion prevention. DeFi actors (activists), on their part, often seek strategies of illegibility and appropriation-proof spaces to escape state-based governance (Scott, 2010). Kellerman and Seddon (2022) then contend that market actors often gyrate between centralised, state-based legal frameworks and decentralised spaces operating outside the regulated sphere.

Bitcoin and the blockchain are clearly illegibility-seeking innovations, with Nakamoto (2008) bemoaning the almost exclusive reliance of internet commerce on centralised, third-party financial institutions and the cons of this financial and global financial (commercial) architecture. Nakamoto (2008) makes a case for the use of an electronic payment system that relies on cryptographic proof instead of third parties, as this would allow any two willing parties to transact directly with each other. The fact that Satoshi Nakamoto published the Bitcoin Whitepaper and its implementation in the blockchain pseudonymously is indicative of the objectives and angst of his proposal and its implications.

According to Kellerman and Seddon (2022), centralised, custodial stablecoins like Gemini and Tether and many CeFi actors as a strategy seek to make new market concepts legible to states and incumbent firms. This is done through centralisation and by translating, intermediating, and snitching on DeFi actors. Thus, whereas DeFi actors seek illegibility by segregating, anonymising, and stymieing markets, CeFi actors seek legibility by snitching, intermediating, and translating the novel processes of DeFi actors to states. This results in a tug-of-war. This tug-of-war between DeFi and CeFi is not always about business interest and governance but could also be informed by ideological stances on states vis-a-vis markets.

Beyond the private CeFi actors, governmental organisations continuously seek to expand regulatory spheres to cover the illegibility-seeking actors as a means to ameliorate stability risks and/or increase the power of the state through taxation. On

stability, centralised stablecoins serve as points of entry and exit where fiat currencies are converted into and out of the crypto ecosystem and thus can make the boundaries between the blockchain-based crypto economy and traditional finance more porous, increasing the risk of spillovers (OECD, 2022). Being the link between the crypto world and the centralised financial architecture, therefore, warrants compliance with regulatory and supervisory frameworks to appropriately protect investors and financial consumers while supporting overall financial stability (OECD, 2022). In this regard, a US President's Executive Order on the development of digital assets identifies and mandates federal institutions and legislation to address three sources of risks. These risks are stability/run risks, transfer risks and concentration risks (Bains et al., 2022).

Stability/run risks are the risks associated with stablecoins runs. Regarding the regulatory trajectory, the executive order directs that legislation aimed at requiring the stablecoins issuers to be insured by depository institutions and be regulated and supervised in such a way that they will be eligible for Federal Reserve emergency liquidity (Bains et al., 2022) be pursued. The transfer risks relate to the spillover of risks on the stablecoin chain. As a remediating step, the order requires all actors in the stablecoin chain, including issuers and wallet providers, to be regulated and supervised. To cater for the concentration risks, federal agencies are mandated to ensure stablecoins issuers and wallet providers do not become sources of systemic risks (Bains et al., 2022).

Supposing legislation tackling the risks as directed by the executive order were to be passed and implemented, it would outlaw all algorithmic stablecoins and, to some extent, on-chain stablecoins since these stablecoins will normally not have an identifiable legal entity that can be held responsible for decisions (Bains et al., 2022). As such, even though illegibility-seeking stablecoins may continue to operate on the sidelines, centralised, legibility and regulatory-seeking stablecoins like Tether and Gemini will likely evolve to become regulated assets backed private money as envisaged by Hayek.

Beyond regulation, governments and their central banks have sought to dictate the direction of blockchain-based finance by developing their own versions of stablecoins, Central Bank Digital Currencies (CBDC). This, especially, gained momentum after

Meta officially unveiled their plan to issue the Libra, a Meta backed stablecoin, in June 2019. Though Meta's plan has since been shelved, more than four-fifths of central banks (Bode et al., 2021) have been extensively researching their own versions of stablecoins, with several pilots already underway or completed. This can be seen as an attempt to counter the growing illegibility-seeking DeFi actors whose actions seek to appropriate an "emblem of national sovereignty", money.

Bode et al. (2021), gleaned from public statements by central bankers on CBDCs, concluded that CBDCs would likely be more than digital native versions of traditional notes and coins and could aim for goals like financial inclusion, and as vehicles for the implementation of monetary and social policies. Duque (2022) contends that some states like China are interested in their own blockchain-based cryptocurrencies, CBDC, in large part because of such currencies' prospects of becoming an international reserve/vehicle currency. Thus far, experiments on the use of the People's Bank of China's CBDC, the Digital Yuan, for cross-border payments have been conducted using the Chinese Autonomous region, Hong Kong (Elston, 2023). A Digital Yuan capable of being used in cross-border payments will strengthen China's position in the global financial system (Elston, 2023). This is informed by the belief that the United States hegemony and the dominance of the US dollar in international finance is intricately linked to the centrality of the Society for Worldwide Interbank Financial Telecommunications (SWIFT), which the US has a tight grip on (Bansal & Singh, 2021). Specifically, SWIFT allows the United States to unilaterally expunge countries and companies, it considers rogue from the global financial architecture since SWIFT is bound to comply with US unilateral sanctions. A truly multipolar world and to challenge the dollar's hegemony will require a move away from not just the dollar but from the payment rails dominated by the dollar, and the best way to simultaneously accomplish both will be through a new payment rail like a CBDC (Bansal & Singh, 2021).

Irrespective of the design or motives of CBDCs, their implementation will entrench the kind of currency competition that Hayek envisaged by nudging central banks (Gomez & Budd, 2012) to keep their currencies stable. This is based on the presumption that CBDCs will be interoperable with private exchanges and wallets, allowing for, say, a major CBDC like the Federal Reserve Coin (fedcoin) to be

interoperable and traded in centralised and decentralised exchanges along with, say, the e-cedi, the proposed digital currency of Ghana along with privately issued stablecoins. This type of architecture will put all digital currencies, CBDC of major and fringe economies and privately issued stablecoins like the GUSD on the same footing with the various blockchains as “decentralised digital clearinghouses” (Broadbent, 2016). This could break the hegemony of the western controlled SWIFT financial messaging system.

The eventual widespread implementation of CBDC interoperable on private blockchains will mean muddying of the money market with extensive activity that spans agile FinTechs, deep-pocketed incumbents, and (mostly government-appointed) central banks (Bode et al., 2021).

3.9. Conclusion

Hayek’s proposal in the *Denationalisation of Money* recommended the institution of competition among public and private note issuing banks. This, he saw, was the remedy to the perennial abuse of governmental monopoly over the issue of money and its accompanying monetary instability and inflation.

Until the internet revolution and perhaps the blockchain revolution, Hayek’s proposition had been berated, and even Hayek himself called his proposition utopian. Fast forward, the internet revolution, electronic money and the blockchain revolution have caused many to reconsider the proposal. Particularly, the proposal is now viewed as the closest description and foretelling of cryptocurrencies. This study examined the pattern of opinion from the publication of the *Denationalisation of Money* in 1976 to and after the proliferation of cryptocurrencies. It is observed that the reception of the *Denationalisation of Money* subtly changed from criticisms of being utopian and uncritical to serving as a guide to understanding the changing world of digital currencies. Also, it is shown that Hayek’s proposal is realised in off-chain custodial stablecoins. The study also hypnotises that going forward, governmental regulation will seek to make the crypto ecosystem legible. This will likely be in the form of outlawing any stablecoin (and, for that matter, cryptocurrency) without a legally incorporated entity backing it. Also, governments will likely attempt to regulate issuers

and custodial wallet providers to make them responsible for criminal and civil liabilities for failures in their operations, mandate them to seek insurance against deposit and comply with governmental regulation in such a way that they will qualify for governmental bailouts in times of crisis. Also, governments will seek, as they have already started, to take charge of the blockchain-based digital revolution by creating their own stablecoins, which in all respects will be a digital fiat currency (CBDCs). Some governments will also seek to achieve other goals like financial inclusion and perhaps to make their CBDCs international vehicle currency. Aside from these, regulated stablecoins could be made interoperable with CBDC blockchains, allowing for a muddying of the currency market and a deepening of currency competition, as proposed by Hayek.



CHAPTER IV

IMPACT OF CRYPTO ON THE VOLATILITY OF THE NAIRA; AN EWMA GARCH-X APPROACH

4.1. Introduction

This essay utilises an Exponential Weighted Moving Average (EWMA) formulation of an exponential GARCH with exogenous covariate (EWMA E-GARCH-X) to examine the impact of cryptocurrency returns on Nigeria's exchange rate volatility. Nigeria was chosen as the country of focus because it has the second-highest cryptocurrency adoption rate in the world, according to Chainalysis (2023). Cryptocurrency adoption, like currency substitution and/or dollarisation, can affect the volatility of the exchange rate by making money demand volatile (Ju, 2020).

Cryptocurrencies are blockchain-based digital “currency” units which utilise cryptographic encryption, hashing, and digital signatures to create and secure a peer-to-peer exchange system. Nakamoto (2008) bemoaned the role of third-party intermediation in commerce and created Bitcoin, the first cryptocurrency, and its underlying blockchain chiefly as a peer-to-peer payment system that will undo third-party intermediation. The usage of blockchain has since transcended the original purpose of its invention in money and finance to support data security and data sharing in fields as diverse as health, military, and defence (Krichen et al., 2022).

