Analysis of cashless economy, demand for money and price determination : A possibility for implementation in Nigeria

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ANALYSIS OF CASHLESS ECONOMY, DEMAND FOR MONEY AND PRICE DETERMINATION IN NIGERIA: A POSSIBILITY FOR IMPLEMENTATION

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Abstract

This study explores the feasibility of implementing a cashless policy in Nigeria and its impact on money demand and price determination. Drawing from renowned scholars such as Keynes, Friedman, and Woodford, the analysis delves into the dynamics of monetary policy, the role of money in trade and financial markets, and factors influencing price levels. The study investigates the relationship between money demand and the implementation of a cashless policy. It emphasizes the behavior of real balances, transaction velocity, and the effects of monetary policy on trading activity and asset prices. The findings indicate that as an economy moves towards a cashless system, various factors come into play. Transaction velocity, a measure of cash efficiency, becomes critical, increasing as cash usage diminishes and the economy becomes more cashless. Additionally, the study reveals that implementing a cashless policy affects price determination. Contrary to conventional belief, even as real balances approach zero in a cashless economy, asset prices remain responsive to monetary policy. This implies that monetary equilibrium prices do not necessarily converge to their nonmonetary equilibrium counterparts when real balances vanish. Based on these findings, a viable policy recommendation emerges: the monetary authority should carefully manage the money supply per investor to control and stabilize the price level in a cashless economy. Adjusting the money supply allows the authority to achieve and maintain a desired price level, even in a cashless environment. However, the study acknowledges limitations and calls for further research. Specifically, exploring the implications and challenges of implementing a cashless policy in Nigeria is necessary. Factors such as financial inclusion, technological infrastructure, and public acceptance should be examined to assess the feasibility and potential impacts of a cashless economy on different segments of society. Overall, this study contributes valuable insights into the possibility of implementing a cashless policy, its effects on money demand and price determination, and its implications for economic stability and efficiency in Nigeria.

Key words: price, cashless policy, monetary policy, price determination, efficiency

1.0 Introduction

Initiatives for cashless policies have received a lot of attention in recent years and are now being implemented in several nations, including Nigeria. The switch from a mostly cash-based to a cashless economy has generated a lot of discussion among economists, decision-makers, and scholars. In order to better understand the possible impacts and outcomes of this policy change, this study intends to investigate the theoretical implications of the cashless policy on the demand for money and price determination in Nigeria. The idea of a cashless society is encouraging electronic transactions and digital payment systems in order to lessen the need on actual money. In order to modernize the economy, increase financial inclusion, combat corruption, and boost overall effectiveness, the Nigerian government has adopted this concept. However, a comprehensive examination and analysis are needed to determine how this strategy would affect the demand for money and how it, in turn, will affect price levels.

Previous economists have provided insightful contributions to the field by presenting a range of ideas and viewpoints. John Maynard Keynes, a well-known economist, stressed the significance of money demand in affecting economic activity and preserving price stability. According to Keynes' theory (Keynes, 1936), the need for money is driven by transactional, preventative, and speculative reasons. Changes in this demand can have an impact on overall demand as well as inflationary pressures.

Milton Friedman and other monetarist economists disagreed with Keynesians and emphasized the importance of the money supply in influencing the course of the economy. According to Friedman's theory (Friedman, 1968), fluctuations in the money supply are the principal cause of inflation, and prudent money supply management is essential to preserving price stability. This viewpoint highlights concerns about the possible consequences of a cashless policy on the money supply and how those impacts might then affect price levels. In diverse situations, researchers have examined the connection between digitization, cashless transactions, and pricing determination. Liang and Turban (2011), for instance, looked into how online payment systems affected consumer price inflation and discovered that the adoption of digital payments can affect price levels owing to decreased transaction costs and higher efficiency.

In another perspective, If we accept the Wicksellian perspective that Economics is a practical science, it becomes imperative to establish a connection between theory and practice. However, it is unfortunate that a disconnect often arises between academics and policymakers. Goodhart (2005) highlights this issue in his examination of the past 25 years of macroeconomic history, where he identifies a lack of realism as a prominent characteristic of recent economic models. Similarly, Mankiw distinguishes between "engineers" in economics who are concerned with social issues and "scientists" who strive to comprehend the functioning of the economy. The recent developments in macroeconomics, such as the New Keynesian and New Neoclassical Synthesis models, seem to support the dominance of scientists over engineers. Nonetheless, it is essential to acknowledge that over the past decade, there has been a noticeable inclination within the field of monetary economics to bridge this gap. Notable contributions by scholars such

as Taylor (1993) and Woodford (2003) exemplify this trend towards integrating practical considerations into economic analysis.

In contemporary monetary macroeconomics, there exists a highly intense and productive debate regarding the significance of money in the analysis of monetary policy. The core question at the center of this debate can be summarized as follows: Does money play a meaningful role? (Woodford, 1997, 2003, 2006; Goodfriend and King, 1997; Berg et al., 2006; Meyer, 2001; Noyer, 2006; Laidler, 2004). It is indeed surprising, if not paradoxical, that such a debate has emerged. From the perspective of an undergraduate student, it would be natural to expect that money is an essential consideration when central bankers make decisions regarding monetary policy. Furthermore, even from a practical standpoint, doubts can arise regarding the relevance of money for shaping monetary policy. The advent of the Information Technology revolution, coupled with the institutional changes in financial markets during the 1980s, has seemingly justified an anti-monetarist position.

The proliferation of electronic money and stored value cards has raised important questions about the relevance and role of traditional forms of money in this new digital era (Goodhart, King, Freedman)2. On a theoretical level, there appears to be a growing consensus regarding the monetary framework that central banks should adopt. This recent body of literature, known under various names such as "Post-Modern Monetary Policy," "New Monetary Policy," or "New Consensus," largely shares a common framework. This framework not only downplays the importance of monetary aggregates but also diminishes the significance of money itself. Consequently, the debate revolves around the theoretical and practical implications of how central banks can conduct monetary policy in a context where money is no longer considered a crucial component of the fundamental equation in economic theory. Among this literature, Woodford's influential work, "Interest and Prices" (2003), holds a prominent position. Woodford's approach is rooted in the notion that the theoretical foundations of monetary analysis relevant to policy are best developed within a model of a cashless economy, where the role of monetary assets is minimized (Laidler, 2005, p.2). Woodford drew inspiration from Wicksell's "Interest and Prices" to construct his innovative framework, specifically focusing on Wicksell's abstracted concept of a pure credit economy.

Woodford's significant contribution lies in his analysis of price determination within a cashless economy framework. In this framework, Woodford defines a cashless economy as one in which there are no transactional frictions that would necessitate holding money balances, even when they do not earn a rate of return (Woodford, 2003, p.61). Consequently, one of the key messages conveyed is that money does not hold significance since it is not integrated into the monetary framework recommended for policymakers. This viewpoint elicited responses from Neo-monetarists (Nelson, 2003; Laidler, 2005) who challenged Woodford's neglect of the supply and demand for money within his equations, considering them to have trivial effects on the economy. A defining feature of Woodford's approach is his disregard for the "implied path of the money supply or the determinants of money demand" (Woodford, 2003, p.237) in determining the

equilibrium of output and prices. In other words, Woodford models an economy in which money seemingly only matters as a unit of account for the economy's single good.

Woodford's approach assumes perfect, frictionless markets, which renders money unnecessary beyond its function as a unit of account. The cashless assumption is predicated on the complete absence of monetary frictions, eliminating the need for money as there are no risks to be safeguarded against. A controversial aspect that supports the view of money's dispensability in Woodford's framework is the assumption of complete financial markets. This implies a situation where all potential events can be anticipated and effectively hedged at the appropriate insurance/option price (Goodhart, 2005, p.10). It is evident that Woodford excludes money from his analysis of monetary policy. However, money does not entirely disappear as he advocates for the utilization of another operative instrument derived from Wicksell's "Interest and Prices": the interest rates gap. Woodford contends that policymakers should focus on controlling the disparity between the actual value of the interest rate and its exogenously determined neutral level, rather than solely considering the nominal interest rate itself.

In light of the significance of the cashless policy for Nigeria's economy and the existing literature on the subject, this research aims to enhance our understanding of the theoretical implications of this policy on the demand for money and price determination. By delving into relevant economic theories and conducting empirical analysis specific to Nigeria, this study intends to offer valuable insights into the potential impact of the cashless policy on the country's macroeconomic dynamics.

Amidst the extensive literature on cashless economies, the analysis conducted by Jürg Niehans (1982) stands out, as it explores the role of monetary policy and the determinacy of the price level within a neoclassical framework. This article aims to examine Niehans's analysis in the context of the ongoing debate in Nigeria, ultimately demonstrating that his theoretical contributions align with the conclusions found in the current body of literature.

2.0 Model

This study builds upon a model emanated from Niehans 1978. The Theory of Money (Niehans, 1978), to construct a framework for examining an economy without the presence of money. This section of the research introduces the model by establishing its microeconomic foundations and subsequently expanding it to an aggregate model. Through the analysis of comparative statics within the aggregate model, significant insights are gained regarding the behavior of the price level. These insights lay the groundwork for further analysis. Finally, the model is explored in the context of a moneyless economy, allowing for a comprehensive examination of its implications.

2.1 Microeconomic foundation

Niehans's macroeconomic model is grounded in the microeconomic foundation of an exchange economy. In this economy, a representative agent receives a specific endowment, denoted as , $\overline{C}$ in each period. The agent's objective is to optimize utility by transforming the received

endowment into a consumption vector, while adhering to constraints related to commodities, money, and bonds. Thus, the individual must make decisions regarding the consumption path and the stocks of commodities, bonds, and money for each period. The overall satisfaction or lifetime utility of the agent can be mathematically represented as L.

$$L = \sum_{i=0}^{n} f(C_{i+b}) \tag{1}$$

where C is consumption and the function f has the usual properties. The individual in Niehans's model seeks to align their desired consumption with the actual endowment received in each period. Since the endowment and desired consumption are unlikely to be equal, the individual holds additional assets to bridge this gap. The motivation for maintaining a diversified portfolio of assets arises from the existence of transaction costs. These costs emerge from the need to mitigate uncertainty in trade, which often involves contractual agreements, legal transfers of ownership, record-keeping, and inspections. Additionally, enforcing contracts may entail legal expenses, and purchasing bonds can incur brokerage fees. Consequently, if the costs associated with selling a commodity outweigh the savings in storage costs, the individual may prefer holding commodities instead of money. Similarly, despite bonds offering positive yields and potential protection against capital losses, the individual may opt for holding money over bonds if the transaction costs outweigh the returns gained from bonds.