In the health industry, blockchain has been used to securely store staff and patient information to prevent unauthorised access (Haleem et al., 2021). Ahmad et al. (2021) lists a litany of the (potential) use cases of blockchain in the aerospace and defence industry. Some of these are battlefield operations management, logistics and supply chain management and the use of blockchain in autonomous SWARM drones’ management, among others. Naturally, the growth in the utility of blockchain has attracted attention with several studies investigating the use of the technology in health

(Araujo-Inastrilla & Vitón-Castillo, 2023; Hölbl et al., 2018; Kaushik & Kumar, 2023), supply chain management (Ahmed, & MacCarthy, 2023), artificial intelligence (AI) (Khan et al., 2023; Makridakis et al., 2018), and military and aerospace (Ahmad et al., 2021; Jadav et al., 2023).

In the finance industry, blockchain has been used to design and replicate financial instruments from lending to derivatives trading. The approval of Spot Bitcoin Exchange-Traded products by the US securities regulatory body, the US Securities and Exchange Commission (SEC), on the 10th of January 2024 is the latest development in the crypto space that enthusiasts see as a validation and an important step towards making blockchain-based products mainstream. In the statement of approval⁷, the SEC Chair, Gary Gensler, notes that the approval of certain Bitcoin EFTs does not amount to the approval of Bitcoin and, as a caveat, re-emphasises the speculative and volatile nature of crypto assets and their use in illicit activities. Nonetheless, the enthusiasm preceding the approval sent Bitcoin price soaring.

Ramaswamy (2024) notes that this approval only entrenched one frivolous use case, as Bitcoin has no practical utility. This expression of contempt by Ramaswamy (2024) is commonplace among traditional finance agents and some sections of the public. However, several reports have documented differing but nonetheless significant and even increasing rates of cryptocurrency adoption, especially among fragile emerging and developing market economies. For example, Finder (2021) surveyed 42,000 members of the public in 27 countries and documented a significant level of adoption among the populace. From the survey, Vietnam was found to have the highest crypto penetration rate in the world, with about 41% of the population surveyed reporting that they owned cryptocurrency. This was followed by Indonesia and India, Malaysia, and the Philippines with 30%, 29% and 28% penetration rates respectively. This was against a global average of 19%. According to Statista (2023), the crypto adoption rate rose from 8% in 2020 to 19% in 2023 in Egypt, from 20% in 2019 to about 47% in 2023 in Turkey, 8% in 2019 to 27% in India and 28% in 2019 to about 47% in Nigeria. Chainalysis (2023), in “The 2023 Geography of Cryptocurrency Report”, notes that globally, crypto adoption saw a marked decline in 2023. Regionally, however, some

⁷ <https://www.sec.gov/news/statement/gensler-statement-spot-Bitcoin-011023>

regions and country groups continue to see increasing crypto adoption rates, with Lower Middle Income (LMI) countries witnessing a marked increase in grassroots crypto adoption.

The International Monetary Fund, in the October 2021 edition of the Global Financial Report (IMF, 2021), notes the increasing crypto adoption in emerging and developing countries. It identifies returns from speculation, relative transaction costs, competitive financial products, and convenience of on-chain custody as some of the pull factors driving cryptocurrency adoption in emerging and developing markets (IMF, 2021). Alzahrani and Daim (2019, August) surveyed the literature on cryptocurrency adoption and contended that anonymity of transactions, acceptance by businesses, swiftness in fund transfers, cost, and curiosity were the main pull factors that entice the public to adopt cryptocurrencies. Using a theory of planned behaviour (TPB), Schaupp and Festa (2018) identified trust in blockchain technology, perceived usefulness, and ease of use as being the main drivers of cryptocurrency adoption. On his part, Roos (2015) utilised the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) to model the factors that drive cryptocurrency adoption among SMEs. Roos concluded that performance expectancy, habit, and price value were the core drivers of adoption. Roos also noted that, though trust is not part of the UTAUT2 model, it was a core driver of adoption.

While the pull factors may be common across countries, most of the drivers of cryptocurrency adoption in emerging and developing economies are push factors that are peculiar to (some of these) emerging and developing markets (IMF, 2021). One of these factors is financial exclusion. Agents in financially underdeveloped countries may adopt cryptocurrencies to benefit from financial services like the receipt of remittances. Aside from financial inclusion, bypassing capital controls is a major motivating factor for cryptocurrency adoption. Chainalysis (2023), for example, observed higher activities on P2P exchanges in countries with stricter capital controls. Alnasaa et al. (2022) found a significant correlation between cryptocurrency usage and capital controls and conjectured that cryptocurrencies could be used to circumvent capital controls and move corruption proceeds. Hu et al. (2021) study the impact of cryptocurrencies on Chinese capital controls, which has long sought to limit outbound remittance of citizens and capital flight. They found evidence of elevated

uneconomical trading in cryptocurrencies to bypass capital restrictions and move domestic assets offshore during periods of economic uncertainty. Their findings also showed that individuals using cryptocurrencies for the purposes of capital flight are incentivised by investment opportunities or the lure of foreign goods and the need to purchase such goods in foreign countries rather than illicit trades or money laundering. Cuen and Zhao (2018), in an editorial on CoinDesk, listed several crypto millionaires who have funnelled their wealth out of China by selling their cryptocurrencies abroad and using the proceeds to purchase real property in the US.

One other, perhaps the most important, push factor for cryptocurrency adoption in emerging and developing countries is currency devaluation and inflation. In the aftermath of the global pandemic, for example, many emerging and developing economies grappled with unsustainable debt levels. To become credit-worthy, most of these countries have been forced to devalue their currencies. In the first two months of 2023, three countries, Egypt, Pakistan, and Lebanon, devalued their currencies in an effort to cling IMF bailout package (Yap et al., 2023). These devaluations usually plunge the devaluing countries into an inflation-cum-devaluation spiral (Nashashibi, 1983). The Nigerian Naira has also been devalued twice in the last 8 months to February 2024. This devaluation has led to the Naira losing about 31% of its value on January 29th, 2024, alone. This followed an earlier devaluation in June 2023(Onu, 2024).

With devaluation and high and persistent inflation, the public resorts to alternatives to safeguard their earnings and purchasing power. In the digital age, the obvious choice is cryptocurrency. Chainalysis (2023) documents this trend in Argentina in the recent currency crisis. They note that cryptocurrency purchases in Argentina spiked in mid-April 2023, around the time Argentina's inflation crossed 100%, and cryptocurrency purchases stabilised just soon after the stabilisation of the Argentinian Peso.

Among crypto assets, inflation and savings-induced cryptocurrency adoption is skewed towards stablecoins. Stablecoins are mostly US dollar-denominated tokens backed by financial assets held in reserves in traditional financial institutions. Chainalysis (2023) reports that over 50% of all on-chain transactions to or from

centralised services between July 2022 and June 2023 were in stablecoins, and over 90% of these stablecoins were pegged to the US dollar. In Argentina, for example, the currency and inflation crisis has propelled a tremendous use of stablecoins, with ordinary Argentines resorting to immediately converting their paychecks into Tether (USDT) and/or USD Coin (USDC) (Chainanalysis, 2023), the stablecoins with the largest market share⁸. This trend of agents substituting their local currency for digital money has been termed cryptoization by Copestake et al. (2023), akin to fiat-based currency substitution and dollarisation.

Given the new trend of cryptocurrency substitution for local currencies, as observed in Argentina, several authors have forewarned monetary and regulatory authorities about the implications of cryptoization on monetary, exchange rate and macroprudential policy. Copestake et al. (2023), for example, note that cryptocurrencies as global currencies can amplify global contagion and facilitate dollarisation (digital dollarisation) and currency substitution, especially for emerging and developing economies with weak currencies. Also, He et al. (2022) note that the adoption of stablecoins may pose a risk to local currencies by replacing them as a medium of exchange, store of value and even a unit of account in countries plunged by high inflation and exchange rate volatility. Benigno et al. (2022), on their part, argue that cryptocurrencies as global currencies mean a complete loss of central bank independence, with central banks risking the crowding out of their currencies and rendering the trilemma even less reconcilable. It is also noted by IMF (2021) that cryptoization could pose a threat to fiscal policy, facilitate tax evasion, and could be used to bypass currency and capital controls.

Despite the apprehensions about the impact of global cryptocurrencies on the impact of emerging market currencies, not many empirical studies have been conducted, with the few studies often focusing on the exchange rate hedging effects of cryptocurrencies (Cheong, 2019) and the connectedness of advanced economies equity, exchange rates and cryptocurrencies (Andrada-Félix et al., 2020; Kostika et al., 2020). For Nigeria, the country with the second highest cryptocurrency penetration in the world, only two empirical studies on cryptocurrencies and their relationship with exchange rates have

⁸ <https://defillama.com/stablecoins>

been conducted. Joseph et al.(2022) estimated the volume and price elasticity of cryptocurrency demand in Nigeria and included the Naira exchange rate as a control variable. They found increasing cryptocurrency demand in times of Naira exchange rate depreciation. The other related study was done by Ajayi et al. (2022), who used a Vector Error Correction (VECM) on monthly data of Bitcoin, Ethereum, Litecoin, Ripple, Binance Coin and the Dollar-Naira exchange rate to examine the long-term and short-term impulse response among the variables. Thus far, no study has been conducted on the volatility impact of cryptocurrencies on the Naira exchange rate. As such, this study aims to fill this empirical gap. This is crucial because of the impact of exchange rate volatility on financial stability through its impact on banking performance (Keshtgar et al.,2020), firm-level productivity (Eklou, 2023), foreign direct investment (Ullah et al., 2012), and inflation (Musa, 2021).