The representative agent can purchase and sell goods, bonds, and money each period.5 The constraints can be expressed as follows. The commodity constraint states that the accumulation of commodity stocks, sg, equals the net purchases of commodity stocks plus the excess of the endowment over consumption less storage costs, γ , and transactions costs, cg and cb, associated with commodity and bond transactions, respectively

$$CS_{i+1}^{g} = (\overline{C}_i - C_i) + (P_i^g - S_i^g) + (1-\eta)CS_i^g - T^g(P_i^b + S_i^b) + T^b(P_i^b - S_i^b) \tag{2}$$

In the above model, Pg represent the goods purchased, Sg denote the goods sold Ct represent Consumption, Pb is the quantity of bonds purchased, and Sb is the quantity of bonds sold.

The aggregation of money stock is as follow:

$$CS_{i+1}^{m} - CS_i^m = \Pr^g(S_i^g - P_i^g) + \Pr^b(S_i^b + P_i^b) + r_i bs - t_i \tag{3}$$

PgTop of Form is the goods price, Pb is the bond price, bs is the stock of bond, r is the interest rate return from investing in bond and t is the lump sum tax.

Finally, the constraint on bond explains that the aggregation of bonds is equivalent to the difference between the purchase and sales of bonds

$$bs_{i+1} - bs_i = P_i^b - S_i^b \tag{4}$$

2.2 Macroeconomic context

In transitioning from the microeconomic foundation to the macroeconomic model, Niehans introduces several simplifying assumptions. Firstly, the assumption of a pure exchange economy is replaced by a production economy that incorporates durable capital goods. Consequently, the demand for commodities in the microeconomic model is now linked to the demand for capital goods, and the storage cost for inventories is replaced by the rate of return on capital goods. Furthermore, endowments and taxes are substituted with disposable income. Additionally, while transaction cost rates are considered in the microeconomic analysis, they are disregarded in the macroeconomic context. Lastly, time subscripts are omitted to focus on a static macroeconomic model.

The macroeconomic model encompasses asset and production markets, with the government budget constraint serving to consolidate monetary and fiscal policies and complete the model.

Within the model, the asset market comprises money, capital, and bonds. Capital (K) is assumed to be owned by wealth owners and rented out to producers, generating a rate of return (e) for the wealth owners. Money (M) represents base money. Government bonds are perpetual bonds with a fixed coupon value of $1 and an associated yield (i). The quantity of bonds can be positive or negative, depending on whether the government operates with a surplus or a deficit. The total demand for money and bond for D individual can be seen below:

$$Q = \sum_{i=1}^{D} MS_{it} = Q(Y, e, r) \tag{5}$$

$$U = \sum_{i=1}^{D} BS_{it} = U(Y, e, r) \tag{6}$$

Where Y represent the income after deduction of tax, e represent the measurement of returns on capital and r represent returns on investment in bonds. The Market for Assets are seen to be in equilibrium, where the supply of the asset is equivalent to the owners of wealth demand for the asset. In the consonance with the above assumption and also assuming that output price is equal to capital price, there are three possible equilibrium condition in the asset market.

$$A_s = A_s(Y, e, r) \tag{7}$$

$$\frac{MS}{P} = Q(Y, e, r) \tag{8}$$

$$\frac{BS}{rP} = U(Y, e, r) \tag{9}$$

Where Y is the real disposable income and expressed as:

$$Y = P + \frac{BS}{P} - T \tag{10}$$

In this analysis, the long-run perspective plays a crucial role in understanding the determination of the price level. Within the macroeconomic framework described earlier, the long run is characterized by the flexibility of nominal wages, which allows employment to reach its equilibrium level. While the capital stock remains fixed, other variables such as real output, the real wage, and the yield on capital goods also remain constant since employment is at its equilibrium level. Given these conditions, examining the impact of money and debt expansion on the price level within the context of the full-employment equilibrium becomes essential. This approach allows for a comprehensive understanding of the price level dynamics by analyzing the effects of monetary and debt-related factors on money and bond equilibrium conditions.

By differentiating the equilibrium conditions for money and bonds, we can easily observe the impact of monetary and debt expansion on the price level. This differentiation allows us to directly analyze how changes in money and debt levels affect the price level.

$$\frac{dP}{dMS \big/ dBS = 0} = \frac{(U_i + \frac{BS}{e^2 p})}{P[(U_i + \frac{BS}{e^2 p})(\frac{MS}{P^2}) - Q_i(\frac{BS}{e^2 p})} > 0 \tag{11}$$

$$\frac{dP}{dBS \big/ dMS = 0} = \frac{Q_i}{P[(U_i + \frac{BS}{e^2 p})(\frac{MS}{P^2}) - Q_i(\frac{BS}{e^2 p})} > 0 \tag{12}$$

The analysis reveals that both monetary and debt expansion lead to an increase in the price level. However, it is noteworthy that the percentage increase in the price level does not correspond proportionately to the percentage increase in the money supply. Equation (11) highlights the significance of government debt in preventing an equal change in the price level due to monetary expansion. This particular insight holds significant importance in the examination of a "moneyless" economy, contributing to our understanding of the dynamics at play.

3.0 Discussion

As illustrated in the previously introduced microeconomic framework, the demand for money hinges on the existence of transaction costs. These costs create a discrepancy between the expenses associated with lending and borrowing, prompting banks to maintain reserves as a means of mitigating such costs. With advancements in information technology, transaction costs are diminished, resulting in a reduced necessity for banks to hold reserves. A similar principle applies to the demand for physical currency, which is directly influenced by transaction costs. As transaction costs approach negligible levels, the demand for currency diminishes accordingly. This observation remains applicable even within the overarching general equilibrium model

described earlier. Niehans (1982) underscores the notion that in the absence of transaction costs, there is no rational basis for holding stocks of money.

Niehans (1982) proposes that financial innovation has the potential to diminish or eliminate the costs associated with transactions, potentially making traditional monetary analysis obsolete. He presents a conceptual framework for the future of banking, envisioning a scenario where individuals and businesses no longer hold demand deposits. Instead, they would hold alternative assets such as time deposits and money market mutual funds, which would not be subject to reserve requirements. Interestingly, money market mutual funds could still offer check-writing services due to the presence of efficient short-term debt markets. Consequently, banks would have limited need for reserve balances, as they could fulfill unexpected withdrawal demands through transactions in the money market. Furthermore, as previously mentioned, the reduction in transaction costs and the availability of check-writing privileges on money market accounts would decrease the demand for physical currency.

This analysis focuses on examining the characteristics of the monetary equilibrium in scenarios where individuals can optimize their use of physical cash and in situations where the overall real cash holdings are relatively small compared to the total real value of financial assets being exchanged. In essence, we investigate economies that can be considered as approximations to either pure-credit or cashless economies. With the objective of achieving this goal, our attention is directed towards the fundamental economy characterized by a general variable N and β01=0. We explore the ultimate equilibrium that emerges for this analysis which are: i. $\phi \to 1$ ii. $r \to \vec{r}$ Iii. $\beta_{10} \to 0$. The first limit corresponds to an economy where a significant portion, denoted as "measure," of type 2 Asset investors can effectively minimize their cash usage by purchasing assets with zero margin, implying infinite leverage. In this scenario, investors can optimize their trades along the intensive margin, resulting in reduced reliance on cash.

In the second limit, we examine an economy where the opportunity cost of holding money is exceptionally high, leading to the marginalization of aggregate real balances. As a result, the significance of money in the economy diminishes substantially.

The third limit represents an economy in which money becomes practically unnecessary for trading purposes. Regardless of the equilibrium value of money, every individual investor can achieve budget feasibility by taking long equity positions while simultaneously shorting bonds, completely bypassing the need for money as a means of payment. For each of these limits, our analysis focuses on the behavior of aggregate real balances, transaction velocity, and the influence of monetary policy on trading activity and asset prices. In a stable and balanced state of the economy, we can define the transaction velocity of money, denoted as TV, as the ratio of the total nominal value of transactions conducted to the total money supply.

$$T_V = \frac{[\beta_1 N(\xi_1^*) + \beta_2 N(\xi_2^*)] P_t A_s}{M_t^s} = \frac{[\beta_1 N(\xi_1^*) + \beta_2 N(\xi_2^*)](\xi_1^* + \sigma_s)}{W} \tag{13}$$

Where TV represent transaction velocity of money, β_1 represent type 1 Asset, β_2 represent type 2 Asset, $P_t A_s$ represent price of the stock of Asset, M_t^s represent money supply. Transaction velocity serves as a valuable metric to assess the effectiveness of cash utilization, specifically as an indicator of the average number of transactions that can be facilitated per unit of currency in circulation.

In the limiting economy $\Delta \to 0$

$$T_V = [\beta_1 N(\xi_1^*) + \beta_2 N(\xi_2^*)]\frac{\varphi}{\psi} \tag{14}$$

$$= \{\frac{\{\beta_1[1-N(\xi_1^*)]+\beta_1][\beta_1 N(\xi_1^*)+\beta_2\mu]\}}{\beta_1 N(\xi_1^*)} \to r\phi < r < \vec{r}(\phi) \tag{15}$$

$$\frac{[(\beta_1+\beta_2)(\beta_1+\beta_2\frac{1}{1-\phi})N(\xi^*)1-N(\xi^*)]}{\beta_1 N(\xi^*)+\beta_2\frac{1}{1-\phi}[N(\xi^*)-\phi} \to 0 < r < \vec{r}(\phi) \tag{16}$$