GARCH-type models are the most widely used estimation methodology in the literature on financial volatility. This is because of their ability to capture the stylised facts of financial time series. These stylised facts are, among others, leptokurtic, volatility clustering and shock asymmetry (Babashova, 2020). A GARCH-type estimation method has not been used to examine the cryptocurrency exchange rate nexus in Nigeria. This essay, by employing the EWMA E-GARCH-X model, contributes to the empirical literature by showing how the changes in the returns of cryptocurrency impact the volatility of the Naira and, as such, indirectly shows the impact of speculative crypto (asset) substitution on the volatility of the Naira.

The following section reviews the theoretical and empirical literature on the impact of currency substitution and dollarisation on exchange rates. The third section presents the data used in the study. Section Four gives a detailed outline of the EWMA GARCH-X model, and section Five presents the results. Finally, Section Six concludes the study.

4.2. Literature Review

Standard monetary theory assumes single money monopolies along sovereign borders (Girton & Roper, 1981). However, years of inflation, currency crisis and the liberalisation of capital markets have brought the monopoly of currencies within

national borders to question. With liberalised capital markets, residents naturally switch to more stable foreign currency holdings (Özbilgin, 2012) for savings and/or transactions. Fischer (1982) also observes movement away from the local currencies in high inflation-prone countries. The switching of local currency holdings for foreign currency holdings for transactional services is termed currency substitution, while switching local currency for foreign currency holdings for savings purposes is termed dollarisation (De Freitas & Veiga, 2006). These two terms are, however, used interchangeably despite their difference (Calvo & Vegh, 1992).

De Freitas and Veiga (2006) concluded that the distinction between currency substitution and dollarisation is irrelevant if money demand is modelled with a restriction on foreign currency-denominated bonds. Thus, with a binding constraint on foreign bond holdings, foreign currency assumes a store-of-value role alongside the means of payment role, making currency substitution indistinguishable from dollarisation. Under such a scenario, the demand for domestic and foreign currency will be influenced by speculative and risk-hedging considerations (De Freitas & Veiga, 2006). The hedging component minimises the portfolio purchasing power risks, while the speculative component is critically determined by the real return differential (Thomas, 1985). Noting the negative effects of money demand volatility on exchange rate volatility (McGibany & Nourzad, 1995), currency substitution and/or dollarisation will necessarily impact exchange rate volatility through the demand for domestic currency function. Girton and Roper (1981) developed a two-currency model of exchange rate assuming exogenous money supply. Their model showed that in the presence of currency substitution, the exchange rate between monies is unstable due to the magnitude of exchange rate movements required to achieve equilibrium. They also note that with perfect currency substitution, exchange rates become indeterminate.

Empirically documented evidence shows that agents tend to substitute local currency savings for foreign currency savings (Demir & Sezgin, 2023) and occasionally even resort to transacting in foreign currencies in times of excessive inflation and currency depreciation. Savastano (1992), for example, examined currency substitution episodes in Bolivia, Uruguay, Peru, and Mexico and concluded that allowing foreign currency deposits in the domestic financial system tends to aggravate the inflationary impact of fiscal imbalances and exchange rate adjustments. Ferrari Minesso (2019) found that a

strong dollar caused by growth momentum and high interest rates in the US tends to trigger capital outflows from emerging markets to the US, which in turn causes emerging market currencies to depreciate. In Lay et al. (2012), the impact of dollarisation on the Cambodian Riel is examined. Dollarisation, as represented by foreign currency deposits to M2, was found to be a source of increasing exchange rate volatility of the Cambodian Riel. Akçay et al. (1997) also found currency substitution to contribute positively to exchange rate volatility in Türkiye. Yusif et al. (2023) examined the impact of currency substitution on the Ghanaian Cedi and documented a positive impact of currency substitution on the volatility of the Ghana Cedi. Giovannini and Turtelboom (1992) provide an excellent theoretical (and empirical review) on currency substitution and dollarisation.

4.3. Data

This section explains and presents the data used in this essay. Particularly, the logic behind the choice of variables and the trend and statistical properties of the variables and data series are presented. All data series are weekly from December 1st, 2017, to January 31st, 2024.

It is a stylised fact that price series of financial assets, including currencies, are non-stationary. As such, the log returns are often modelled instead. The percentage log returns are computed using the weekly price series as in equation (4.1).

$$r_{i,t} = 100 \times \log \left(\frac{p_{i,t}}{p_{i,t-1}} \right) \quad (4.1)$$

With $r_{i,t}$ representing the returns on asset i on week t , $p_{i,t}$ representing the price of asset i on week t and $p_{i,t-1}$ the price of asset i on week $t - 1$.

The Dollar-Naira exchange rate until May 2021 was relatively stable, trading below 400 Naira per dollar since December 2017. However, this changed following the devaluation of the currency in the official Nigerian Autonomous Foreign Exchange Fixing (NAFEX) on 14th May 2021, causing a plummet of the Naira to 419.8 Naira per dollar, as depicted in Figure 4.1. This soon worsened, with the Naira trading at 896 per dollar as of 25th December 2023 and over 1500 Naira per dollar as of February 2024.

USD/Naira Exchange Rate

2017-11-27 / 2024-01-29

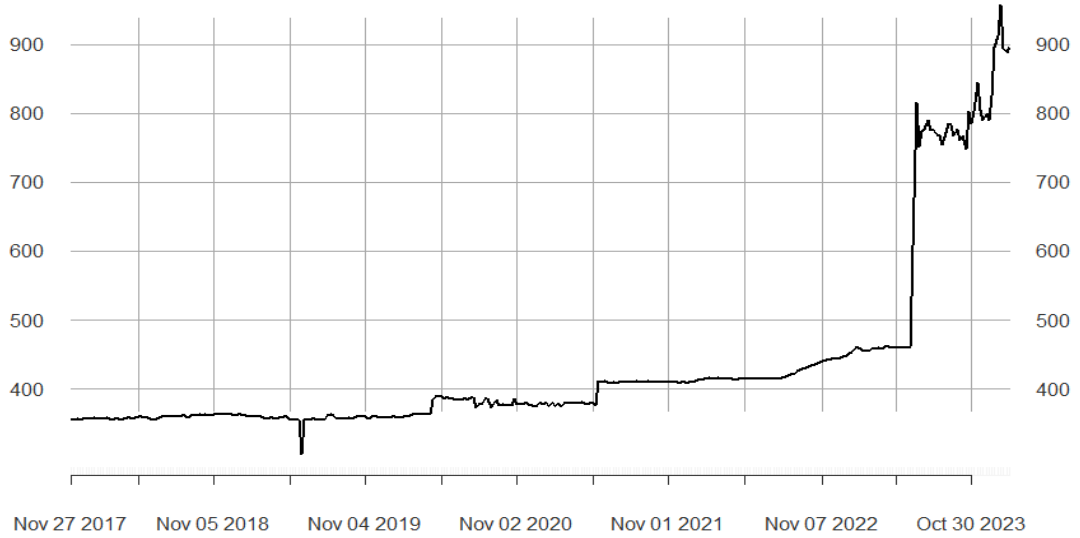


Figure 4.1. US Dollar/Naira Weekly Exchange Rates

Source(s): Author's own creation/work from data

Along with the now repetitive devaluation and depreciation of the Naira, the percentage returns on the Naira, as shown in Figure 4.2, have gone through several spikes.

Naira Returns

2017-12-11 / 2024-01-29

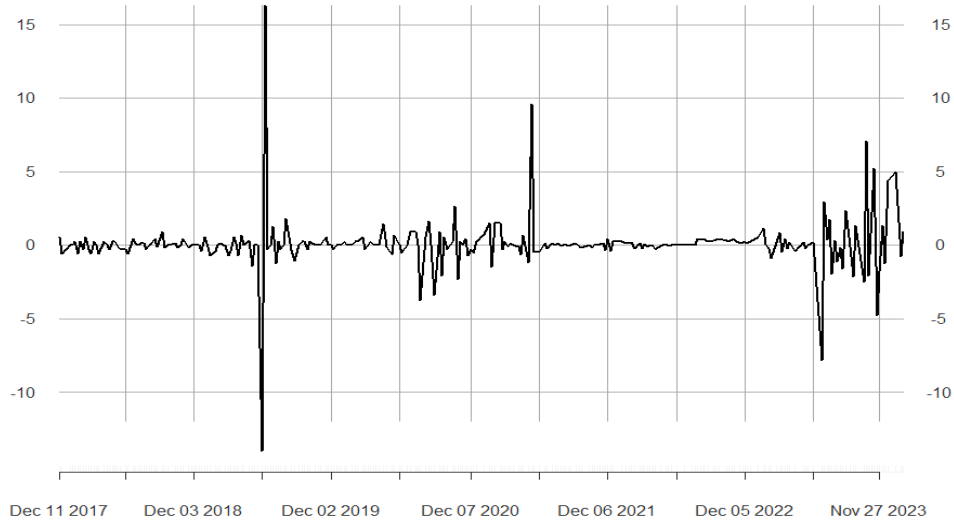


Figure 4.2. US Dollar/Naira Weekly Exchange Rate Returns

Source(s): Author's own creation/work from data

The weekly returns on the Naira touched a minimum of -13.988 on the week of June 2nd, 2019 when the Naira appreciated against the dollar, opening at 359.5 Naira per dollar and closed trading at 306.2 Naira per dollar. The Naira then went on to lose all the gains by June 18th, trading at 360.50.