Proposition 1: considering the limiting economy with $\Delta \to 0$ with β1, β2 ∈(0,1), let

$$\varphi_{\phi=1}^n = \underset{\phi\to 1}{Lim}\,\varphi^n = \bar{\xi} + \beta_2\phi(\xi_H - \bar{\xi})$$

$$\phi \to 1, \xi_1^* = \xi^* \to \xi_H$$

$$\frac{\psi}{\varphi} \to \frac{\beta_1 N(\xi_1^*)}{[(1-N(\xi_1^*)][\beta_1+\beta_2]} \tag{17}$$

$$T_v \to \frac{\{\beta_1(1-N(\xi_1^*)]+\beta_2\}[\beta_1 N(\xi_1^*)+\beta_2]\}}{\beta_1 N(\xi_1^*)} \tag{18}$$

$$\varphi \to \varphi_{\phi=1}^n + [\beta_1+\beta_2(1-\nu)])\int_{\xi_L}^{\xi_1^*}(\xi_1^*-\xi)dN(\xi \tag{19}$$

Where $\xi_1^* \in (\xi_L, \xi_H)$ is the unique solution to:

$$\frac{\beta_2\nu(\xi_H-\xi_1^*)+[\beta_1+\beta_2(1-\nu)\int_{\xi_1^*}^{\xi_H}(\xi-\xi_1^*)dN(\xi)}{\xi+[\beta_1+\beta_2(1-\phi)]\int_{\xi_L}^{\xi_1^*}(\xi_1^*-\xi)dN(\xi)+\beta_2\nu(\xi_H-\xi)} = r \tag{20}$$

The Proposition 1 shows that, as $\phi \to 1$ real balances remain positive and velocity remains

Bounded as long as $\beta_1 \in R_{++}$ and $r < \overleftarrow{r}(1)$. This observation is expected since the demand for money in the OTC round is driven by low-valuation investors of type 2, while the demand for money in the second sub-period is influenced by the likelihood of becoming a high-valuation investor of type 10 in the subsequent period. The investor of type 2's portfolio problem remains fully defined even as the parameter approaches 1.because the equilibrium real interest rate in that limit becomes very high, $P^s \to \frac{\xi_H}{\varphi} P$ which in equilibrium limits their desire to short the bond.

Proposition 2: consider the limiting economy as ($\Delta \to 0$) with $\beta_1, \beta_2 \in (0,1),$ as $r \to \vec{r}(\phi), \xi_1^* = \xi^n, \xi_1^* \to \xi_L$

$$\frac{\Psi}{\varphi} \to 0 \qquad (21)$$

$$T_V \to \infty \qquad (22)$$

$$\varphi \to \varphi^n \qquad (23)$$

Proposition 2 represents a well-known scenario in micro-founded monetary models known as the "cashless limit." As the opportunity cost of holding money becomes extremely high, the real balances tend to diminish towards zero. In this scenario, the transaction velocity of money exhibits an infinite divergence, driven by the positive real value of equity purchases made by β2 type 2 investors. Conversely, the transaction velocity associated solely with type 1 investors remains bounded. For more explicit explanation, we can decompose TV into two facet namely TV=TV1+TV2, where $T_{V1} = \beta_1 N(\xi_1^*) \frac{\varphi}{\Psi}$ and $T_{V2} = \beta_2 N(\xi_2^*) \frac{\varphi}{\Psi}$ are the various augmentation of both agent of type 1 asset and type2 asset to the velocity of transaction .it can be illustrated as follows:

$$T_{V1} = 1 - N(\xi_1^*)]\beta_1 + \beta_2 \quad \text{if } r(\phi) < r < \vec{r}(\phi)$$

$$\frac{\beta_1 N(\xi^*) 1 - N(\xi^*)](\beta_1 + \beta_2 \frac{1}{1-\phi})}{\beta_1 N(\xi^*) + \beta_2 \frac{1}{1-\phi}[N(\xi^*) - \phi]} \quad \text{if } 0 < r \le r(\phi)$$

$$T_{V2} = \frac{\beta_2 \phi\{[1 - N(\xi_1^*)]\beta_1 + \beta_2\}}{\beta_1 N(\xi_1^*)} \quad \text{If } r(\phi) < r < \vec{r}(\phi)$$

$$\frac{\beta_1 N(\xi^*)1-N(\xi^*)](\beta_1+\beta_2\frac{1}{1-\phi})}{\beta_1 N(\xi^*)+\beta_2\frac{1}{1-\phi}[N(\xi^*)-\phi]} \quad \text{If } 0<r\le\bar{r}(\phi)$$

Hence, as $r\to\bar{r}(\phi)$, we have $T_{V2}\to\infty$ and $T_{V1}\to(\beta_1+\beta_2)$

Proposition 3: consider the limiting economy with $\beta_1=\beta_s\beta,\beta_2=\beta_s(1-\beta)$ and $\beta_s\in(0,1)$, let

$$\bar{\varphi}^n\equiv\lim_{\beta\to 0}=\vec{\xi}+\beta_s\phi\,[\int_{\xi_L}^{\xi^n}(\xi^n-\xi)dN(\xi)+\frac{\phi}{1-\phi}\int_{\xi_L}^{\xi_H}(\xi-\xi^n)dN(\xi)] \tag{24}$$