Currency substitution is often measured as the ratio of foreign currency deposits to M2 in the local banking industry (Akçay et al., 1997; Lay et al., 2012; Yusif et al., 2023). The anonymous and global nature of cryptocurrencies, however, makes it impossible to know the amount of cryptocurrency holdings within the borders of a country. However, noting that currency substitution (Girton & Roper, 1981; Ramirez-Rojas, 1986) and dollarisation (Civcir, 2005) are intricately determined and modelled as dependent on the relative rate of returns between the domestic and foreign currency, it is reasonable to assume a linear relationship between currency substitution/dollarisation and the change in the rate of returns.

For cryptocurrencies, this is particularly valid considering the role of speculation in cryptocurrency demand and transaction volumes. For example, Di Casola et al. (2023) modelled the transaction volume of Bitcoin on peer-to-peer platforms and found a positive association between returns and trading volumes. Jermann (2021) studied the money demand sensitivity to expected changes in the price of Bitcoin and Ethereum and found the money demand sensitivity parameter to be close to one. Implying that Bitcoin demand is very sensitive to price changes. As such, we employ the percentage log returns of the cryptocurrencies to proxy cryptoization.

Bitcoin is the oldest cryptocurrency, having been implemented by the pseudonymous Satoshi Nakamoto in 2009. Bitcoin has since been the undisputed leader in the cryptocurrency market, with an unparalleled dominance in spillover transmission to other cryptocurrencies (Moratis, 2021). Figure 4.2 depicts the evolution of Bitcoin price since December 2017.



Figure 4.3. Bitcoin Price

Source(s): Author's own creation/work from data

As can be seen in Figure 4.3, Bitcoin started 2018 trending downward and traded below 10000 dollars per coin throughout 2019. From July 2020, however, Bitcoin gained momentum, rising to as high as 65,466.840 dollars per coin in November 2021 before plummeting to 16,444.627 dollars in November 2022. The percentage returns associated with these price oscillations are depicted in panel B of Figure 4.4.

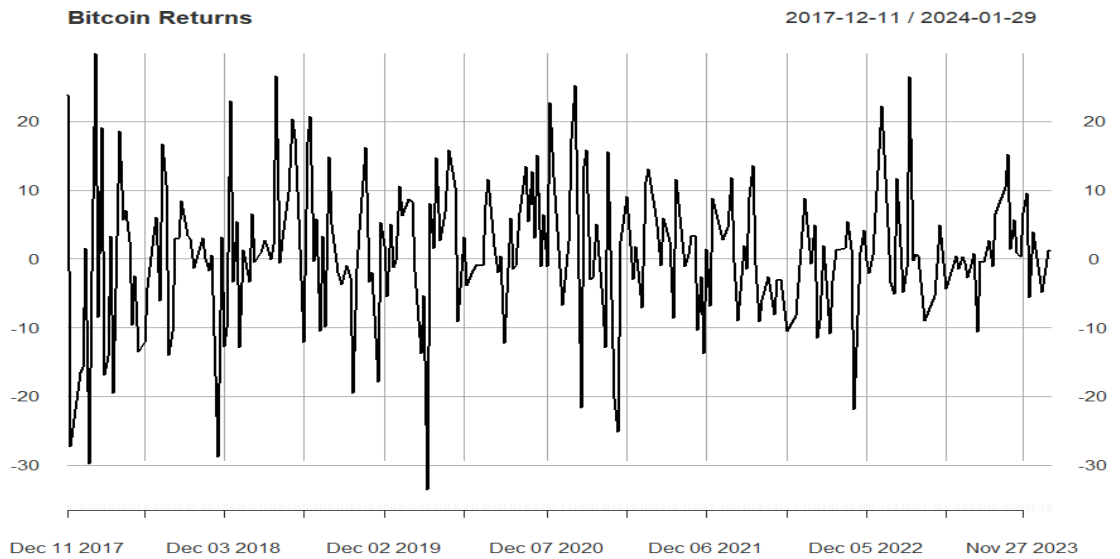


Figure 4.4. Bitcoin Weekly Percentage Returns

Source(s): Author's own creation/work from data

As depicted in Figure 4.4, Bitcoin percentage weekly returns have been quite volatile, seamlessly touching plus and minus 10%.

As a measure of the developments in the stablecoin market, we computed a stablecoin index following the methodology of the Coindesk Stablecoin Index for the period. The Coindesk Stablecoin Index is designed as a capitalisation-weighted index of the key coins in the stablecoin market⁹. In computing the index, four stablecoins are used. These are USD Tether, USD Coin, Dai, and PayPal Stablecoin. Tether is the oldest stablecoin and the stablecoin with the largest market share and capitalisation. As of 27th February 2024, Tether had a stablecoin market dominance of 70.07%, according to DeFillama¹⁰. In calculating the index, Coindesk assigns weights of 0.7525, 0.2030, 0.042 and 0.0024 to USD Tether, USD Coin, Dai, and PayPal Stablecoin, respectively. The weekly percentage returns of the stablecoin market, as represented by the computed stablecoin index, is presented in Figure 4.5.

⁹ <https://www.coindesk.com/indices/csc>

¹⁰ <https://defillama.com/stablecoins>

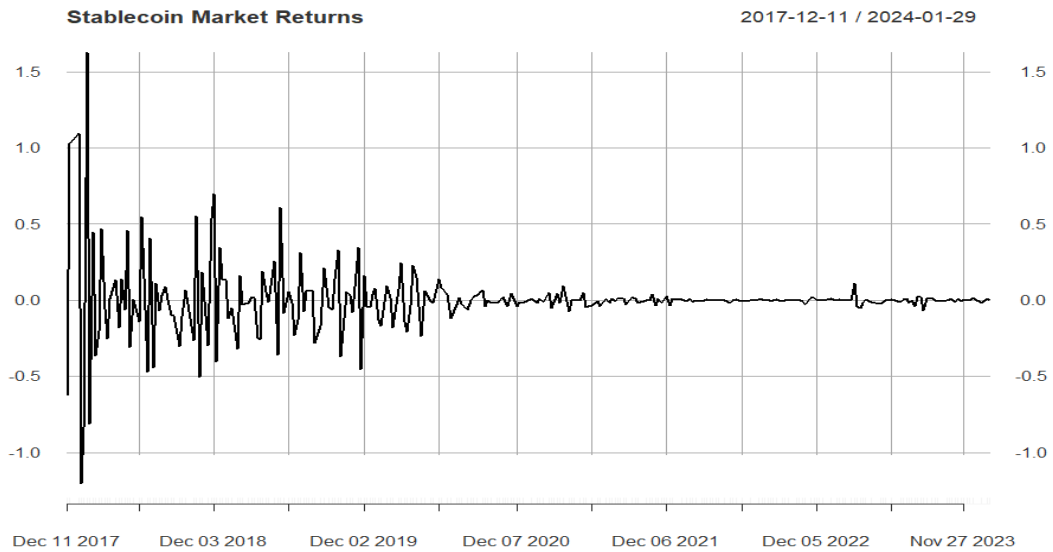


Figure 4.5. Percentage Weekly Stablecoin Index Returns

Source(s): Author's own creation/work from data

As can be seen, the price oscillations in the stablecoin market were immense prior to 2020. Stablecoins returns have since stabilised indicative of market maturity.

Aside from the money demand volatility (instigated by currency substitution), the interest rate differential is found to be a significant determinant of exchange rate volatility in the literature. Effiong (2014) documented a significant impact of the interest rate differential on exchange rates in Nigeria. Scott Hacker et al. (2012) studied the relationship between the interest rate differential and spot exchange rates between the Swedish krona and the British pound, the American Dollar, the Japanese Yen, the Euro, the Norwegian Krono, the South Korean Won and the Swiss Franc using wavelet approach. They found a negative relationship between the interest rate differential and the value of the Swedish Krono for four of the currency pairs, especially in the short run.

In determining the interest rate differential between the Nigerian Naira and the US dollar, the Naira Overnight Interbank Offer Rate (NIBOR) rate obtained from Refinitiv Eikon Datastream is used. The weekly rate of the Naira NIBOR is depicted in Figure 4.6.

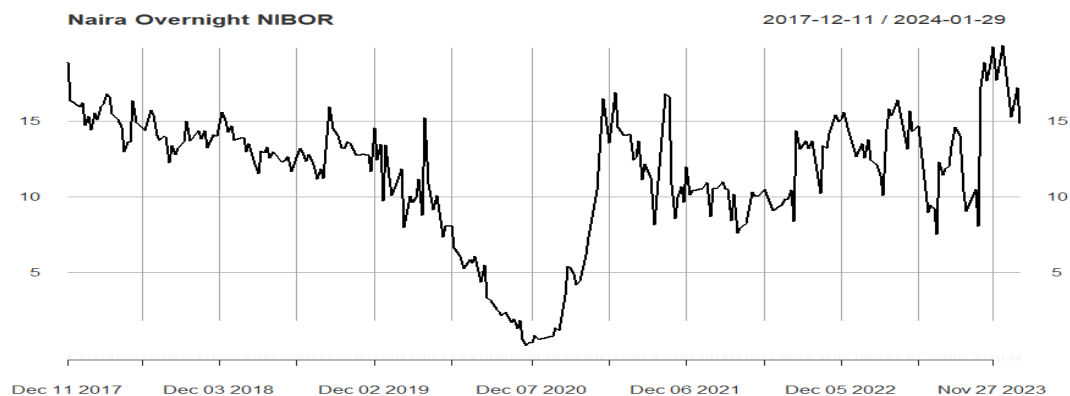


Figure 4.6. Nigerian Naira Interbank Offered Rate

Source(s): Author's own creation/work from data

As depicted in Figure 4.6, the Naira NIBOR dropped from around 20% in 2017 to about 3% in 2020 before the currency and inflation crisis forced interest rates back to about 19.33% by February 23rd, 2024.

The Secured Overnight Financing Rate (SOFR) has become the reference rate for US dollar-denominated loans since 3rd April 2018. Prior to this date, the London Interbank Offered Rate (LIBOR) was the reference for dollar-denominated loans. This reference series was formally discontinued in June 2023¹¹, paving the way for the SOFR to become the main interest benchmark for the US dollar. In this study, the LIBOR rate from December 2017 to April 2018 is used for the period prior to the SOFR. The SOFR and LIBOR data are obtained from the Federal Reserve Bank of St. Louis Economic Data¹².

¹¹ <https://www.newyorkfed.org/arrc/sofr-transition#:~:text=June%2030%2C%202023%20then%20marked,U.S.%20dollar%20interest%20rate%20benchmark.>

¹² <https://fred.stlouisfed.org/series/SOFR>

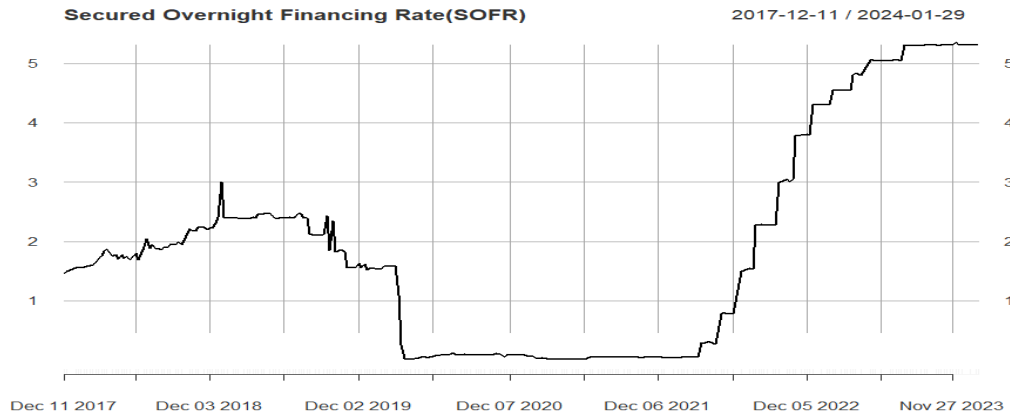


Figure 4.7. Weekly LIBOR/SOFR Rates

Source(s): Author's own creation/work from data

As depicted in Figure 4.7, the reference rates on US dollar loans started to rise beyond 1% from April 2022 in response to rising federal funds rate to combat inflation momentum post COVID-19. Currently, the SOFR is hovering around 5.3%. The interest differential between the Naira and dollar is depicted in Figure 4.8.

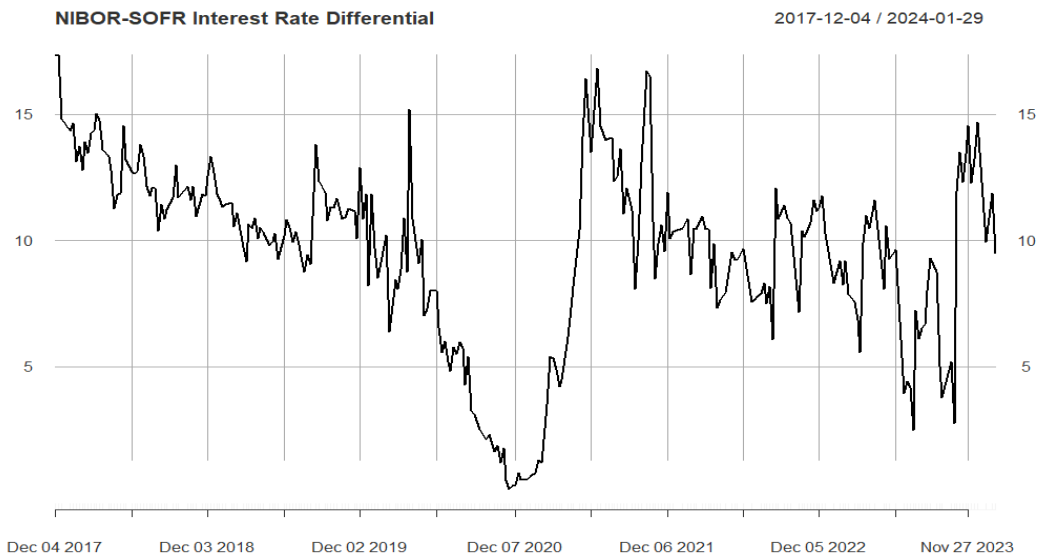


Figure 4.8. NIBOR-SOFR Interest Rate Differential

Source(s): Author's own creation/work from data

The insignificance in the magnitude of SOFR made the behaviour of the interest rate differential mimic the NIBOR.

Also, Shank and Vianna (2016) contend that passive investment instruments like Exchange Traded Funds (ETFs) may have become source of exchange rate volatility. This was empirically tested by Sakarya and Ekinici (2020), who found an asymmetric relationship between exchange rate movements and ETF flows in Türkiye. As such, we include the returns of the Global MSCI Nigeria ETF index percentage weekly returns as controls. The prices and percentage returns of the Nigeria ETF are presented in Figure 4.9.

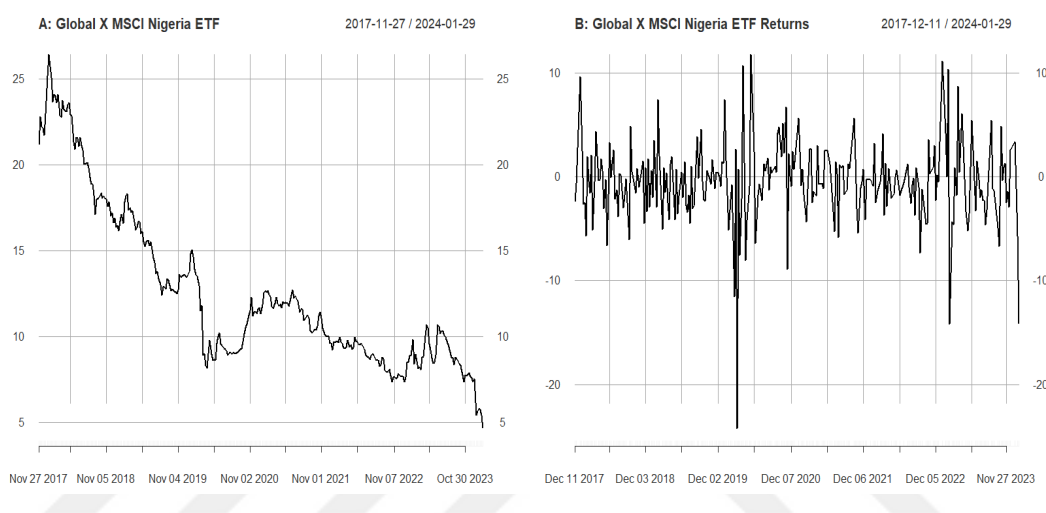


Figure 4.9. Global X MSCI Nigeria ETF Price and Returns

Source(s): Author's own creation/work from data

True to the findings of Kunjal et al. (2022), who found political and economic risks to be intricately correlated with the volatility of ETFs, the Global X MSCI Nigeria ETF was trending downward as of December 2017 following the Recession in 2016. The recovery was further stalled by the COVID-19 pandemic and its associated uncertainties and resulted in further price declines. From a price of 63.24 in June 2014, the MSCI Nigeria ETF was trading at about 5.36 as of December 2023.