At $\beta\to 0$

If $\sigma(0)<r<\sigma(0)$,then

$$\frac{\Psi}{\varphi}\to 0 \tag{25}$$

$$T_V\to\infty \tag{26}$$

$$\varphi\to\bar{\varphi}\equiv\bar{\varphi}^n+\beta_s(1-\eta)\int_{\xi_L}^{\xi_1^*}(\xi_1^*-\xi)dN(\xi) \tag{27}$$

Where $\xi_1^*\in(\xi_L,\xi^n)$ is the unique solution to

$$\frac{(1-\eta)\int_{\xi_1}^{\xi_H}(\xi-\xi_1^*)dN(\xi)+\eta[\xi^n-\xi_1^*+\frac{1}{1-\phi}\int_{\xi^n}^{\xi_H}(\xi-\xi^n)dN(0)}{\frac{\vec{\xi}}{\beta_s}+(1-\eta)\int_{\xi_L}^{\xi_1^*}(\xi_1^*-\xi)dN(\xi)+\eta[\int_{\xi_L}^{\xi^n}(\xi^*-\xi)dN(\xi)+\frac{\phi}{1-\phi}\int_{\xi^n}^{\xi_H}dN(\xi)}=r \tag{28}$$

if $0<r\le\sigma(0)$, then

$$\frac{\Psi}{\varphi}\to\frac{N(\xi^*)-\phi}{1-N(\xi^*)} \tag{29}$$

$$T_V\to\frac{\beta_s N(\xi^*)[1-N(\xi^*)]}{N(\xi^*)-\phi} \tag{30}$$

$$\varphi\to\bar{\varphi}\equiv\vec{\xi}+\beta_s[\int_{\xi_L}^{\xi_1^*}(\xi_1^*-\xi)dN(\xi)+\eta\frac{\phi}{1-\phi}\int_{\xi^*}^{\xi_H}(\xi-\xi^*)dN(\xi) \tag{31}$$

Where $\xi^* \in (\xi^n, \xi_H)$ is the unique solution of

$$\frac{(1-\eta+\eta\frac{1}{1-\phi})\int_{\xi^*}^{\xi_H}(\xi-\xi^*)dN(\xi)}{\frac{\vec{\xi}}{\beta_s}+\int_{\xi_L}^{\xi^*}(\xi^*-\xi)dN(\xi)+\eta\frac{\phi}{1-\phi}\int_{\xi^*}^{\xi_H}(\xi-\xi^*)dN(\xi)}=r \tag{32}$$

Proposition 3 examines the economy in its limiting form as the fraction of investors without access to margin loans diminishes, while maintaining a constant proportion of investors engaged in equity trading. In other words, as β approaches zero, both β1 and β2 tend towards zero. This limiting economy allows for nearly all investors to finance their equity purchases by shorting the bond, meaning they can acquire equity shares even without holding any cash at the beginning of the period. As discussed in the context of Proposition 2, in a monetary equilibrium, investors of type 10 with relatively low equity valuation consistently demand money during the OTC trading round, while investors of type 2 with relatively low valuation demand money in the OTC round only when $0 < r < \delta(0)$. Consequently, as β1 tends towards zero, the extensive margin of money demand from type 1 investors, i.e., the number of type 1 investors desiring to hold money, approaches zero.

If the nominal policy rate falls within the range of $0 < r < \delta(0)$, as indicated in part (ii) of Proposition 3, the aggregate money demand from type 1 investors diminishes in the limit, while the aggregate money demand from type 11 investors with low valuation remains positive in the limit. The value of money in this limiting economy can be understood from two perspectives. Firstly, money demand can persist overnight due to the expected binding collateral constraint for type 3 investors. Holding money allows them to take larger long positions in equity than they would be able to with just margin loans. Secondly, type 1 investors with low valuation are willing to hold cash at the end of the OTC round because the nominal rate on bonds (i.e., the opportunity cost of holding cash in the OTC round) is zero when $0 < r < \delta(0)$. This indifference between holding wealth in money or bonds leads them to hold a combination of both. Consequently, in economies where $0 < r < \delta(0)$ holds, indicating relatively low inflation and limited leverage capacity, real balances approach a positive limit (as shown in equation (29)), and velocity converges (as shown in equation (30)) as β1 approaches zero.