Global uncertainty is also one of the main determinants of exchange rate volatility (Aftab et al., 2024; Ferrari Minesso, 2019), and one of the most recognisable measures of global uncertainty is the Chicago Board of exchanges implied volatility index (CBOE VIX)(Engle & Campos-Martins, 2023). This has been used by Sakarya and Ekinici (2020) to capture global risk while modelling exchange rate volatility. As such,

we include the CBOE VIX to capture the impact of global risk as an additional control. Figure 4.10 presents the price movement of the CBOE VIX index from December 2017 to December 2023.

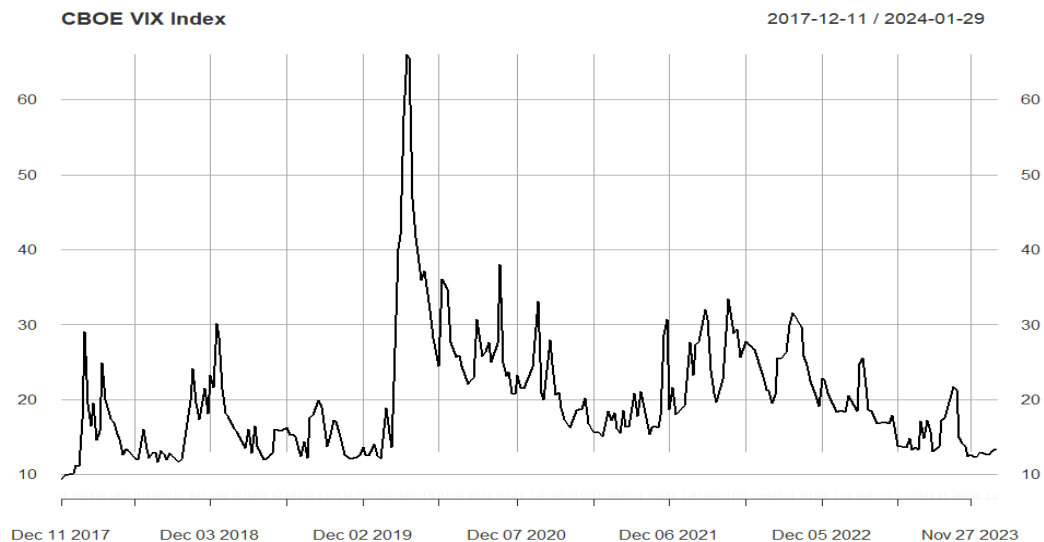


Figure 4.10. CBOE VIX Index

Source(s): Author's own creation/work from data

As can be seen, global uncertainty, as represented by the VIX index, was moderate, hovering below 30% prior to the COVID-19 Pandemic in 2019. Thereafter, the index climbed to about 66% in March 2020 before trending downwards. It has since been hovering just within the pre-pandemic levels of below 30%.

As a pre-estimation analysis, we test for the presence of ARCH effects with the Lagrange Multiplier (LM) test developed by Engle (1982) and implemented in Graves (2024). This test is a popular diagnostic test in regression analysis (Hatemi & Hacker, 2005) and pre-empts the appropriateness of conditional volatility modelling (Chand et al., 2012). The existence of ARCH effects implies that the conditional variance of the time t prediction error is a function of time. Also, the stationarity of the time series are examined.

Except for the reference rates, all other data series are obtained from Yahoo Finance¹³.

Table 4.1 presents the descriptive statistics of the data used.

Table 4.1. Descriptive Statistics

Variable	r_{ngn}	r_{btc}	r_{sci}	r_{etf}	vix	$intdiff$
obs	251	251	251	251	251	251
Mean	0.10	0.86	0.00	-0.53	20.07	0.14
Median	0.00	0.83	0.00	-0.50	18.07	-0.01
Maximum	16.26	29.79	1.62	11.73	66.04	5.47
Minimum	-13.99	-33.49	-1.20	-24.24	9.42	-4.44
Standard Deviation	1.90	10.12	0.24	3.91	8.13	1.35
Skewness	1.30	-0.19	1.23	-0.79	2.34	0.65
Kurtoisis	35.60	1.06	13.82	6.38	8.78	3.03
ADF Test	-6.89***	-6.09***	-7.03***	-5.84***	-3.3*	-6.26***
ARCH-LM	44.44***	-	-	-	-	-

Source(s): Author's own creation/work from data

As depicted in Table 4.1, the percentage weekly returns of the Nigerian Naira averaged 0.10% with a minimum and maximum of -13.99% and 16.26%, respectively. As in most financial returns series, the percentage of weekly returns on the Naira is stationary and leptokurtic, with evidence of heteroscedasticity as evidenced by the ARCH-LM test. Over the period of the study, Bitcoin weekly returns averaged 0.86% with a minimum of -33.49% and a maximum of 29.79%. On stationarity, we utilised the returns of all the assets except for the CBOE volatility index and the interest rate differential, which are percentage indices. The CBOE volatility index is a volatility index of the S&P 500 index. Due to the non-stationarity of the interest rate differential (not reported), the first difference of the level series was employed as in Pippenger (1974).

¹³ <https://finance.yahoo.com/>

4.4. Methodology

This section presents the methodology used in this study. It explains the EWMA E-GARCH-X formulation employed in this study to capture the impact of cryptocurrency returns on Naira volatility.

The Generalised Conditional Heteroskedastic (GARCH) type models utilise a two-step procedure with a mean equation and conditional volatility equation. The mean equation is often modelled as a sum of the average return and a time-dependent prediction error term, ϵ_t , as in equation 4.2.

$$r_{fx} = \omega + \epsilon_t \quad (4.2)$$

The prediction error term ϵ_t , can be decomposed multiplicatively as in Equation (4.3), with v_t being a real-valued standardised innovation with mean zero and unit variance while σ_t is the standard deviation of ϵ_t .

$$\epsilon_t = \sigma_t v_t \quad (4.3)$$

The conditional variance of ϵ_t , σ_t^2 , is widely modelled (Sucarrat, 2021) as a first-order Generalised Autoregressive Conditional heteroskedasticity, GARCH (1,1) process as in Equation (4.4) following the classic formulation of Bollerslev (1986).

$$\sigma_t^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2, \quad (4.4)$$

With restrictions on $\alpha_0 > 0$, $\alpha_1 \geq 0$, and $\beta_1 \geq 0$. ϵ_{t-1}^2 and σ_{t-1}^2 are termed the ARCH (1) and GARCH (1) terms, respectively (Sucarrat, 2021).

Following the lead of Nelson (1991) and several other studies (Engle & Bollerslev, 1986; Kroner & Lastrapes, 1993; Panait & Slavescu, 2012), we include the contemporaneous conditional volatility term in the mean equation to capture the risk premia. Thus, a mean equation of the form in Equation (4.5) is estimated.

$$r_{fx} = \omega + \delta \sigma_t^2 + \epsilon_t \quad (4.5)$$

Nelson (1991) raised three fundamental issues with the standard GARCH (p, q) specification. For one, standard GARCH (p, q) specifications are based on the assumption that only the size of lagged residuals, not the sign, is important in determining conditional variance. Thus, standard GARCH models contend symmetry. This has, however, been found to be questionable, beginning with Black (1976) and several authors after. Also, standard GARCH (p, q) models impose nonnegativity restrictions on the constant, the ARCH and the GARCH parameters to ensure that the

conditional variance term is always positive with probability one. These nonnegativity constraints can create computational problems. A third concern raised by Nelson (1991) on the standard GARCH formulation has to do with the degree and how to evaluate persistence.

To remedy these situations, Nelson (1991) suggests modelling the ARCH term as a linear combination of two lags of the standardised innovation term, v_t , such as, $\alpha_i v_{t-i} + \gamma_i(|v_{t-1}| + E|v_{t-1}|)$, with $\gamma_i(|v_{t-i}| - E|v_{t-i}|)$ capturing the magnitude effect while $\alpha_i v_{t-i}$ captures the asymmetry. On the question of persistence, Nelson suggested taking the log of the conditional variance and its lags, which renders the stationarity and ergodicity of the conditional variance easily checkable. Nelson's (1991) formulation has come to be termed the exponential GARCH (p, q) and is depicted in Equation (4.6).

$$\ln\sigma_t^2 = \alpha_0 + \sum_{i=1}^p (\alpha_i v_{t-i} + \gamma_i(|v_{t-i}| - E|v_{t-i}|)) + \sum_{j=1}^q \beta_j \ln\sigma_{t-j}^2 \quad (4.6)$$

With p and q being the ARCH and GARCH orders, respectively. In this formulation, α_i captures the leverage effects while γ_i captures the normal ARCH effects.

Recently, a growing number of studies have found that a restricted GARCH with $\alpha_0 = 0$ has better performance and predictive power over standard GARCH formulations following RiskMetrics' publication of their risk strategies in 1994 (Mina & Xiao, 2001). These restricted GARCH models have come to be known as EWMA GARCH models. The restrictions on EWMA GARCH models stem from the assumption that volatility follows a random walk with no long-run mean reversion (Ding & Meade, 2010).

Comparing EWMA GARCH, GARCH and Stochastic volatility forecasting performance, Ding and Meade (2010), for instance, concluded that EWMA models are superior to GARCH models due to their robust structure. Harris and Nguyen (2013) compared the economic and statistical performance of the long-memory EWMA, EWMA-DCC, FIGARCH-DCC, and component GARCH-DCC models. It was concluded that the EWMA models are superior to the GARCH-based models in both short and long memory forecast horizons. They also found the results to be valid in high- and low-dimensional covariances matrices and low- and high-correlation assets

and to be robust to the estimation window. As such, we restrict the mean parameter in equation (6) to zero as in equation (4.7)

$$\ln\sigma_t^2 = \sum_{i=1}^p (\alpha_i v_{t-i} + \gamma_i (|v_{t-i}| - E|v_{t-i}|)) + \sum_{j=1}^q \beta_j \ln\sigma_{t-j}^2 \quad (4.7)$$

The usefulness of exogenous covariates in volatility modelling and prediction has been underscored by Engle and Patton (2001). They contend that despite the proliferation of univariate GARCH models, no one actually believes that historical information in a series is the only relevant information for the prediction of the series' volatility. Engle and Patton (2001) also emphasise the structural and economic interpretational value of covariates in volatility models. Also, Sucarrat (2021) contend that the extension of the GARCH model to include exogenous covariates could help substantially in predicting and explaining volatility. In this regard, Melvin and Tan (1996) employed a GARCH model with exogenous covariates to test the impact of country risk factors, including social unrest and demonstrations, on the volatility of the foreign exchange bid-ask spread of the South African Rand and a cross-section of industrialised and developing countries. In line with this, we adopt a restricted (EWMA) exponential GARCH (1,1) with exogenous covariates as in Equation (8), to test the impact of Bitcoin and the stablecoin index returns, if any, on the conditional volatility of the Nigerian Naira exchange rate.

$$\ln\sigma_t^2 = \alpha v_{t-1} + \gamma (|v_{t-1}| - E|v_{t-1}|) + \beta \ln\sigma_{t-1}^2 + \rho X_{t-1} \quad (4.8)$$

From equation (8), X_{t-1} represents the lag of weekly returns of the target exogenous covariate. In our model estimations, the normal distribution is assumed as in Kılışınbay (2010).

As a robustness, we estimate Equation (9), which includes variables, $V_{i,t-1}$, for the VIX index, $ETF_{i,t-1}$, for the Global X MSCI Nigeria ETF returns, and $INTDIFF_{i,t-1}$, the differenced interest rate differential as controls.

$$\ln\sigma_t^2 = \alpha v_{t-1} + \gamma (|v_{t-1}| - E|v_{t-1}|) + \beta \ln\sigma_{t-1}^2 + \rho X_{i,t-1} + \varphi_1 V_{t-1} + \varphi_2 ETF_{t-1} + \varphi_3 INTDIFF_{t-1} \quad (4.9)$$

The estimations are done by maximising the log-likelihood function, as is the norm in GARCH literature, using Ghalanos(2022). Both the optimal and robust parameters are reported.

4.5. Results

This section presents the estimation results of equations (4.5), (4.8) and (4.9). Model 4.1 is the estimation results of equations (4.5) and (4.8) with Bitcoin returns, while Model 4.2 is the estimations of equations (4.5) and (4.9) with Bitcoin returns. Similarly, estimations of equations (4.5) and equations (4.8) with the stablecoin index returns are presented as Model 4.3 and estimations of equations (4.5) and (4.9) with the Stablecoin Index returns is presented as Model 4.4. The results for models 4.1 and 4.2 are presented in Table 4.2.

Table 4.2. Results of Model 4.1 and 4.2

Parameter	Model 4.1		Model 4.2	
	Optimal	Robust Standard Errors	Optimal	Robust Standard Errors
Mean Equation				
ω	0.07*	0.07	0.05***	0.05**
δ	0.04***	0.03***	-0.01	-0.01
Variance Equation				
α	-0.17***	-0.17**	-0.51***	-0.51***
γ	0.94***	0.94***	0.86***	0.86***
β	0.04**	0.04	0.16***	0.16
ρ	0.04***	0.04***	0.03***	0.04***
φ_1			0.00	0.00
φ_2			-0.03**	-0.03
φ_3			0.39***	0.39***

Source(s): Author's own creation/work from data

From Table 4.2, the risk premia is seen to be significant in Model 4.1, implying that volatility in the Naira impacts the Naira returns. On the variance equation, the leverage term α is found to be negative and significant in both Models 4.1 and 4.2 and in both optimal and robust standard error results, implying that negative and positive shocks have different impacts on the volatility of the Naira. The ARCH term, γ , and GARCH terms, β , are significant using the optimal standard errors with only γ being significant in the robust standard error results. The parameter for Bitcoin, the focus of this study,

is found to have a positive and statistically significant impact on the conditional volatility of the Naira with a magnitude of about 0.04. This implies that, as Bitcoin price trends upward, resulting in positive returns, there is a shift in money demand from Naira to Bitcoin, resulting in a depreciation and, thus, Naira return volatility. Thus, a positive spillover from Bitcoin to the Naira. This aligns with the findings of Urquhart and Zhang (2019), who used an asymmetric DCC-GARCH framework to document a positive conditional correlation between the Swiss Franc, the British Pound, and the Euro. Also, Rehman et al. (2023) studied the tail dependence of various currencies and Bitcoin and found a positive correlation between Bitcoin and the Indian Rupee, the Russian Ruble, and the Japanese Yen. They were also found to have the same directional movement under bearish market conditions.

Of the control variables, only the Global MSCI Nigeria ETF and the interest rate differential is significant, with the interest differential found to be a positive contributor to the Naira return volatility. The ETF parameter is a negative contributor to Naira volatility, implying that positive All Nigeria Select 25/50 Index market returns decreases the Naira return volatility. This aligns with the findings of Sakarya and Ekinci (2020), who concluded that the outflows of exchange-traded-funds that will necessarily result in a decreased price of the investment instrument results in a decrease in exchange rate uncertainty and, thus, the volatility. The results on the interest rate differential, however, contrast the conclusions of Scott Hacker et al. (2012), who concluded a negative relationship between the interest rate differential and the exchange rate.

Table 3 also presents the results of Models 4.3 and 4.4, which are estimates of equations (4.5), (4.8) and equation (4.9) with stablecoin index returns.

Table 4.3. Results of Model 4.3 and Model 4.4

Parameter	Model 3		Model 4	
	Optimal	Robust Standard Errors	Optimal	Robust Standard Errors
Mean Equation				
ω	0.27***	0.27**	0.01*	0.01***

Table 4.3. (cont.)

δ	-0.00	-0.00***	-0.00***	-0.01***
Variance Equation				
α	-0.43***	-0.43***	-0.44***	-0.44
γ	0.90***	0.90***	0.84***	0.84***
β	0.34***	0.34**	0.45***	0.45**
ρ	3.26***	3.26***	3.72***	3.71***
φ_1			0.01***	0.01**
φ_2			-0.03	-0.03
φ_3			0.29***	0.29**

Source(s): Author's own creation/work from data

As in Models 4.1 and 4.2, evidence of asymmetry in the volatility of the Naira is found for both optimal and robust standard error results in Model 4.3 and the optimal standard error results in Model 4.4. The ARCH, γ , and GARCH, β , terms are also statistically significant in both Model 3 and 4 and in both optimal standard error results and robust standard error results.

The Stablecoin index parameter, ρ , is found to have a magnitude of 3.26 when only stablecoin index returns alone is included as a covariate and a magnitude of 3.72 when the VIX index, the MSCI Nigeria ETF and the differenced interest rate differential is included in Model 4. Whereas all the controls maintain their signs in both models 2 and 4, the significance swapped between the VIX and the ETF with VIX being statistically significant in the stablecoin model, and ETF is statistically significant in the Bitcoin model. The interest differential is statistically significant across all models, thus presenting a strong case of the impact of the interest rate differential on the exchange rate volatility. This reinforces the findings of Effiong (2014), who studied the monetary exchange rate model for the case of Nigeria and concluded the interest rate differential to be a significant predictor of exchange rate volatility in Nigeria.

4.6. Conclusion

Nigeria, with a population of over 200 million and an annual GDP of over 1 trillion dollars, is the largest economy in West Africa. It is also the country with the second-

highest cryptocurrency penetration rate in the World as of 2023. Since June 2023, the Nigerian economy has been going through a currency and inflation crisis, with two devaluations of the currency since then. Episodes of devaluation and high inflation are known to trigger currency and asset substitution, with the public often resorting to saving and transacting in relatively stable foreign currencies. Governments often try to remedy this by instituting capital and exchange rate controls. Economic agents, however, are always able to find means to circumvent the controls. The advent and wide adoption of cryptocurrencies have made cryptocurrencies an obvious tool of such circumventions, with evidence of macroeconomic factors like currency depreciation and inflation being key drivers of cryptocurrency adoption.