If the nominal policy rate is relatively high, specifically within the range of $\delta(0) < r < r(0)$ as stated in part (i) of Proposition 3, real balances tend to converge to zero (as shown in equation (30)), and transaction velocity approaches infinity (as shown in equation (31)) as β1 approaches zero. This outcome can be attributed to the fact that, with this elevated policy rate, the total money demand in the OTC round diminishes as β1 approaches zero for two reasons. Firstly, although low-valuation investors of type 1 would be willing to hold money, the number of type 1 investors diminishes significantly as β1 approaches zero. Secondly, low-valuation investors of type 2 are

disinclined to hold money since the rate of return on money is outperformed by the collateralized inside bond. Given that practically nobody desires to hold money in the OTC round, money loses its value in the limiting economy as β1 approaches zero within the range of δ(0) < r < r(0). The key result is that

$$\lim_{\beta\to 0}\frac{\Psi}{\varphi}=\lim_{\beta\to 0}\frac{1}{T_V}=0<\lim_{\beta\to 0}(\varphi-\varphi^n)=\beta_s(1-\eta)\int_{\xi_L}^{\xi_1^*}(\xi_1^*-\xi)dN(\xi) \tag{35}$$

Significantly, in the limit as β1 approaches zero, where real balances and velocity converge to their nonmonetary equilibrium levels, the real equity price in this cashless scenario surpasses the price observed in the nonmonetary equilibrium by the value of a resale-option term, as indicated in equation (35). Since the resale-option term (ε*) is a function of the nominal policy rate (r) according to equation (28), it follows that in the cashless limit, the asset price continues to be responsive to monetary policy, and this responsiveness remains bounded away from zero even as the quantity of real balances converges to zero. This finding contrasts with the more conventional result that monetary equilibrium prices and allocations converge to their nonmonetary equilibrium counterparts when real balances diminish, as seen in the cashless limit described in Proposition 2..

Intuitively, the reason behind equation (35) is that an investor of type 2 with a valuation ξ in the range (ξL, ξ1) possesses the option to sell equity for cash in the equity market. This option enhances the investor's bargaining power with bond dealers and enables them to capture a larger share of the gains from reallocating their portfolio from equity to bonds. Importantly, the value of this option to individual investors remains strictly positive in the limit as β approaches zero, even as aggregate real money balances and cash transactions in the equity market converge to zero. This observation may appear counterintuitive: why doesn't the value of the investor's outside option diminish in the limit?

To address such questions, it is helpful to consider the equilibrium conditions. Firstly, it is worth noting that each individual investor of type 2 aims to execute an infinitesimally small trade in the equity market. As a result, regardless of how small the equity market becomes along the path towards the cashless limit, the investor of type 2 can always carry out their trade. Secondly, an inquiry may arise regarding the counterpart on the other side of the transaction, who would be buying equity for cash if the type 2 investor with a valuation ξ in the range (ξL, ξ1) were to exercise their option to sell their portfolio for cash in the equity market (although they do not exercise this option in equilibrium). The answer lies in the presence of investors of type 2 with valuations in the interval (ξ1, ξH), along with a small number of type 10 investors with valuations in the interval (ξ2, ξH), who still remain present along the trajectory towards the cashless limit.

To summarize, in the cashless limit as β approaches zero, the equilibrium exhibits the following behavior: the positive resale value option described in equation (35) arises because even in the

limit, an individual investor of type 1 can strategically threaten to sell their equity for cash in the equity market. This off-equilibrium threat enhances their bargaining power with the bond broker, enabling the investor to capture a larger portion of the trade surplus. Due to the positive resale value option persisting in the limit, the asset price remains relatively high. In particular, it surpasses the price in the nonmonetary equilibrium, where cash has no value in equilibrium, and the investor lacks the ability to leverage the threat of selling equity for cash in the equity market to enhance their bargaining position.

Implementing a cashless policy in Nigeria, aimed at reducing cash transactions and promoting electronic payments, has been a priority for the government in recent years. The goal is to enhance efficiency, transparency, and financial inclusion. Understanding the implications of such a policy becomes crucial.

In the theoretical analysis, we observe that as the economy moves towards a cashless limit (with β approaching zero), the demand for money diminishes, and real balances tend to zero. This suggests that in a cashless economy, the reliance on physical cash decreases significantly, and transactions primarily occur through electronic means.

Furthermore, the discussion highlights the importance of transaction velocity, which represents the efficiency of cash use. As transaction costs decrease and electronic payment systems become more accessible, the transaction velocity improves, allowing a higher number of transactions to be conducted per unit of money in circulation. This aligns with the objective of a cashless policy, which aims to enhance the efficiency and speed of transactions in the Nigerian economy.

However, it is important to note that the theoretical analysis also reveals that certain factors impact the demand for money even in a cashless economy. These factors include the opportunity cost of holding cash, the value of resale options, and the presence of different types of investors. These insights suggest that while the implementation of a cashless policy can reduce the reliance on physical cash, other factors such as investor behavior and market dynamics can still influence the demand for money.

Therefore, in the context of Nigeria, the implementation of a cashless policy would likely lead to a significant reduction in cash transactions and an increased reliance on electronic payment systems. This shift can bring benefits such as improved efficiency, transparency, and financial inclusion. However, it is essential to consider the broader economic and financial landscape, including investor behavior and market dynamics, to fully understand the implications of a cashless policy in Nigeria. Ongoing monitoring and adaptation of the policy framework would be necessary to address any emerging challenges and ensure a smooth transition towards a more cashless economy.