In this study, we conjecture that the shift to cryptocurrency might feed into currency woes by making the currency demand unstable and increase volatility of the exchange rate in line with the literature on currency substitution and dollarisation. We test this conjecture for the Nigerian Naira by employing an indirect method by testing the volatility impact of cryptocurrency returns on the return volatility of the exchange rate. We used a restricted (EWMA) exponential GARCH model with exogenous covariates and the weekly data from December 2017 to December 2023. Our findings confirm the conjecture with both measures of cryptocurrency returns, Bitcoin and the Stablecoin Index returns positively contributing to the volatility of the naira even after accounting for global risk sentiment, the dollar-naira interest rate differential and country risk using the VIX index, Naira NIBOR and SOFR rate difference and the Global X MSCI Nigeria ETF as controls.

CHAPTER V

SUMMARY AND CONCLUSION

5.1. Summary of Findings

5.1.1. Monetary Union and Financial Stability of Member Countries

The purpose of this thesis is to answer three questions that are consequential for financial stability but have not been addressed in the literature.

The first essay presented in Chapter 2 sought to determine if monetary union can impact financial stability by increasing the level or volatility of financial institutions' asset quality as represented by their nonperforming loan ratios (NPLs). Specifically, the study counterfactually examines the empirical implications of a unionised monetary policy in the West African Monetary Zone (WAMZ) on financial stability as represented by the nonperforming loan ratios of Ghana.

This is done by proposing a theoretical model for nonperforming loan ratios. Specifically, nonperforming loan ratios are modelled to depend on an exogenous nonperforming loan ratios rate, the lending gap proxied by the monetary policy rate and the output gap proxied by GDP growth rates in a reduced policy framework. The reduced policy parameters are estimated using quarterly data from 2008 Quarter 1 to 2021 Quarter 4. The baseline methodology employed in the parameter estimation is the Autoregressive Distributed Lag Model (ARDL) as employed by Pesaran and Smith (2016).

As a counterfactual experiment, the estimated parameters are used to estimate the impact of a unionised monetary policy crudely measured as a simple and GDP growth-weighted means of member countries' individual monetary policy rates. The results

point to a dampening effect of unionised monetary policy on both the level and volatility of Ghana's nonperforming loan ratios.

As a robustness check, similar analysis and conclusions are arrived at using a Least Absolute Shrinkage and Selection Operator (LASSO) regression to predict the counterfactual impact of a unionised monetary policy in the WAMZ. This affirmation provides convincing evidence that monetary union in the West African Monetary Zone could be less distorting in terms of its impact on the level and volatility of financial institutions' asset quality.

5.1.2. Cryptocurrencies and Hayekian Currency Competition: A Critical Review

In the second essay of this thesis, presented in Chapter 3, the literature on Hayek's proposal in the Denationalisation of Money is reviewed. In the Denationalisation of Money, Hayek recommended the institution of competition among public and private note issuing banks. This, for him, was the remedy to the perennial abuse of governmental monopoly over the issue of money.

Since its publication, the proposal has been criticised for being utopian, among other things. Hayek himself came to view the implementation of his proposal as unlikely. The balance of opinion, however, began to change in the later part of the 20th Century with the proliferation of internet-based electronic money and, most recently, the blockchain. His proposal for the denationalisation of money is now considered the closest foretelling and a guide to understanding the economics of the cryptocurrency revolution.

This apparent change in opinion on the denationalisation of money and a general review of the literature on the denationalisation of money has not been conducted. The second essay sought to fill this gap by examining the pattern of opinion from the publication of the Denationalisation of Money in 1976 to and after the proliferation of cryptocurrencies. Also, the degree of realisation of Hayek's proposal in cryptocurrencies is examined, and preliminary comments on the future of currency competition, especially as we enter the CBDCs era, are made.

It is observed that the reception of the Denationalisation of Money subtly changed from criticisms of being utopian and uncritical to serving as a guide to understanding the changing world of digital currencies. Also, it is shown that Hayek's proposal is realised in off-chain custodial stablecoins. The study also hypothesises that going forward, governmental regulation will seek to make the crypto ecosystem legible and will seek to maintain control over money through CBDCs. This might, however, result in fierce competition, especially if these CBDCs are interoperable on public and private blockchains with private stablecoin participation.

5.1.3. The Impact of Crypto on the Volatility of the Naira: An EWMA GARCH-X Approach

In the third essay, which constitutes Chapter 4, the implications of crypto-currency competition as reflected in the substitution of local currency for cryptocurrencies are examined.

The purpose of the study is to empirically examine the impact of cryptoization on Nigeria's exchange rate volatility. This is essential since Nigeria is a fragile emerging market economy which is undergoing (undergone) inflation and devaluation crises (in recent times). Also, Nigeria is the country with the second-highest cryptocurrency penetration rate in the world. This makes Nigeria a good case for studying the impact of cryptocurrencies on emerging markets.

In this study, we conjecture that the shift to cryptocurrency might feed into currency woes by making the currency demand unstable and increasing the volatility of the exchange rate, which is in line with the literature on currency substitution and dollarisation. We test this conjecture for the Nigerian Naira by using cryptocurrency returns, particularly Bitcoin and a stablecoin index returns, as a proxy for cryptoization.

On Methodology, a restricted (EWMA) exponential GARCH model with exogenous covariates is used. This is due to the increasing evidence of its predictive power over standard GARCH models. Weekly data from December 2017 to December 2023 is used.

Our findings confirm the conjecture with both measures of cryptocurrency returns, Bitcoin and the Stablecoin Index returns positively contributing to the volatility of the Naira even after accounting for global risk sentiment, the dollar-naira interest rate differential and country risk using the VIX index, Naira NIBOR and SOFR rate difference and the Global X MSCI Nigeria ETF as controls.

5.2. Conclusions and Implications for Financial Stability

5.2.1. Monetary Union and Financial Stability of Member Countries

In Chapter 2, evidence in support of the thesis that monetary union in the WAMZ will have a dampening effect on the level and volatility of NPLs for Ghana was found. This implies that the monetary union will have a positive effect on the financial sector, particularly on the magnitude and volatility of nonperforming loan ratios. This means members should perhaps increase the momentum towards monetary union.

Naturally, a monetary union is an extreme form of a fixed exchange rate regime which creates predictability among the member countries and can have a positive impact on trade. It is estimated that the European Monetary Union increased intra-regional trade by 8 to 23% (Vinokurov et al., 2017). The averaging required of a unionised central bank and the increased independence associated with the multilateral nature of such central banks will normally lead to reduced variability of monetary variables. Particularly, the likelihood of monetary policy being used to lean against the wind is less likely in a monetary union. Considering the uncertain results of leaning against the wind (IMF, 2015), a rule-based monetary policy as likely to be adopted by an independent, multilateral central bank will likely be financial stability improving as argued by Austrian economist and Monetarist.

5.2.2. Cryptocurrencies and Hayekian Currency Competition: A Critical Review

From the literature reviewed in Chapter 3, it is observed that while some of the criticisms of Hayek's proposal are still relevant and noted, more and more authors are now focusing on the merits and the implications of its realisation. Several other authors

have arrived at the conclusion that competition in money is already with us and has been with us since the collapse of the Bretton Woods system and the capital and exchange rate liberalisation that followed it. This competition in money, it is claimed, is characterised by competition among international vehicle currencies and by currency substitution and dollarisation. Also, we arrive at the conclusion that off-chain custodial stablecoins most reflect Hayek's private money proposal and will likely survive a legibility regulation of cryptocurrencies by national governments. It is also concluded that governments will seek to maintain control over money through CBDCs. The proliferation and interoperability of CBDCs are, however, predicted to make currency competition among government and private digital currencies fiercer. The implications of currency competition for financial stability will depend on the trajectory of developments. If digital currency competition results in Rothbardian free banking with 100% reserves, then financial stability might improve. This is the contention of Askari and Krichene (2016). They claim that 100% reserve banking devoid of debt money inflation is an essential foundation and prerequisite for long-term financial stability. Retail CBDCs, as proposed by some central bankers, for example, could reduce financial friction and counter market power in deposits and, thus, financial stability enhancing. However, retail CBDCs are likely to result in financial disintermediation (Infante et al., 2023) that might be consequential for the real and, ultimately, the financial sector.

5.2.3. The Impact of Crypto on The Volatility of The Naira: An EWMA GARCH-X Approach

Chapter 4 examined the impact of cryptocurrency returns on the exchange rate volatility of Nigeria, the country with the second-highest cryptocurrency adoption rate in the world. The results from the EWMA E-GARCH-X estimation point to a positive relationship between Bitcoin and the stablecoin index returns and exchange rate volatility in Nigeria.

This could be taken to mean that, during periods of increasing cryptocurrency returns, Nigerians switch their Naira holdings to cryptocurrency holdings, leading to a volatile demand for the Naira and, as such, its exchange rate against the dollar. This is certainly inimical to financial stability if anything from the literature on currency substitution

and dollarisation is anything to go by. For example, CBRT (2022) note that dollarisation increases the vulnerabilities in the financial sector by increasing the payment capacity(default) risk and liquidity risk through currency depreciation.

In conclusion, financial and monetary authorities should be wary of the supposed (increasing) crypto- currency competition through the substitution of local currency for cryptocurrency. This could lead to an unstable demand for the local currency, impact on the exchange rate and perhaps financial stability.



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