3.1 Determination of Price level in a cashless Economy

The determination of the price level in cashless economies has been extensively studied in the literature, including works by Woodford (2003). For the purpose of comparison, it is helpful to

discuss how the price level behaves in the cashless limit of our economy. In a cashless economy, the price level can be measured by the nominal price of equity shares.

$$P_t = \frac{\xi_1^* + \partial^s}{\Psi S^A} M^A \tag{36}$$

In the discrete time formulation with period length is $P_t = [\xi_1^* + \partial^s(\Delta)]M^A / (\Psi(\Delta)S^A$, so as $\Delta \to 0$, we get

$$P_t = \frac{\partial^s}{\Psi S^A} M^A = \frac{[1 - N(\xi_1^*)]\beta_1 + \beta_2 M^A}{\beta_1 N(\xi_1^*)} \to r(\phi) < r < \bar{r}(\phi) \tag{37}$$

$$\frac{[1 - N(\xi_1^*)]\beta_1 + \beta_2 \frac{1}{1-\phi}]M^A}{\beta_1 N(\xi^*) + \beta_2 \frac{1}{1-\phi} / N(\xi^*) - \phi / S^A} \to 0 < r < \hat{r}(\phi) \tag{38}$$

If the monetary authority wishes to implement a certain price path for a recursive monetary equilibrium of the cashless limiting economy with $r \in (\hat{r}(\phi, \bar{r}(\phi))$ then it can simply choose a money supply process $(M^A)_{t=0}^{\infty}$ given by:

$$M^A = \theta A_t \text{ With } A_t = \pi A_t .$$

Which incorporate a price level in a cashless economy that is equivalent to

$$\underset{\beta \to 0}{Lim} P_t = \frac{A_t}{S^A N(\xi_1^*)} \tag{39}$$

By adjusting the level of A0, the monetary authority has the ability to establish any desired price level in the Restricted Monetary Equilibrium (RME) of the cashless limiting economy. The intuitive understanding is that the monetary authority can maintain a well-defined (infinite) price level even in the cashless limit by ensuring the stability of the money supply per investor of type 1 throughout the process.

In a cashless economy, where transactions are predominantly conducted electronically and the use of physical cash is significantly reduced, the determination of prices becomes even more crucial. The response highlights that in the cashless limiting economy, the monetary authority can influence and implement any desired price level by controlling the money supply per investor of type 1. This implies that in a cashless economy, the monetary authority has the ability to directly impact the price level by adjusting the money supply. By maintaining stability in the money supply per investor of type 1, the monetary authority can ensure that the price level remains well defined and can be effectively controlled.

The implementation of a cashless policy in an economy like Nigeria would bring about significant changes in the way transactions are conducted. As more transactions shift towards digital platforms and electronic payment systems, the influence of the monetary authority on price determination becomes more pronounced. By effectively managing the money supply in a cashless economy, the monetary authority can exercise greater control over inflation and price stability. This highlights the importance of implementing appropriate monetary policies and regulations to ensure that the transition to a cashless economy aligns with the objectives of price stability and overall macroeconomic stability.

However, it is worth noting that the successful implementation of a cashless policy requires careful consideration of various factors, including the readiness of the financial infrastructure, the level of financial inclusion, and the availability of secure and reliable electronic payment systems. Additionally, effective communication and public awareness campaigns are crucial to ensure smooth adoption and acceptance of cashless transactions by individuals and businesses. Overall, a well-executed transition to a cashless economy can provide the monetary authority with enhanced tools and mechanisms to manage and influence price determination, thereby contributing to a more efficient and stable economic environment.

4.0 Conclusion

The study on the properties of a cashless economy provides valuable insights into the dynamics of monetary equilibrium, transaction velocity, and the impact of monetary policy on trading activity and asset prices. It highlights the potential benefits of transitioning towards a cashless economy, such as increased efficiency in cash use, reduced transaction costs, and greater control over price determination through the manipulation of the money supply.

Based on the findings, a workable policy recommendation for Nigeria would be to continue promoting and incentivizing the adoption of electronic payment systems and digital transactions. This could be achieved through measures such as improving the infrastructure for electronic payments, enhancing financial literacy and awareness, and providing support to businesses and individuals in transitioning to cashless transactions. Additionally, the central bank and relevant regulatory authorities should closely monitor the impact of monetary policy on price determination in the evolving cashless economy and adjust policies accordingly to maintain price stability.

However, it is important to acknowledge the limitations of the study and identify areas for further research in the Nigerian context. One limitation is the need to consider the unique characteristics and challenges of the Nigerian economy, including the prevalence of informal and cash-based transactions, the level of financial inclusion, and the impact on vulnerable populations. Future studies could delve deeper into the specific implications of implementing a cashless policy in Nigeria and assess the effectiveness of policy measures in addressing these challenges.

Furthermore, the study could explore the potential social and economic consequences of a cashless economy, including income inequality, access to financial services, and the digital divide.

Understanding the distributional effects and ensuring inclusivity in the transition to a cashless economy should be a priority to ensure that the benefits are equitably shared.

In summary, while the study provides valuable insights into the properties of a cashless economy and its implications for price determination, further research tailored to the Nigerian context is necessary to fully understand the challenges and opportunities associated with implementing a cashless policy.

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